(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 603 189 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.12.2005 Bulletin 2005/49

(51) Int Cl.[7]: **H01Q 1/24**, H01Q 9/14, H01Q 9/16, H01Q 1/08

(21) Application number: **05104593.8**

(22) Date of filing: **30.05.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR LV MK YU

(30) Priority: **31.05.2004 JP 2004162413**

(71) Applicant: **KABUSHIKI KAISHA TOSHIBA**
Tokyo 105-8001 (JP)

(72) Inventors:
- **Fujihara, Mikine**
  105-8001, Tokyo (JP)
- **Shingu, Koji**
  105-8001, Tokyo (JP)
- **Kudo, Katsuya**
  105-8001, Tokyo (JP)
- **Ono, Yuuji**
  105-8001, Tokyo (JP)
- **Yoshida, Kazuyoshi**
  105-8001, Tokyo (JP)
- **Asano, Toshio**
  105-8001, Tokyo (JP)

(74) Representative: **Henkel, Feiler & Hänzel**
Möhlstrasse 37
81675 München (DE)

(54) Broadcast receiver

(57) An broadcast receiver has a housing (12), a dipole antenna (16) composed of a first antenna element (16a) arranged in a loop shape inside the housing (12) and a second antenna element (16b) arranged in parallel with the first antenna element (16a) so that a direction where a current in the housing (12) flows becomes same as that of the first antenna element (16a), and a receiving circuit (17) to be supplied a broadcast signal received through the dipole antenna (16).

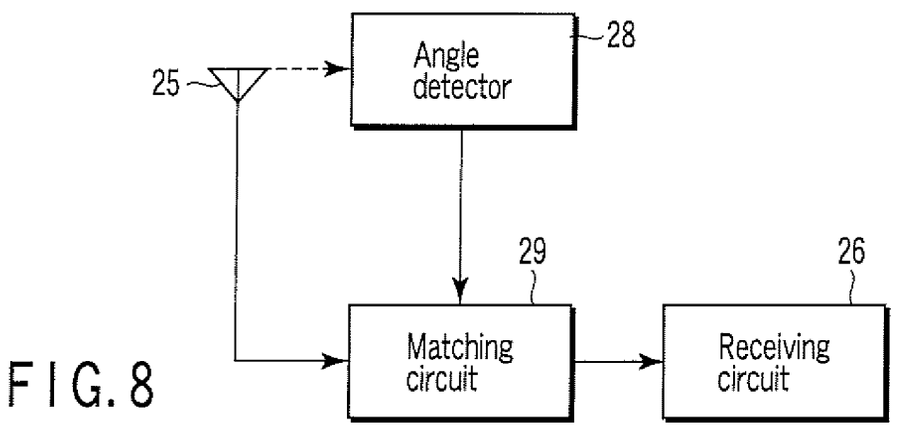

FIG. 8

EP 1 603 189 A1

(Cont. next page)

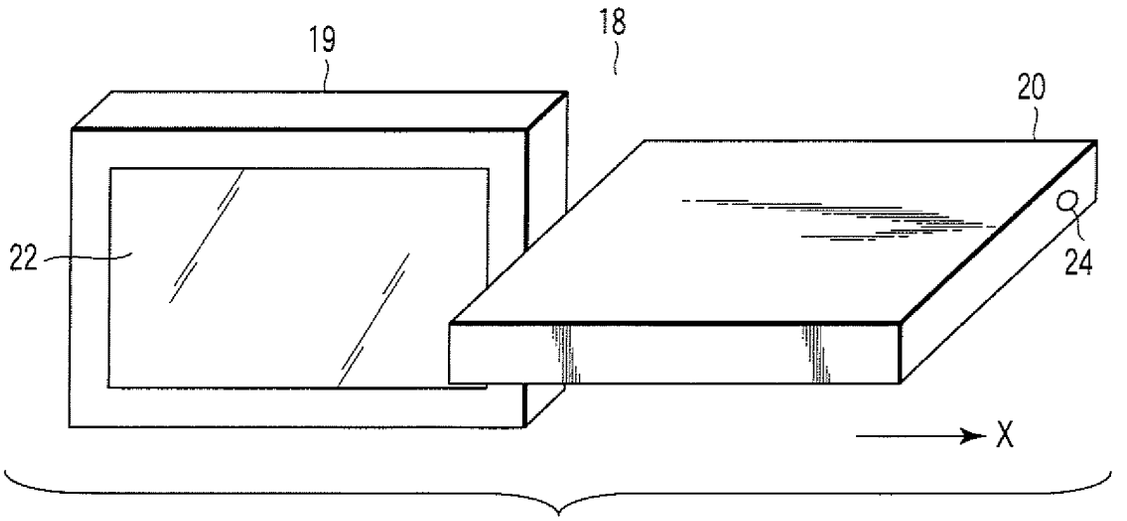

FIG. 9

Description

[0001] The present invention relates to, for example, a broadcast receiver appropriate for use in a portable broadcast receiver and the like to receive terrestrial digital broadcasting.

[0002] As is commonly known, in recent years, terrestrial digital broadcasting has been putting in practical use. This terrestrial digital broadcasting provides low data rate broadcasting, so-called mobile broadcasting, one segment broadcasting, mainly to a mobile object such as a portable broadcast receiving terminal as a service object.

[0003] By the way, the terrestrial digital broadcasting uses a broadcast frequency lower in frequency and longer in wavelength than those of a frequency of a mobile telephone. Therefore, a broadcast receiving terminal for receiving the mobile broadcasting requires measures to efficiently receive an electric wave with a long wavelength while moving.

[0004] Jpn. Pat. Appln. KOKAI 2002-299933 and U. S. patent No. 6,614,401 disclose configurations that realizes miniaturization and broadening of frequency by providing a non-feed radiation electrode for generating a double resonance state to an electrode structure of an antenna of which the ground unit of a mounted substrate also performs an antenna operation by being energized by an antenna operation of a feed radiation electrode.

[0005] However, both of these two patent documents describe about mobile telephones and do not at all describe about the measures especially suitable for receiving of the mobile broadcasting in a lower frequency than that of the mobile telephone.

[0006] In view of the foregoing, an object of the invention is to provide a broadcast receiver capable of maintaining high receiving performance even in a low frequency without deteriorating miniaturization.

[0007] According to one aspect of the present invention, there is a broadcast receiver comprising: a housing; a dipole antenna composed of a first antenna element arranged in a loop shape inside the housing and a second antenna element arranged in parallel with the first antenna element so that a direction where a current in the housing flows becomes same as that of the first antenna element; and a receiving circuit to be supplied a broadcast signal received through the dipole antenna.

[0008] This summary of the invention does not necessarily describe all necessary features so that the invention may also be a sub-combination of these described features.

[0009] The invention can be more fully understood from the following detailed description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a perspective view showing a first embodiment of the invention and explaining an external appearance of a broadcast receiving terminal;

FIG. 2 is a view explaining an arrangement of a dipole antenna of the broadcast receiving terminal of the first embodiment of the first invention;

FIG. 3 is a perspective view showing a second embodiment of the invention and explaining an external appearance of a folded broadcast receiving terminal;

FIG. 4 is a perspective view explaining an external appearance of a developed broadcast receiving terminal of the second embodiment of the invention;

FIG. 5 is a view explaining an arrangement of a dipole antenna of the broadcast receiving terminal of the second embodiment of the invention;

FIG. 6 is a view showing a third embodiment of the invention and explaining an arrangement of a dipole antenna of a broadcast receiving terminal;

FIG. 7 is a block diagram explaining shortening of an antenna length of the broadcast receiving terminal of the third embodiment in the invention by using a matching circuit;

FIG. 8 is a block diagram explaining correction of a deviation of a resonant frequency accompanied by an opening angle of the broadcast receiving terminal of the third embodiment of the invention;

FIG. 9 is a perspective view explaining an example of a movable shape of the broadcast receiving terminal of the third embodiment of the invention;

FIG. 10 is a perspective view explaining an other example of the movable shape of the broadcast receiving terminal of the third embodiment of the invention;

FIG. 11 is a perspective view explaining an other example of the movable shape of the broadcast receiving terminal the third embodiment of the invention; and

FIG. 12 is a perspective view explaining an other example of the movable shape of the broadcast receiving terminal of the third embodiment of the invention.

[0010] Hereinafter, an embodiment of the invention will be explained in detail by referring drawings. FIG. 1 shows an external appearance of a broadcast receiving terminal 11 to be explained in a first embodiment of the invention. The receiving terminal 11 has a portable housing 12 shaped in a thin box.

[0011] One plane section 12a of the housing 12 of the receiving terminal 11 has a display unit 13 and an operation unit 14, and one side face 12b of the housing 12 has a connector 15 for sound outputting so as to connect a headphone or the like.

[0012] Here, as shown in FIG. 2, the receiving terminal 11 receives a broadcast signal through a dipole antenna 16 incorporated in the housing 12 and performs tuning, demodulation processing and the like by supplying the received signal to a receiving circuit 17.

[0013] In this case, a first antenna element 16a composing the dipole antenna 16 is arranged so that one end of the first antenna element 16a is connected to the

receiving circuit 17 and the other end thereof forms a loop along an inner wall of the housing 12.

[0014] A second antenna element 16b composing the dipole antenna 16 is arranged in parallel with the first antenna element 16a in a manner that one end of the second antenna element 16b is connected to the receiving circuit 17 and the other end thereof forms a loop in the reverse direction to the first antenna element 16a.

[0015] Since the first and the second antenna elements 16a, 16b composing the dipole antenna 16 are arranged in a loop shape along the inner wall of the housing 12, the dipole antenna 16 can make an antenna length long and sufficiently respond to a low frequency without deteriorating miniaturization.

[0016] The first and the second antenna elements 16a, 16b are arranged in parallel with each other so as to form loops in reverse directions with each other. Thereby, at paralleled parts of the first and the second antenna elements 16a, 16b, currents flow in the same direction as shown by an arrow "a" and affect to increase each other, so that the dipole antenna 16 can enhance its receiving performance.

[0017] Next, a second embodiment of the invention will be explained. FIG. 3 and FIG. 4 show external appearances of a broadcast receiving terminal 18 to be explained in the second embodiment. The receiving terminal 18 rotatably connects two housings 19, 20 with thin box shapes by a hinge mechanism 21.

[0018] In this case, the receiving terminal 18 can take a folded position in which a housing 19 and a housing 20 are overlapped with each other as shown in FIG. 3 and take a developed position as shown in FIG. 4 by rotating the housings 19, 20 around a Y axis as a center by the hinge mechanism 21.

[0019] The housing 19 is provided with a display unit 22 on a surface 19a facing the housing 20 in the folded position. Furthermore, the housing 20 is provided with an operation unit 23 on a surface 20a facing the housing 19 in the folded position. One side face 20b of the housing 20 is also provided with a connector 24 for a sound output to connect a headphone, etc.

[0020] As shown in FIG. 5, the receiving terminal 18 receives a broadcast signal through a dipole antenna 25 incorporated in one housing 19 and performs tuning, demodulation processing and, etc., by supplying the received signal to a receiving circuit 26.

[0021] In this case, a dipole antenna 25 is arranged, in which one end of a first antenna element 25a composing the dipole antenna 25 is connected to the receiving circuit 26 and the other end thereof is shaped in a loop along an inner wall of the housing 19.

[0022] A second antenna element 25b composing the dipole antenna 25 is arranged in parallel with the first antenna element 25a so that one end of the antenna element 25b is connected to the receiving circuit 26 and the other end thereof forms a loop in the reverse direction to the first antenna element 25a.

[0023] Since the first and the second antenna elements 25a, 25b composing the dipole antenna 25 are arranged in a loop shape along the inner wall of the housing 19, the dipole antenna 25 can make an antenna length long and sufficiently respond to a low frequency without deteriorating miniaturization.

[0024] The first and the second antenna elements 25a, 25b are arranged in parallel with each other so as to form loops in reverse directions with each other. Thereby, at paralleled parts of the first and the second antenna elements 25a, 25b, currents flow in the same direction as shown by an arrow "b" and affect to increase each other, so that the dipole antenna 25 can enhance its receiving performance.

[0025] It is obvious that the dipole antenna 25 and the receiving circuit 26 may be provided in the housing 20.

[0026] FIG. 6 shows a third embodiment of the invention. Referring now to FIG. 6 in which like elements in FIG. 5 are given like reference marks, the first antenna element 25a extended from the receiving circuit 26 incorporated in the housing 19 is arranged so as to form a loop along an inner wall of the housing 20. The second antenna element 25b extended from the receiving circuit 26 is arranged so as to form a loop along an inner wall of the housing 19.

[0027] As shown in FIG. 11, the display unit 22 of the housing 19 and an operation unit 23 (not shown in FIG. 11) of the housing 19 can be faced in reverse directions with each other by rotating the housing 20 by 180 degree around an X axis as a center from the developed position shown in FIG. 4. The two housings 19, 20 may be also folded from this developed position.

[0028] In the case that two housings 19, 20 are rotatably coupled by the hinge mechanism 21, the housings 19, 20 can rotate in a plurality of directions by increasing the number of axes of the hinge mechanism 21. For example, it is possible for the housing 20 to rotate from the developed position in which the housing 20 is rotated by 180 degree around a Y axis as a center to the housing 19 shown in FIG. 4 to the position in which the housing 20 is rotated by 90 degree around an X axis as a center as shown in FIG. 9 and further rotate to the position in which the housing 20 is rotated by 90 degree around a z axis as a center.

[0029] Furthermore, as shown in FIG. 12, the housing 20 slides from the developed position shown in FIG. 4 by its thickness in a direction of the z axis and rotates by 180 degree around the z axis as a center from the slid position. Thereby, the housings 19, 20 can be overlapped so as to make the surface 19a with the display unit 22 of the housing 19 is disposed thereon and a surface on its opposed side and the surface 20a with the operation unit 23 of the housing 20 disposed thereon face with one another.

[0030] As shown in FIG. 9 to FIG. 12, if the housings 19, 20 are structured so as to take a variety of rotatable positions, the first and the second antenna elements 25a, 25b in the folded position are sometimes not arranged in parallel with each other in reverse directions

and, in contrast, they are arranged in parallel with each other in the same direction.

[0031] In such a case, at the sections in which the first and the second antenna elements 25a, 25b are in parallel with each other, such effect that currents flow in reverse directions and enhance each other can not be achieved.

[0032] Thus, it is required to achieve a structure by which the first and the second antenna elements 25a, 25b can not be folded so that they are put in parallel by loops having the same direction and to promote a user to put marks on side faces of the housings 19, 20 and fold the housings 19, 20 in order to each mark come into matching with each other.

[0033] As mentioned above, each housing 19, 20 can be made thinner by respectively arranging the first and the second antenna elements 25a, 25b composing the dipole antenna 25 inside the two housings 19, 20 connected rotatably.

[0034] In the position with two housings 19, 20 folded therein, the first and the second antenna elements 25a, 25b are arranged in parallel while forming a loop oppositely in direction to each other. Therefore, at the section where the first and the second antenna elements 25a, 25b are paralleled with each other, currents flow in the same direction and affect to increase each other, so that the dipole antenna 25 can enhance its receiving performance.

[0035] In the case that lengths of the first and the second antenna elements 25a, 25b are set 1/4 of a wavelength of the received signal, the most advantageous gain can be obtained for the dipole antenna 25.

[0036] However, as shown in FIG. 7, it becomes possible to obtain performance equivalent to a dipole antenna with a whole length of $\lambda/2$ even if the lengths of the first and the second antenna elements 25a, 25b are set shorter than $\lambda/4$ by inserting a matching circuit 27 composed of a coil and the like between the dipole antenna 25 and the receiving circuit 26. This fact also goes same in the first and the second embodiments.

[0037] The first and the second antenna elements 25a, 25b composing the dipole antenna 25 are respectively arranged inside the two housings 19, 20 connected rotatably. Thereby, a V-shaped dipole antenna 25 can be formed by varying the opening angle formed by the housing 19 and 20.

[0038] It is known for the V-shaped dipole antenna 25 to enhance directivity in an opening end direction of a V shape. Accordingly, the dipole antenna 25 can obtain higher receiving performance by facing the V-shaped opening end toward an incoming direction of an electric wave by adjusting the opening angle formed by the housings 19 and 20.

[0039] The dipole antenna 25 is normally set to achieve matching in the case that the opening angle formed by the housings 19 and 20 is set to 180 degree as shown in FIG. 6, that is, in the state that the first and the second antenna elements 25a, 25b are put on a straight line.

[0040] Whereby, in the case of forming the v-shaped dipole antenna 25 resulting from change in opening angle formed by the housings 19 and 20, it becomes possible to improve the receiving performance by correcting a deviation in resonant frequency caused by the change in opening angle.

[0041] FIG. 8 shows an example of a means for correcting the deviation in the resonant frequency resulting from the forming of the V-shaped dipole antenna 25. That is, the matching circuit 29 corrects the deviation in the resonant frequency of the broadcast signal received at the dipole antenna 25 by controlling the matching circuit 29 on the basis of a detection result from an angle detector 28 detecting the opening angle of the dipole antenna 25 and supplies the corrected signal to the receiving circuit 26.

[0042] The matching circuit 29 is composed of, for example, variable coils connected in series and can correct the deviation in resonant frequency by varying inductance of the variable coils in response to the opening angle of the dipole antenna 25.

[0043] More specifically, when achieving the matching in the state of arrangement of the first and the second antenna elements 25a, 25b in the straight line, the resonant frequency becomes higher as the opening angle formed by the first and the second antenna elements 25a and 25b is made narrower from the position of the matching.

[0044] Whereby, the matching circuit 29 can correct the deviation in resonant frequency by increasing the inductance of the variable coils as the opening angle formed by the first and the second antenna elements 25a and 25b becomes narrow.

[0045] As for the angle detector 28, for example, by varying the opening angle formed by the housings 19 and the 20 step by step in a rage form 0 degree to 180 degree, a method of detecting that which step is currently set, a method of having a slide resister, etc., varying a resistance value in response to the opening angle formed by the housings 19 and 20 and detecting its resistance value or the like can be considered.

[0046] It is possible for the matching circuit 27 shown in FIG. 7 and the matching circuit 29 shown in FIG. 8 to be shared.

[0047] It is our intention that the invention is not limited to the specific embodiments described herein without any change, and the invention can be brought into shape by varying constituent elements without departing from the sprit and the scope of the invention. A variety of inventions can be achieved by appropriately combining a plurality of constituent elements disclosed in the embodiment described herein. For example, it is preferable that some constituent elements to be eliminated from the whole of the constituent elements shown in the embodiments. Furthermore, it is preferable to appropriately combine the constituent elements relevant to different embodiments.

Claims

1. A broadcast receiver **characterized by** comprising:

housings (12, 19, 20);
a dipole antenna (16, 25) composed of a first antenna element (16a, 25a) arranged in a loop shape inside the housings (12, 19, 20) and a second antenna element (16b, 25b) paralleled with the first antenna element (16a, 25a) so that directions where currents in the housings (12, 19, 20) flow become same as that of the first antenna element (16a, 25a); and
a receiving circuit (17, 26) to be supplied a broadcast signal received through the dipole antenna (16, 25).

2. The broadcast receiver according to claim 1, **characterized in that** a display unit (13, 22), an operation unit (14, 23) and a terminal for a sound output (15, 24) are provided in the housings (12, 19, 20).

3. The broadcast receiver according to claim 1, **characterized in that**

the housings (19, 20) are composed of the rotatably connected first and the second housings (19, 20), and

the first and the second antenna elements (25a, 25b) are provided in the first housing (19).

4. The broadcast receiver according to claim 1, **characterized in that**

the housings (19, 20) are composed of the first and the second housings (19, 20) rotatably connected to be positioned in such a position that the housings (19, 20) overlap with each other, and

the first antenna element (25a) is arranged in the first housing (19) and the second housings (19, 20) is arranged inside the second housing (20) so that a direction where a current in the second antenna element (25b) flows becomes same as that of the first antenna element (25a) at the folded position of the first and the second housings (19, 20).

5. The broadcast receiver according to claim 3 or 4, **characterized in that**

a display unit (22) is provided in one of the first or the second housing (19, 20) and the operation unit (23) is provided in the other.

6. The broadcast receiver according to claim 3 or 4, **characterized in that**

the first and the second housings (19, 20) are rotatably supported around a plurality of axes as centers, respectively.

7. The broadcast receiver according to claim 3 or 4, **characterized by** further comprising

a matching circuit (27) shortening lengths of the first and the second antenna elements (25a, 26b) composing the dipole antenna (25).

8. The broadcast receiver according to claim 4, **characterized by** further comprising:

an angle detection circuit (28) detecting an opening angle formed by the first antenna element (25a) and the second antenna element (25b); and
a matching circuit (29) correcting deviation in a resonant frequency from a matching state of the dipole antenna (25) on the basis of a detection result from the angle detection circuit (28).

9. The broadcast receiver according to claim 1, **characterized in that**

the dipole antenna (16, 25) is set so as to respond to receiving of mobile broadcasting.

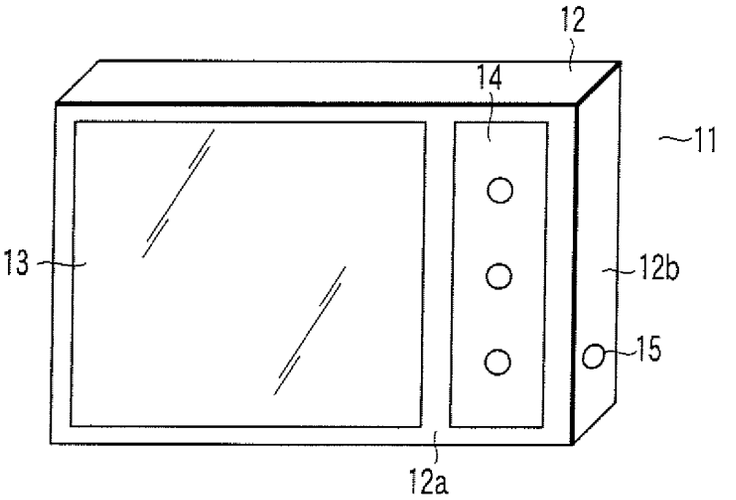

FIG. 1

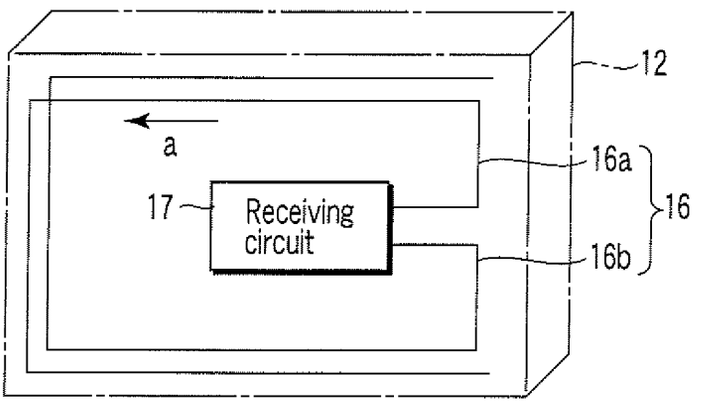

FIG. 2

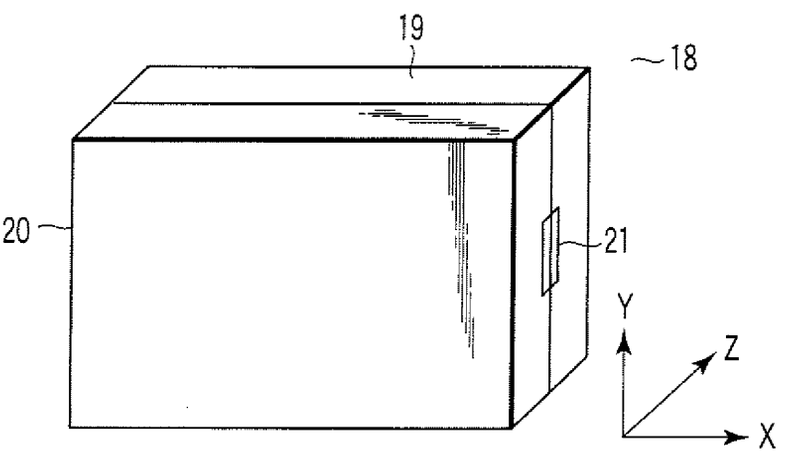

FIG. 3

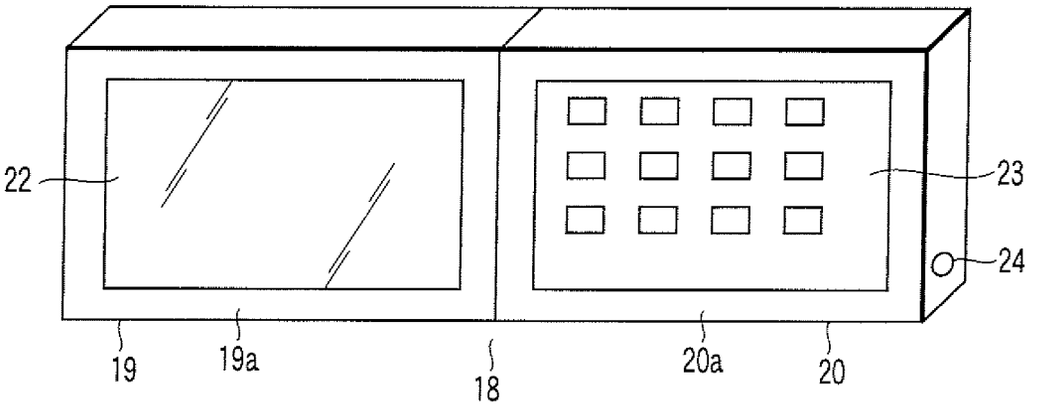

FIG. 4

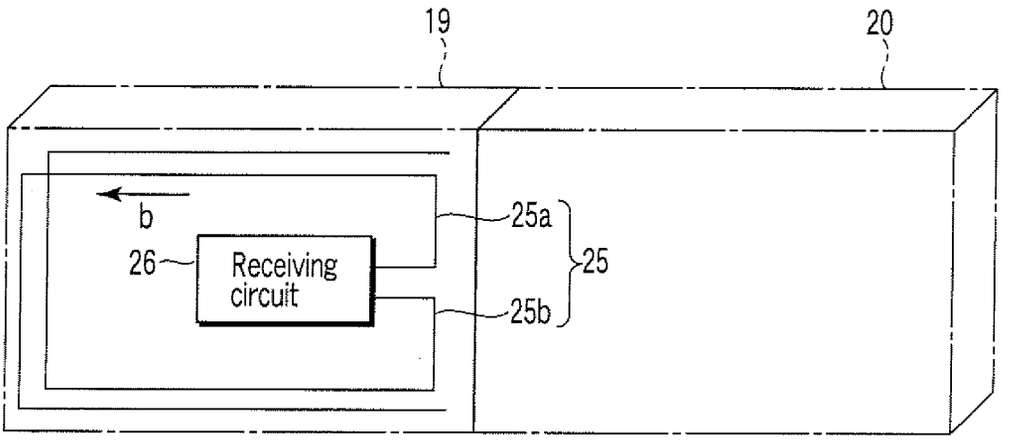

FIG. 5

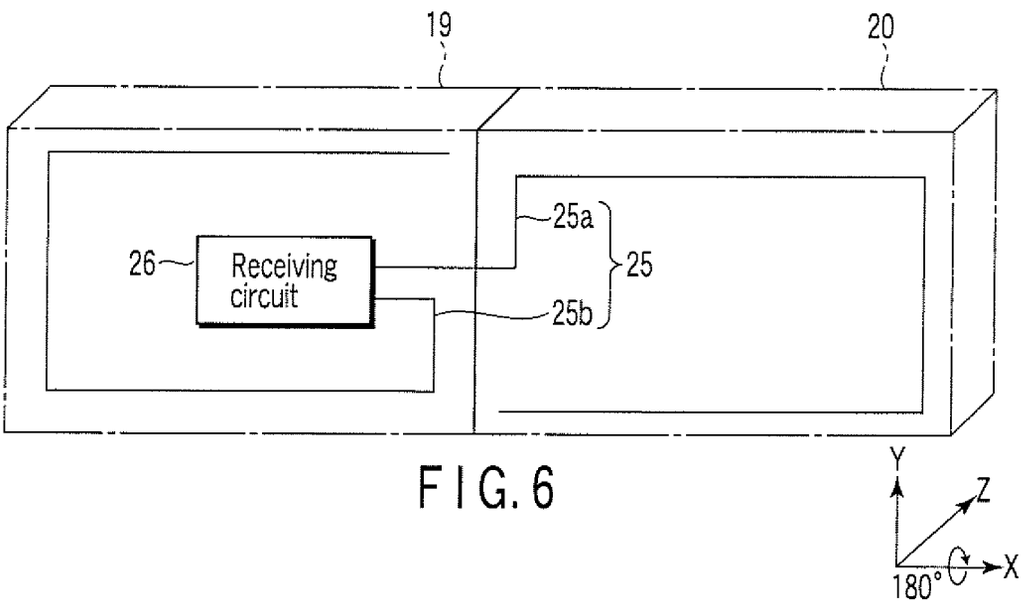

FIG. 6

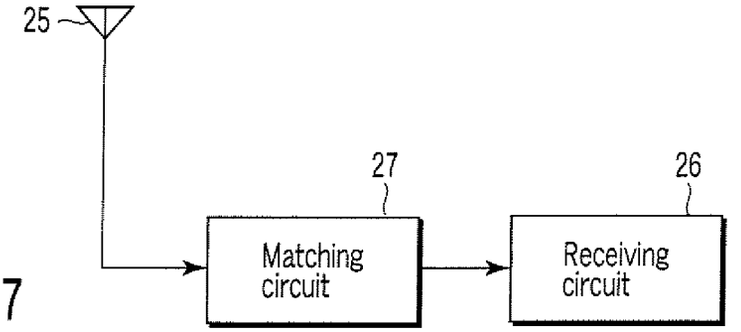

FIG. 7

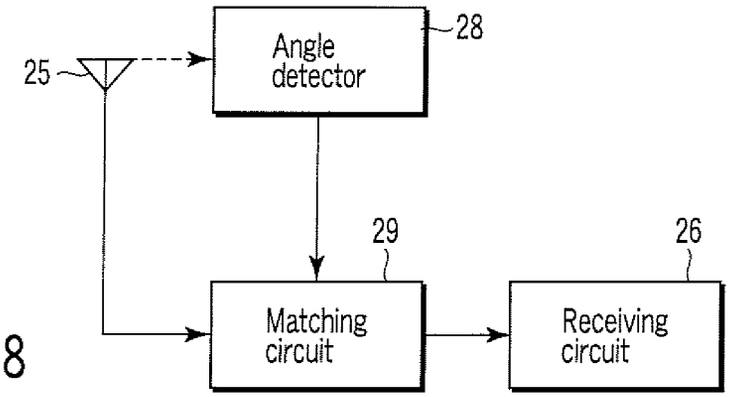

FIG. 8

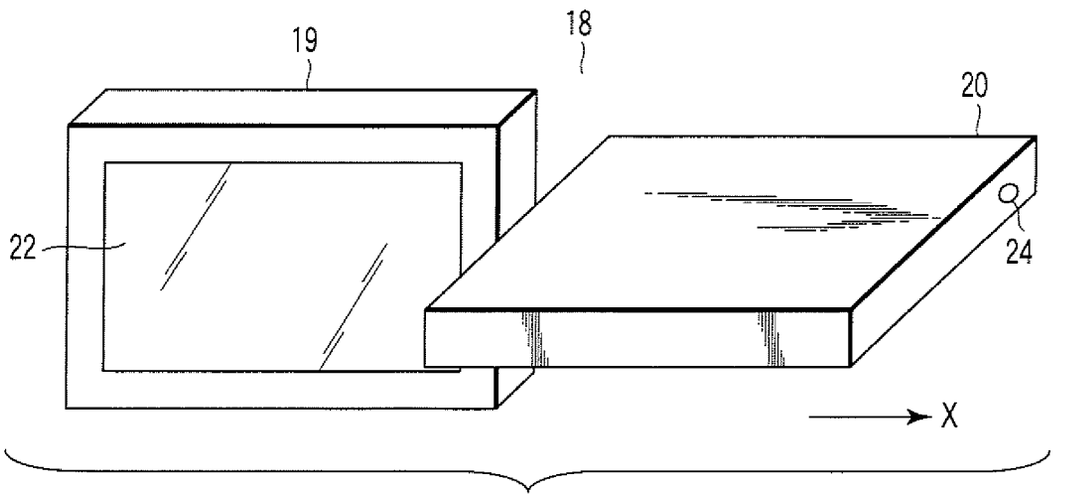

FIG. 9

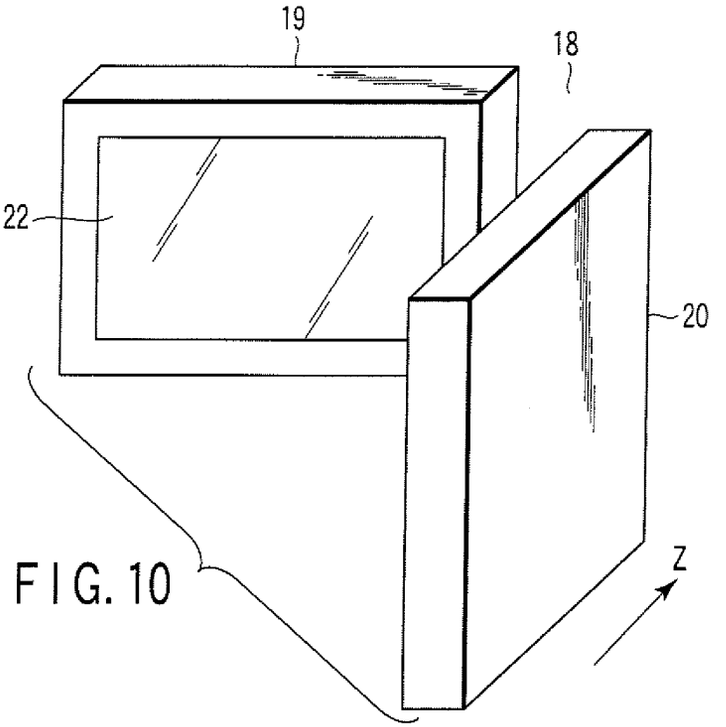

FIG. 10

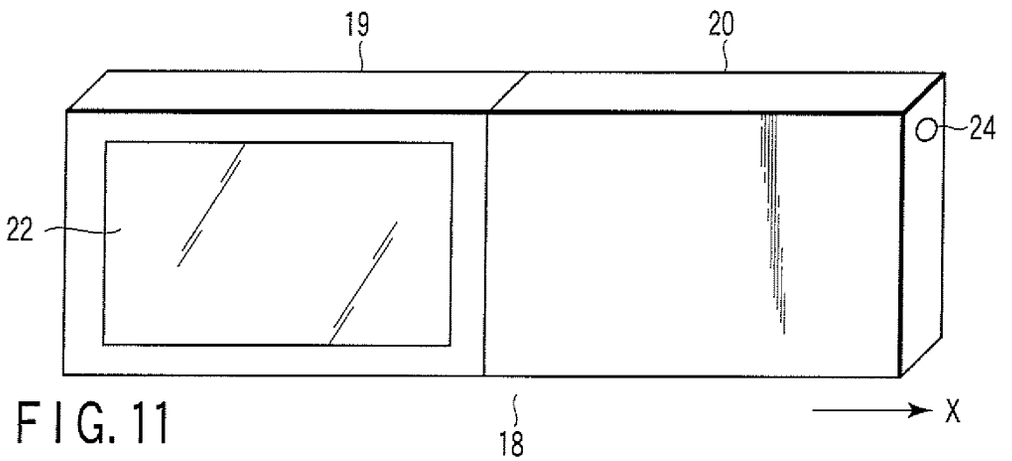

FIG. 11

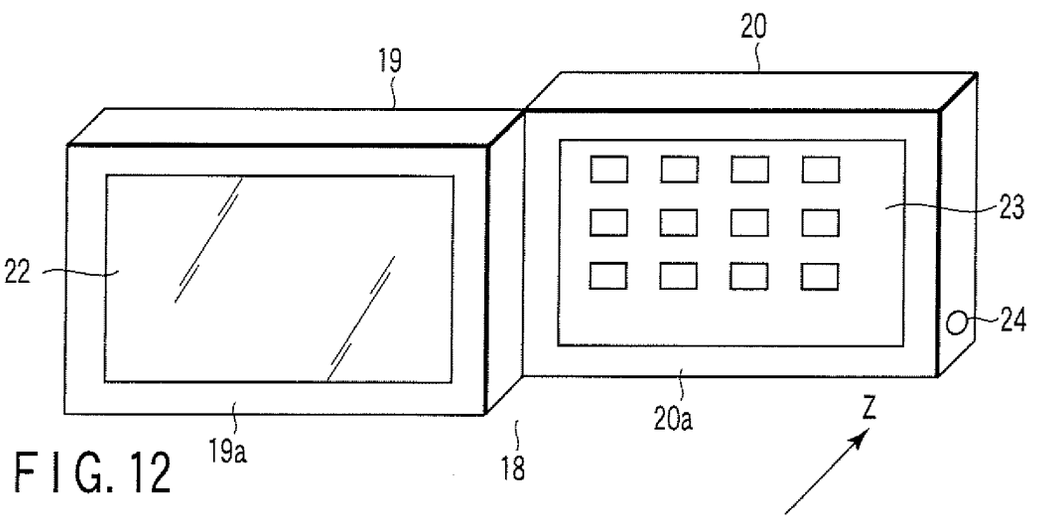

FIG. 12

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 10 4593

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	US 6 011 519 A (SADLER ET AL) 4 January 2000 (2000-01-04) * the whole document *	1-7,9	H01Q1/24 H01Q9/14 H01Q9/16 H01Q1/08
X	EP 1 296 407 A (MITSUBISHI DENKI KABUSHIKI KAISHA) 26 March 2003 (2003-03-26) * the whole document *	1,3	
A	US 5 561 437 A (PHILLIPS ET AL) 1 October 1996 (1996-10-01) * the whole document *	1-9	
A	EP 1 168 658 A (MITSUBISHI DENKI KABUSHIKI KAISHA) 2 January 2002 (2002-01-02) * the whole document *	1-9	
A	US 5 649 306 A (VANNATTA ET AL) 15 July 1997 (1997-07-15) * the whole document *	1-9	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

H01Q

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 September 2005	Wattiaux, V

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

4

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 10 4593

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-09-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6011519 A	04-01-2000	AU 1342600 A	29-05-2000
		CN 1333934 A	30-01-2002
		DE 19983701 T0	08-11-2001
		JP 2002529998 T	10-09-2002
		TW 443000 B	23-06-2001
		WO 0028617 A1	18-05-2000
EP 1296407 A	26-03-2003	CN 1370341 A	18-09-2002
		WO 0197325 A1	20-12-2001
US 5561437 A	01-10-1996	NONE	
EP 1168658 A	02-01-2002	CN 1343401 A	03-04-2002
		WO 0152445 A1	19-07-2001
US 5649306 A	15-07-1997	BR 9504678 A	08-10-1996
		CA 2156967 A1	17-03-1996
		CN 1123476 A	29-05-1996
		DE 19533247 A1	28-03-1996
		FR 2724773 A1	22-03-1996
		GB 2293277 A	20-03-1996
		IT RM950612 A1	18-03-1996
		JP 3645948 B2	11-05-2005
		JP 8102609 A	16-04-1996

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82