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(54) **Title**: FLEXIBLE FLAT SCREEN DISPLAY DEVICE

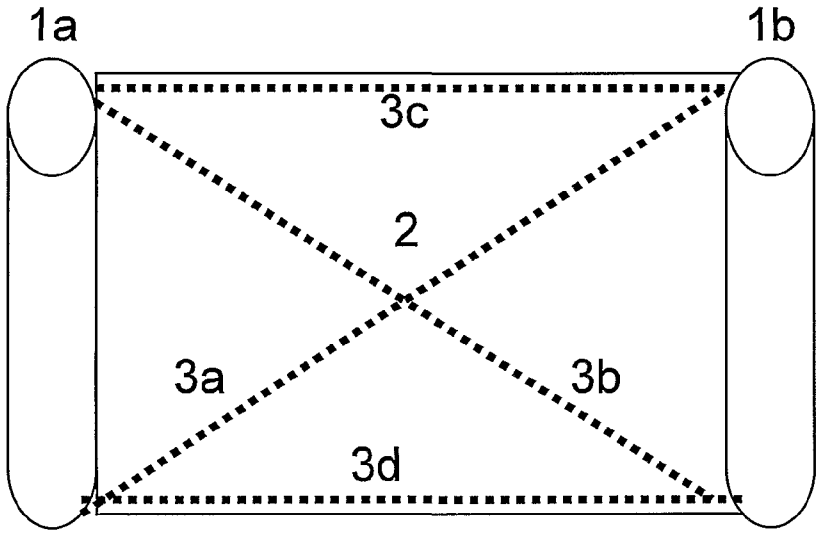

FIG. 1

(57) **Abstract**: A portable electronic device comprises: a device part in a housing, a flexible screen movable between an extended position extending out of said housing for viewing by a user and a retracted position wherein said screen is retracted within said housing; and at least two extensible members for extending retractably with said screen to hold said screen taut while in said extended position. In one version, an independently angled screen section is touch sensitive and provides a retractable soft keyboard.

FLEXIBLE FLAT SCREEN DISPLAY DEVICE

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to a flexible flat screen display device and, more particularly, but not exclusively to a display device with a flexible flat screen, which device is optimized for portability.

With the turn of the 21st century, we are witnessing a second communication revolution, that of the portable or mobile device. Now, more than ever, we purchase more and more gadgets for obtaining information and keeping in touch and up to date with our friends, family and the world around us.

These days, one's knowledge in music is defined by the storage on one's Mp3 player, one's hi-tech savvy is only as advanced as one's personal computer, and one is as organized as one's PDA. We have come to rely more and more on these products. As such- we have come to replace large fold-up maps with GPS systems, books and orchestras with E-books and MP3/4 players, letters with text messages and emails, and secretaries with PDAs and smart-phones.

Information is now available practically anywhere requiring a mere click on one of these portable devices, and the average person currently requires considerable pocket or travel bag space for his gadgets.

However, the more knowledge available at one's fingertips, the harder it is to access and enjoy. Who can really say it is comfortable to read a city map on the screen of a small cellular phone?

In response to this need, Polymer Vision, a subsidiary of Philips, presented a prototype of a portable consumer device with a rollable display at the Internationale Funkausstellung (IFA) in Berlin, Germany, September 2-7, 2005. The prototype, called Readius, had a monochrome 5-inch QVGA display with four grey levels that was able to show a maximum of two images per second.

One of the problems of such a rollable screen was lack of visibility when the screen was unrolled.

SUMMARY OF THE INVENTION

The present embodiments relate to the problem of lack of visibility as being an issue of making the screen sufficiently taut when unrolled. As such retractable extensors are used to form a frame to hold the screen in its extended position.

According to one aspect of the present invention there is provided a portable electronic device comprising:

a first device part having a housing;

a flexible screen movable between an extended position extending out of said housing for viewing by a user and a retracted position wherein said screen is retracted towards said housing; and

at least two extensible members for extending retractably with said screen to hold said screen taut while in said extended position.

In an embodiment, said screen is mounted on a roller, which roller is mounted within said housing, said retracted position comprising being rolled on said roller within said housing.

In an embodiment, said first device part comprises a first cylinder at one end of said screen, a first of said extensible members being attached to an opposite end of said screen, and a second of said extensible members being extensible between said housing and said first extensible member to hold said screen taut between said housing and said first extensible member.

An embodiment may comprise a second device part connected along an edge of said screen opposite said first device part, wherein said first and a third extensible member run parallel between said first and second device parts and said second and a fourth extensible members extend diagonally across said screen between said first and second device parts, said first to fourth extensible members holding said screen taut.

In an embodiment, said first and second device parts are hinged to form upper and lower parts which are respectively foldable.

In an embodiment, said first and second device parts are split into connected upper and lower parts and said screen comprises respectively attached upper and lower parts.

In an embodiment, said lower parts of said first and second device parts are split into connected first lower and second lower parts and said screen comprises respectively attached upper and lower parts.

In an embodiment, said lower screen part comprises touch sensitivity and is configurable with soft keys to provide a retractable keyboard.

In an embodiment, at least one of said extensible members is telescopic and comprises a catch for holding said member releasably in said extended position.

An embodiment may comprise a first speaker mounted in said housing and a second speaker mounted in said first extensible member.

In an embodiment, said second extensible member is lengthwise adjustable.

An embodiment may comprise communication electronics for receiving images from surrounding device for display on said screen.

An embodiment may comprise a navigation device, the navigation device comprising a plurality of activation units mounted on said cylinders.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. The materials, methods, and examples provided herein are illustrative only and not intended to be limiting.

The word "exemplary" is used herein to mean "serving as an example, instance or illustration". Any embodiment described as "exemplary" is not necessarily to be construed as preferred or advantageous over other embodiments and/or to exclude the incorporation of features from other embodiments.

The word "optionally" is used herein to mean "is provided in some embodiments and not provided in other embodiments". Any particular embodiment of the invention may include a plurality of "optional" features unless such features conflict.

Implementation of the method and/or system of embodiments of the invention can involve performing or completing selected tasks manually, automatically, or a combination thereof. This refers in particular to tasks involving the control of the spectral equipment.

Moreover, according to actual instrumentation and equipment of embodiments of the method and/or system of the invention, several selected tasks could be

implemented by hardware, by software or by firmware or by a combination thereof using an operating system.

For example, hardware for performing selected tasks according to embodiments of the invention could be implemented as a chip or a circuit. As software, selected tasks according to embodiments of the invention could be implemented as a plurality of software instructions being executed by a computer using any suitable operating system. In an exemplary embodiment of the invention, one or more tasks according to exemplary embodiments of method and/or system as described herein are performed by a data processor, such as a computing platform for executing a plurality of instructions. Optionally, the data processor includes a volatile memory for storing instructions and/or data and/or a non-volatile storage, for example, a magnetic hard-disk and/or removable media, for storing instructions and/or data. Optionally, a network connection is provided as well. A display and/or a user input device such as a keyboard or mouse are optionally provided as well.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in order to provide what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

In the drawings:

FIG. 1 is a simplified schematic diagram illustrating a first flexible screen device in a screen open position according to the present embodiments;

FIG. 2 shows the device of FIG. 1 in a closed position seen in a perspective view;

FIG. 3 shows the device of FIG. 1 in plan;

FIG. 4 is a cutaway view of the device of FIG. 1;

FIG. 5 is a simplified schematic diagram showing a second flexible screen device in a screen open position according to the present embodiments;

FIG. 6 shows the device of FIG. 5 in a closed position seen end on;

FIG. 7 shows the device of FIG. 5 in a perspective view;

FIG. 8 is a simplified schematic diagram showing a third flexible screen device in a screen open position according to the present embodiments;

FIG. 9 shows the device of FIG. 8 closed and in a perspective view;

FIG. 10 shows the device of FIG. 8 open and in a perspective view;

FIG. 11 is a simplified schematic diagram showing a fourth flexible screen device in a screen open position according to the present embodiments; and

FIG. 12 shows the device of FIG. 11 closed and folded in a perspective view.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a flat screen display and, more particularly, but not exclusively to a flat screen display optimized for a portable device.

Stents, or extensors, which may be telescopic or spring loaded, or hinged, or collapsible, are used to support the screen in the extended position to make the screen taut and thus improve visibility, and overall screen effectiveness.

The screen may be held taut by the extensors between two cylinders. The cylinders may be in foldable sections for greater compactness. An additional length of cylinder may have a separate screen which can be set at an angle with respect to the first length, and may be touch sensitive, to provide a retractable keyboard.

In one variation, a wireless rollable and/or flexible display device may allow any mobile devices in proximity, whether mobile phones, smartphones, PDAs, GPS, MP3, etc to connect wirelessly to a single light-weight display unit so as to centrally view, listen and manage information, multimedia and data. The display unit in a closed, standby mode makes it extremely light-weight, small and easy to travel with. The open, operational mode provides a large convenient display, suitable for a user's various different gadgets.

The principles and operation of an apparatus and method according to the present invention may be better understood with reference to the drawings and accompanying description.

Before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments or of being practiced or carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein is for the purpose of description and should not be regarded as limiting.

Reference is now made to Figs. 1 - 4 which shows a portable electronic device 1 which is made up of two device parts 1a and 1b, conveniently formed as cylinders, each having a housing, and a flexible screen 2 which can move between an extended position extending out of the housing, as shown in Fig 1 or Fig. 4, for viewing by a user and a retracted position in which the screen is retracted within the housing or rolled around the cylinder. Extensible members extend retractably with the screen to hold the screen taut while in the extended position. Two extensible members 3c and 3d may hold the two cylinders stably apart but diagonals, 3a and 3b make the structure more mechanically stable.

The cylinder at the far end may merely be a holder for providing mechanical strength to support the open screen and allow it to be pulled open.

The extensible members may be telescopic, hinged, collapsible etc.

The screen may be mounted on a roller 32, which roller is mounted within the housing. The retracted position may comprise being rolled on the roller within a chamber in the housing.

A first cylinder may be mounted at one end of the screen, with one extensible member attached to an opposite end of the screen. A second extensible member may connect between the housing and the first extensible member to hold the screen taut between them. More typically, second cylinder 1b would be connected along an edge of the screen 2 opposite the first cylinder 1a. Then two extensors 3c and 3d run parallel between the cylinders and two more extensors 3a and 3b extend diagonally across the

screen between the cylinders. The four extensible members 3a – 3d hold the screen taut between the two cylinders.

As illustrated, the two cylinders are the same size. However one cylinder may be larger than the other, say to accommodate the rolled up screen when retracted.

Furthermore, although a cylinder is a convenient shape, other shapes may be used in the alternative. Furthermore there is no requirement that the device parts are the same shape. It is however convenient that, whatever shape, they extend for the full height of the screen.

As shown in Figs 5 – 7, the first and second cylinders may be hinged along line 60 to form upper and lower parts which can be folded over each other. Fig. 7 shows the folded position. Greater compactness in the retracted position can thus be achieved.

Figs 8 – 10 show how the first and second cylinders are split into connected upper and lower parts with the screen split between them into upper and lower screen parts. The lower part of the screen may be folded over to provide a double sided screen – as shown in Fig. 8, or set at an angle from the upper part as shown in Fig. 10 and may be made touch sensitive and provided with a soft keyboard. Thus it is possible to provide both a retractable screen and keyboard. Each screen part is held taut by its own system of four extensors.

Figs 11 and 12 show a combination of the embodiments of Figs. 5 – 7 and Figs 8 – 10. In Figs 11 and 12 a device is shown in which upper screen 2a and associated cylinder parts, are foldable about a hinge 70, and a keyboard is provided from a lower screen 2b which is angled from the upper screen 2a. Each screen part is held taut by its own system of four extensors.

The extensors, or at least the parallel extensor arms, may be telescopic and may comprise catches for releasable retainment in the extended position. The diagonal extensors may be hinged to open into the extended positions, as convenient. Extensors may be of adjustable length, say to provide different levels of tightness for the screen.

As shown in Fig. 4, speakers may be mounted in the cylinders.

The device may include communication electronics, say a Bluetooth™ transceiver, for receiving images from surrounding devices for display. The device can thus provide a portable display for numerous other devices.

The device may include a mouse or like interaction or navigation ability. For example the device may allow a user to interact therewith via activation units such as buttons mounted on the cylinders.

Considering the embodiments in greater detail we return to Fig. 1, which is a simplified schematic diagram illustrating a device with a retractable flexible screen in accordance with an embodiment of the present invention. The main body of wireless rollable and/or flexible display device 1 consists of a flexible display 2 and two cylindrical parts 1a and 1b, about which the main display is able to roll.

The device 1 has two positions, an extended and a retracted position. A closed, or screen retracted or rolled, position, is shown in fig. 2 in which the device is placed when off or in standby. The display may be rolled around one of the cylnders or may be rolled within one of the cylinders on an internal roller, through an opening or slit in the cylinder.

Fig. 3 shows the closed position viewed from above.

Fig. 1 shows an open position of the device in which the device is in, operational mode, with the display unrolled from the above opening. The screen is supported by a telescopic and/or collapsible frame. Here the frame is made of two diagonal members 3a and 3b and two parallel members 3c and 3d. The frame serves to keep the screen taut in the open position, thus improving display flatness and therefore visibility.

The device may be supplied with a mouse or rollerball or touchpad or touchscreen or keypad or any combination thereof for user interaction and to facilitate navigation and user control. In one embodiment, user interaction is facilitated by a jog dial 4 on one of the cylinders. On the opposite cylinder, two buttons 5 and 6 provide functions such as left click and right click or enter/exit and ok/cancel. Further, an additional menu button 7 may be provided to open any currently available or in context menus. On cylinder 1a is provided a jack 8 for earphones. On cylinder 1a there is also provided a slit 9 for insertable memory cards such as flash card 62 shown in Fig. 4. On the same cylinder 1a there is provided a USB port 10 and cylinder 1b has a charging port 11.

At each cylinder a speaker, 12a and 12b, may provide a stereo or surround sound experience. Cylinder 1b comprises a small flexible display 13 to show system status,

notifications, current time and any other suitable information. The screen may comprise a flexible touch sense layer as an underlay to the screen as a second layer so as to achieve touch-screen capabilities and enhanced user-interface and applications.

Reference is now made to Fig. 4, which is a simplified diagram showing a cutaway view of the device to describe the interior structure of the two cylinders. Inside the cylinders, the device may include: a processor 20, memory 22, a battery 24, surround speaker system 26a, 26b, and a wireless transceiver 28 of any suitable technology, for example: wifi, Bluetooth, GSM/UMTS, satellite, etc. A camera (not shown) may optionally be included. A roller 30 and pivot 32 provide a mounting for the screen and allow the screen to be retracted by rotating the roller. The roller may be spring loaded with a catch for release, or may be operated by an electric motor such as a stepper motor. The roller may lie within a chamber 34 which has sufficient room for the screen in its rolled up position. Thus the retracted screen may be retained within the device housing for protection.

Reference is now made to Fig. 5, which illustrates an additional rollable and foldable design which may achieve increased compactness. In this design each of the two cylinders of the main body may comprise two units, in this case 1a + 1b and 1c + 1d, hinged together at hinge 60 to allow for foldability. Additional extensible members 3c, 3d, 3e, 3f and 3g may as necessary be added to the support frame to provide full support to the parts of screen2 on either side of the fold. Thus the screen is held taut when open irrespective of the cylinders being foldable for compactness. The two cylinders are themselves each foldable along the hinge 60. The device is shown unfolded with screen open in Fig. 5, unfolded with screen rolled in Fig. 6 and folded at the hinge in Fig. 7 with screen rolled.

Fig. 8 shows a variation of the device of Fig. 1 in which the screen is in fact two separate screens 2a and 2b. In the embodiment of Fig. 8 the two screens are provided back to back to provide a double layer display. Fig. 9 shows the four cylinders involved.

In Fig. 10 the two screens are angled from each other to provide a keyboard and screen configuration. The lower screen 2b may be touch sensitve and function as a rollable keyboard. To provide an answer to the need of mobile work environment, the two sets of cylinders 1a and 1b may be hinged or otherwise joined to the lower set of cylinders 1c and 1d, and a further collapsible frame, made up of extensible members as

before, supports the lower screen so that it can be held sufficiently taut to be touch sensitive. The frames or cylinders may be hinged so as to allow the device to be unrolled and opened into the back to back configuration shown in Fig. 8 and in the screen and keyboard variation as desired. In an embodiment, the unrolling of the device may activate the device to function as a screen, whereas opening the device may activate the inner display to operate as a keyboard.

Figures 11 and 12 illustrate a further embodiment of the present invention which combines the hinged cylinders of Fig. 5 with the rollable keyboard of Fig. 10. As shown in Fig. 11 the two cylinders are each divided into three parts, two for the main screen and one for the keyboard. Each of the three sections has its own frame for holding the screen taut.

The device of any of the preceding embodiments may be used as a wireless monitor to provide screens for nearby devices, or may be used in Navigational display for personal mapping systems such as GPS. The device may be used to enhance the multimedia capability of mobile devices, allowing the device itself to be smaller or lighter. The device may provide an enhanced user interface for the ultra portable mobile office and may provide a portable replacement for large screens, such as projector screen displays.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable subcombination.

Although the invention has been described in conjunction with specific embodiments thereof, it is evident that many alternatives, modifications and variations will be apparent to those skilled in the art. Accordingly, it is intended to embrace all such alternatives, modifications and variations that fall within the spirit and broad scope of the appended claims. All publications, patents, and patent applications mentioned in this specification are herein incorporated in their entirety by reference into the specification, to the same extent as if each individual publication, patent or patent application was specifically and individually indicated to be incorporated herein by reference. In addition, citation or identification of any reference in this application shall

not be construed as an admission that such reference is available as prior art to the present invention.

CLAIMS

What is claimed is:

1. A portable electronic device comprising:

a first device part having a housing;

a flexible screen movable between an extended position extending out of said housing for viewing by a user and a retracted position wherein said screen is retracted towards said housing; and

at least two extensible members for extending retractably with said screen to hold said screen taut while in said extended position.

2. The device of claim 1, wherein said screen is mounted on a roller, which roller is mounted within said housing, said retracted position comprising being rolled on said roller within said housing.

3. The device of claim 1, wherein said first device part comprises a first cylinder at one end of said screen, a first of said extensible members being attached to an opposite end of said screen, and a second of said extensible members being extensible between said housing and said first extensible member to hold said screen taut between said housing and said first extensible member.

4. The device of claim 3, comprising a second device part connected along an edge of said screen opposite said first device part, wherein said first and a third extensible member run parallel between said first and second device parts and said second and a fourth extensible members extend diagonally across said screen between said first and second device parts, said first to fourth extensible members holding said screen taut.

5. The device of claim 4, wherein said first and second device parts are hinged to form upper and lower parts which are respectively foldable.

6. The device of claim 4, wherein said first and second device parts are split into connected upper and lower parts and said screen comprises respectively attached upper and lower parts.

7. The device of claim 5, wherein said lower parts of said first and second device parts are split into connected first lower and second lower parts and said screen comprises respectively attached upper and lower parts.

8. The device of one of claims 6 or 7, wherein said lower screen part comprises touch sensitivity and is configurable with soft keys to provide a retractable keyboard.

9. The device of claim 1, wherein at least one of said extensible members is telescopic and comprises a catch for holding said member releasably in said extended position.

10. The device of claim 3, further comprising a first speaker mounted in said housing and a second speaker mounted in said first extensible member.

11. The device of claim 3, wherein said second extensible member is lengthwise adjustable.

12. The device of any preceding claim, further comprising communication electronics for receiving images from surrounding device for display on said screen.

13. The device of claim 4, further comprising a navigation device, the navigation device comprising a plurality of activation units mounted on said cylinders.

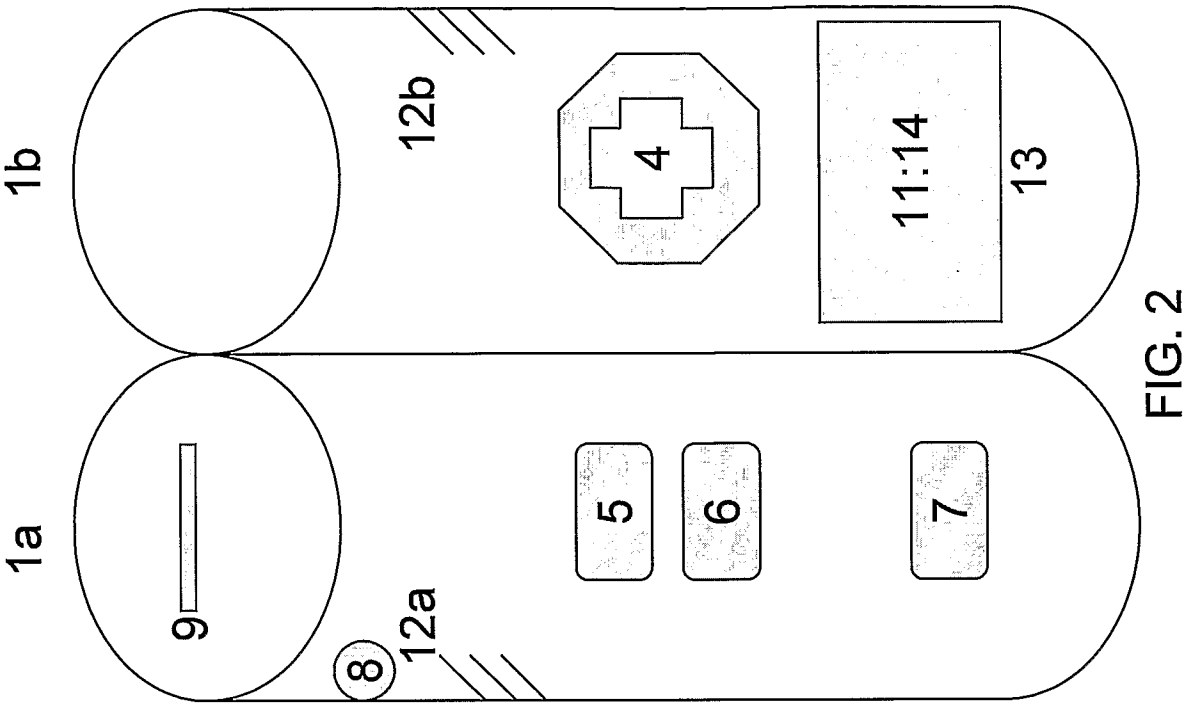

FIG. 2

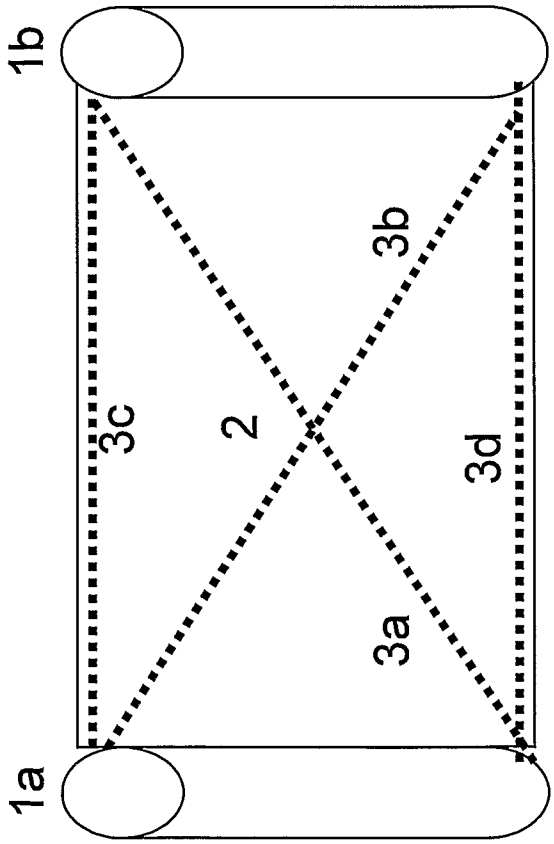

FIG. 1

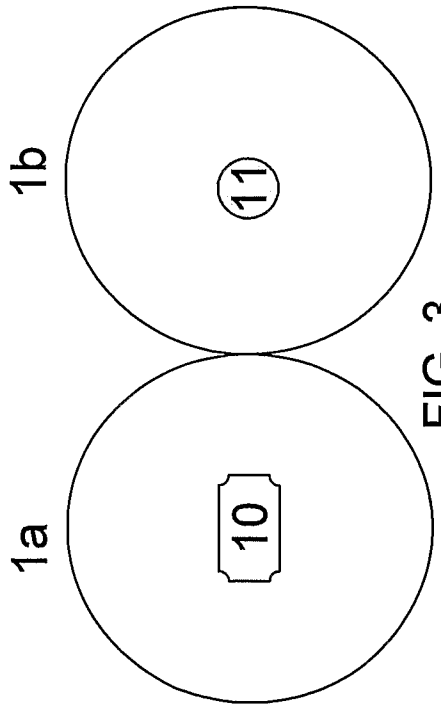

FIG. 3

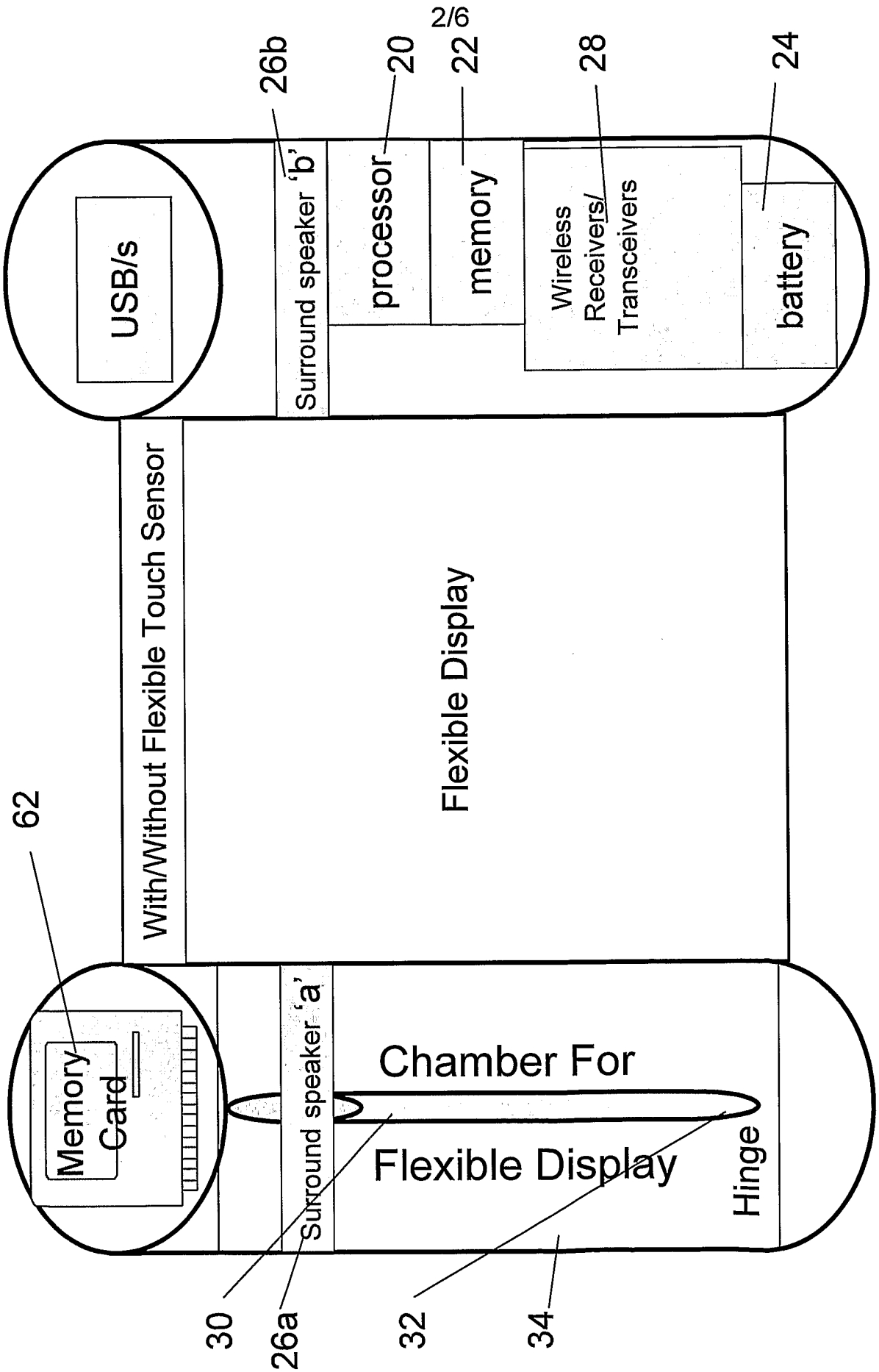
26b
20
22
28
24
USB/s
Surround speaker 'b'
processor
memory
Wireless Receivers/ Transceivers
battery
With/Without Flexible Touch Sensor
Flexible Display
62
Memory Card
Surround speaker 'a'
Chamber For Flexible Display
Hinge
30
26a
32
34

FIG. 4

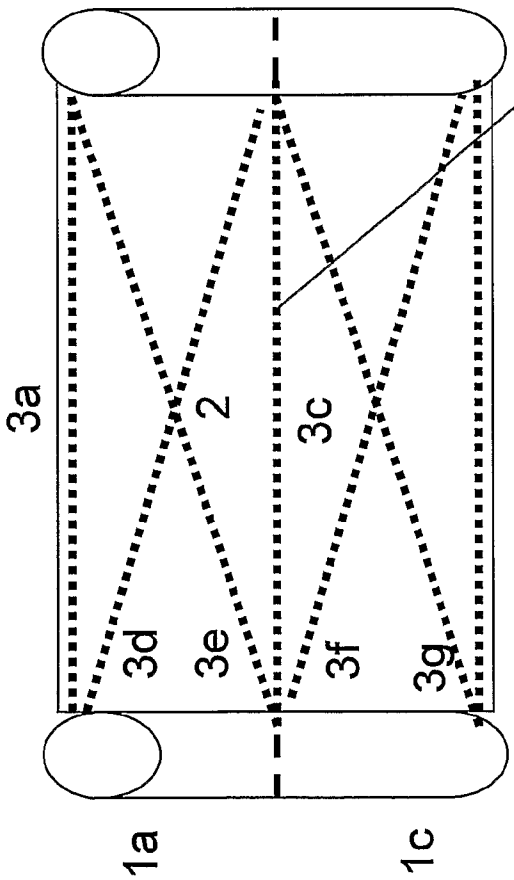

FIG. 5

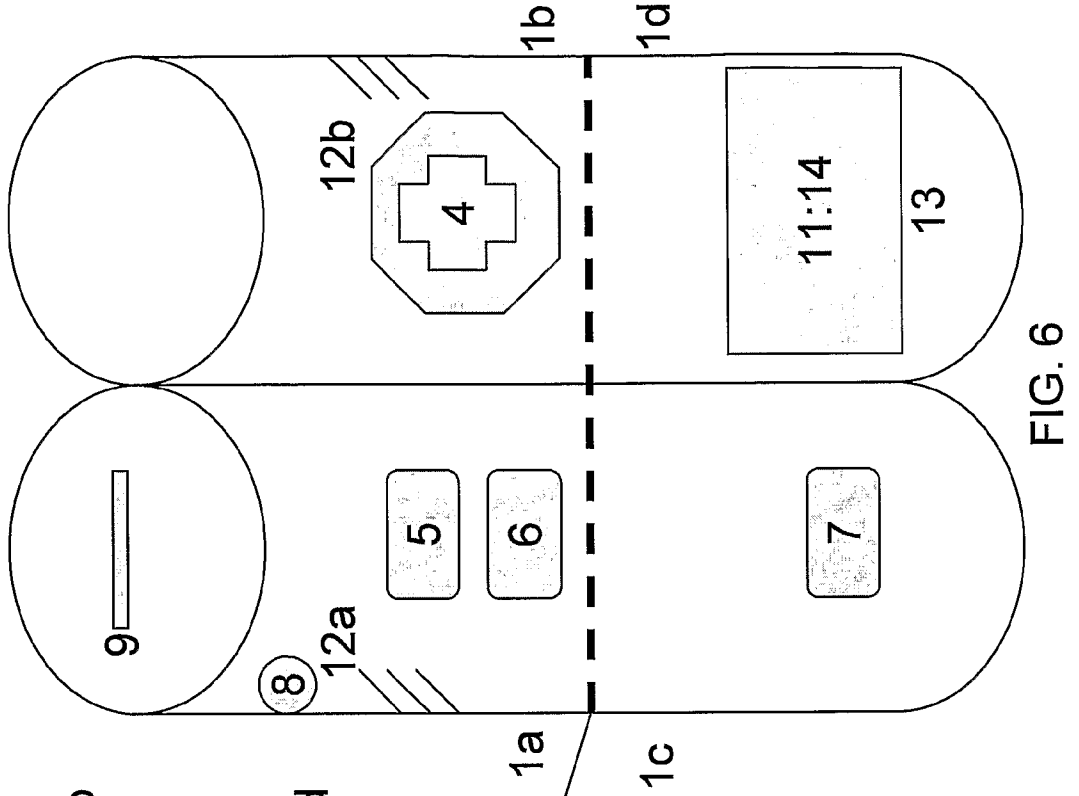

FIG. 6

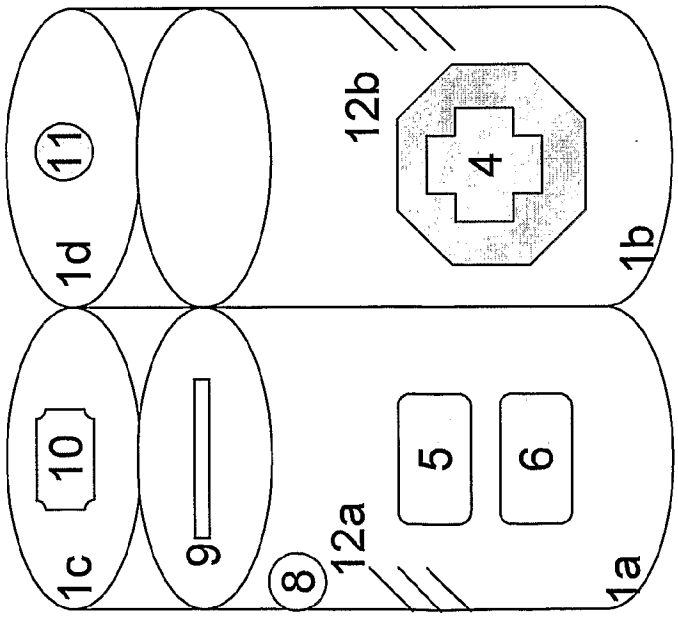

FIG. 7

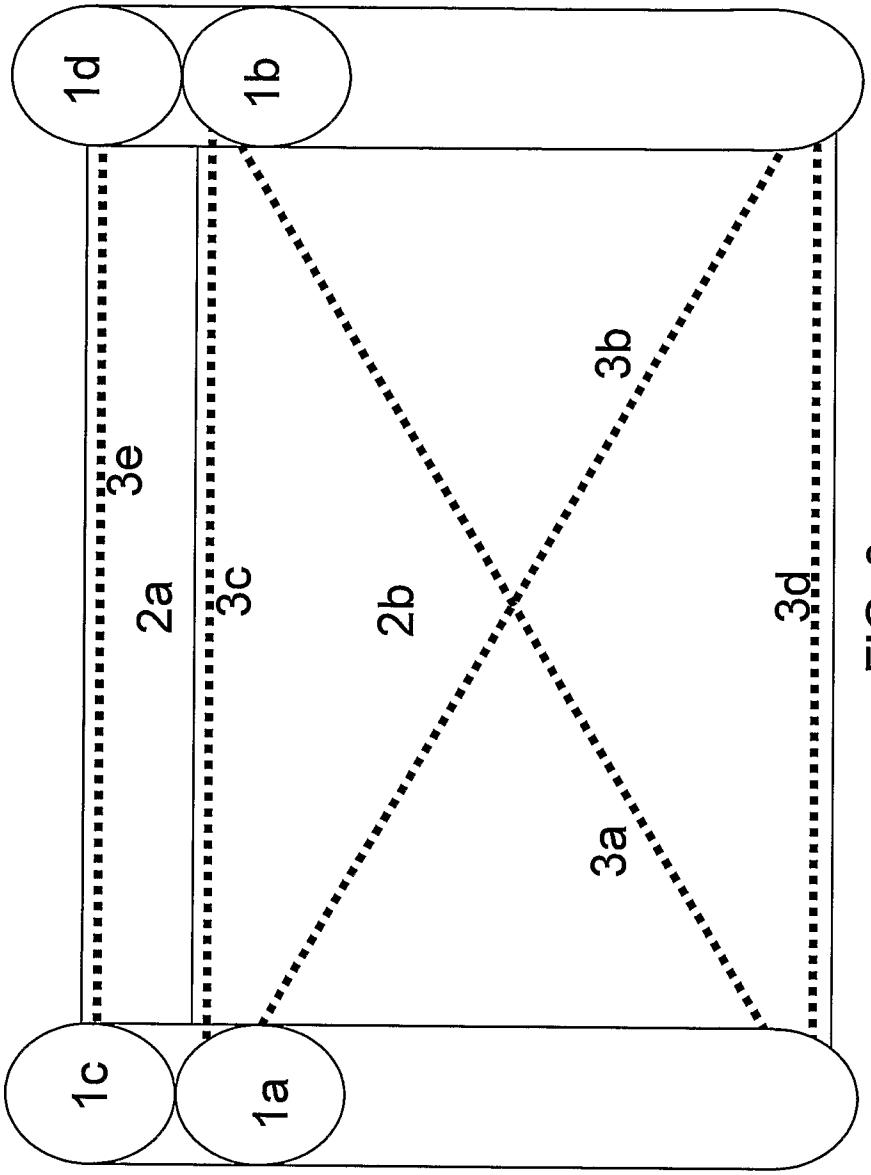

FIG. 8

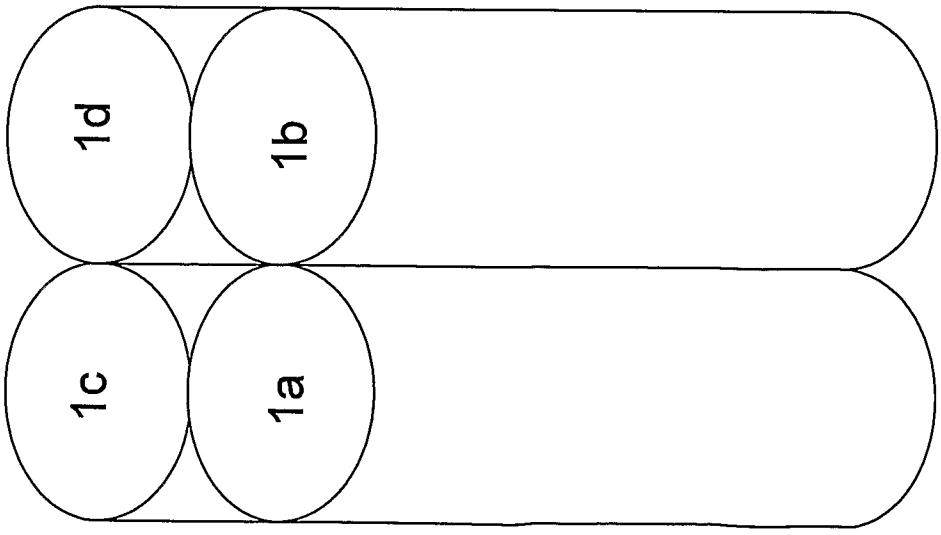

FIG. 9

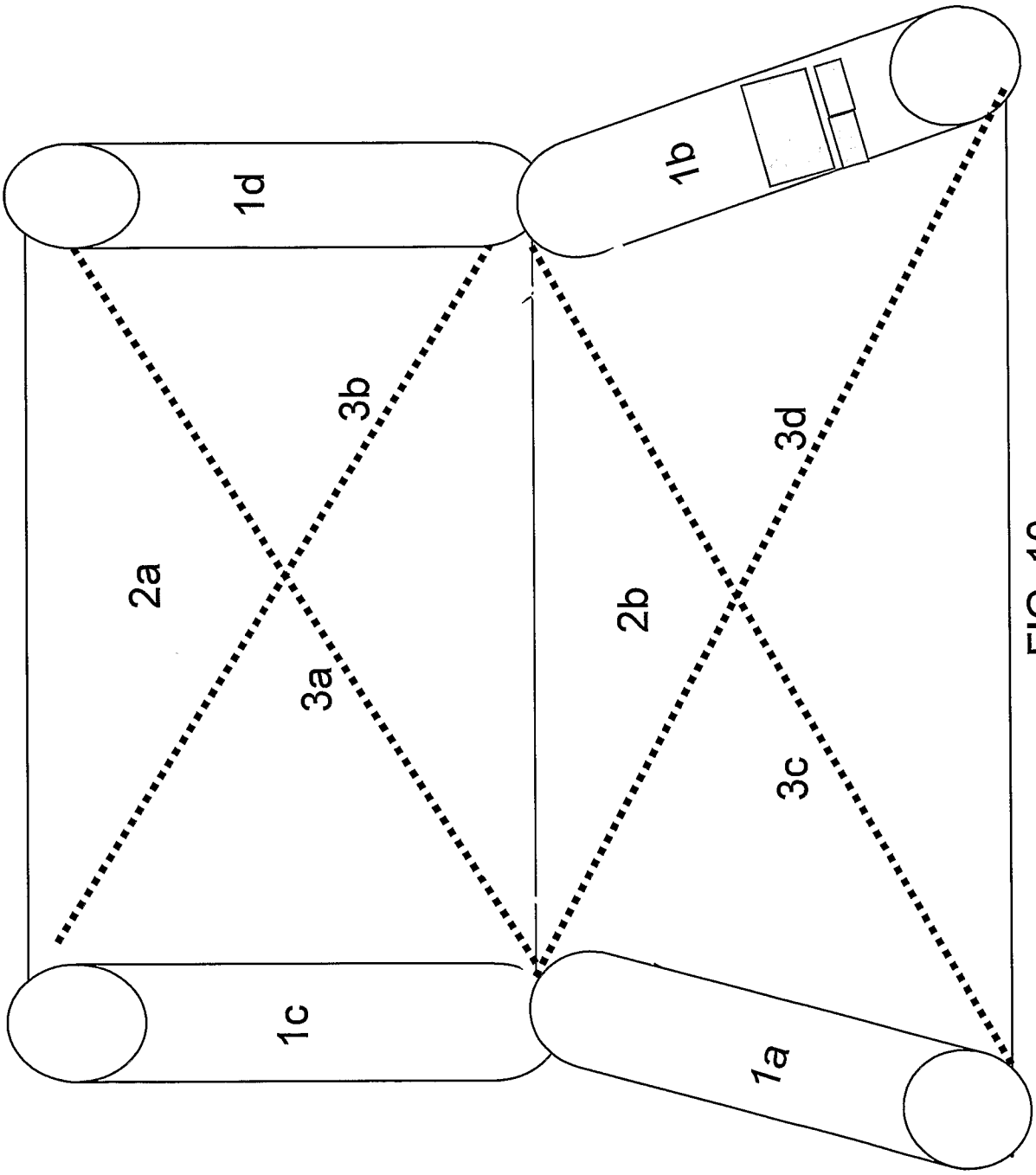

FIG. 10

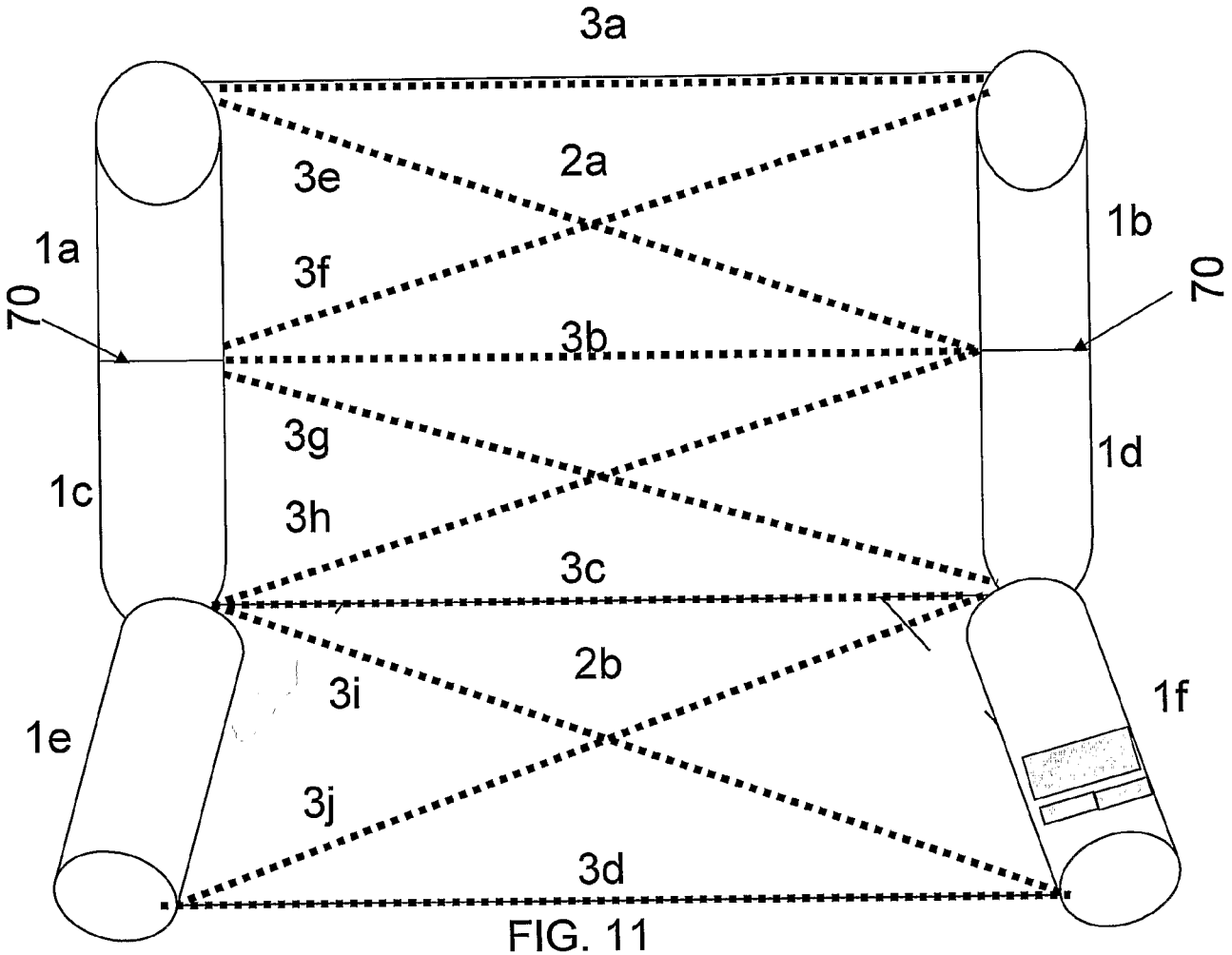
3a
3e
2a
1a
1b
3f
70
70
3b
3g
1d
1c
3h
3c
2b
3i
1f
1e
3j
3d

FIG. 11

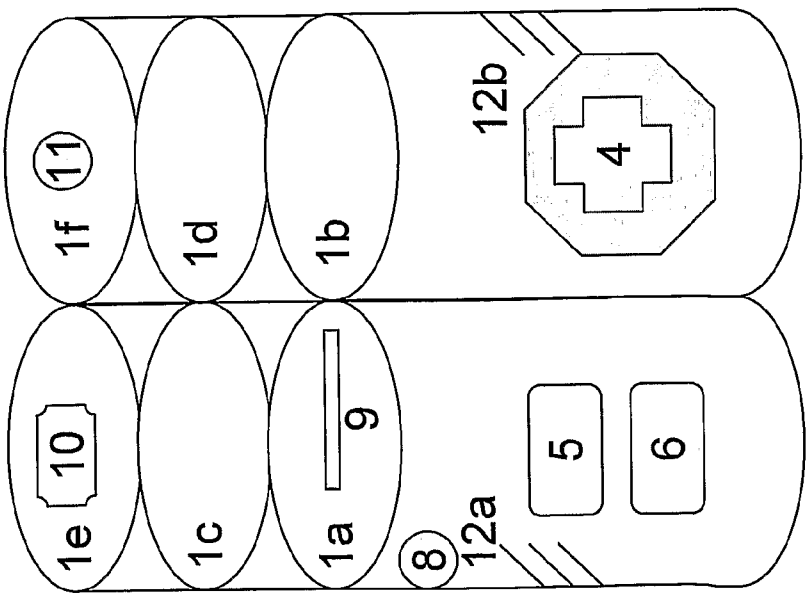
12b
4
11
1f
1d
1b
10
9
5
6
1e
1c
1a
8
12a

FIG. 12

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2009/000529

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02F1/13 G06F1/16 G09F11/29

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)
G02F G06F G09F

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 practical, 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	US 2005/041012 A1 (DANIEL SIMON R [GB] ET AL) 24 February 2005 (2005-02-24) figures 1-3,8 paragraph [0012] paragraph [0035] - paragraph [0039] paragraph [0051] - paragraph [0052] paragraphs [0056], [0059]	1-4,8,9, 11-13
Y		5-7,10
X	WO 2006/038171 A (KONINKL PHILIPS ELECTRONICS NV [NL]; PHILIPS CORP [US]; BEMELMANS DAVI) 13 April 2006 (2006-04-13) abstract figures 1-10 column 6, line 22 - line 24	1,2

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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
27 July 2009	06/08/2009

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	Kentischer, Florian

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2009/000529

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/070910 A1 (FUJIEDA ICHIRO [JP] ET AL) 13 June 2002 (2002-06-13) figure 2 paragraph [0058] - paragraph [0059] paragraph [0053] - paragraph [0054]	1,2
Y		10

X	WO 2008/048100 A (POLYMER VISION LTD [NL]; HUITEMA HJALMAR EDZER AYCO [NL]; VAN LIESHOUT) 24 April 2008 (2008-04-24) figures 8,9 page 11, line 3 - line 9	1,2
Y		5-7

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2009/000529

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2005041012 A1	24-02-2005	US 2007177404 A1	02-08-2007
WO 2006038171 A	13-04-2006	EP 1800280 A1	27-06-2007
		JP 2008516270 T	15-05-2008
		KR 20070057911 A	07-06-2007
US 2002070910 A1	13-06-2002	CN 1359077 A	17-07-2002
		JP 2002182582 A	26-06-2002
		TW 594565 B	21-06-2004
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