Attorney Docket No.: 891.0013.U4(US)

# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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## NEW APPLICATION TRANSMITTAL FORM

Sir:

Transmitted herewith for filing is the patent application of

Inventor(s): **Claus H. JORGENSEN**

For (title): **Portable Electronic Device**

Enclosed are the following:

- ☒ Application Cover Page
- ☒ **19** pages of Specification that consists of, **12** pages of Description, **6** pages of Claims and **1** page of Abstract;
- ☒ **6** sheet of drawings;
- ☒ Inventor(s) Declaration;
- ☒ Preliminary Amendment;
- ☐ Certified Copy of priority document(s);
- ☐ English language translation of priority document;
- ☒ Application Data Sheet;
- ☒ Information Disclosure Statement and/or Form PTO 1449 and cited non-U.S. art (if applicable);
- ☐ Assignment and Recordation Form Cover Sheet;
- ☐ Return Receipt Postcard;
- ☒ Other: Power of Attorney and Transmittal;
  Certificate and Request for Prioritized Examination Under 37 CFR 1.102(e)
  6 Replacement Sheets

Assignment Data

- ☒ An assignment of the invention to Nokia Corporation
  - ☐ is attached.
  - ☐ will follow.
  - ☒ has been previously filed.

Small Entity Status

- ☐ Applicant claims small entity status.



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IPR2024-00798 (Amazon.com, Inc., Amazon.com Services LLC v. Nokia Technologies Oy)

Fees

☒ Utility ☐ Reissue

☐ Design

| | | | | | |
|---|---|---|---|---|---|
| Basic Filing Fee | | | | | $ 280.00 |
| Excess Claim Fee | | | | | |
| | Number Filed | Number Extra | | Rate | |
| Total Claims | **18** -20 = | **0** | x | $ 80.00 | **$** |
| Independent Claims | **2** - 3 = | **0** | **x** | $ 420.00 | **$** |
| ☐ Multiple Dependent Claim Fee ($780.00) | | | | | $ |
| Examination Fee | | | | | $ 720.00 |
| Patent Search Fee | | | | | $ 600.00 |
| Exceeding of 100 sheets of paper fee ($400.00 per each 50 sheets) | | | | | $ |
| Assignment Recordal | | **0** | **x** | $ 40.00 | $ |
| **Publication Fee as set forth in 37 CFR 1.18(d)** | | | | | **$300.00** |
| **Prioritized Exam Fee as set forth in 37 CFR 1.17(i)** | | | | | **$130.00** |
| **Prioritized Exam Fee as set forth in 37 CFR 1.17(c)** | | | | | **$4,000.00** |
| TOTAL FEES | | | | | **$6,030.00** |

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   b. a registered attorney or agent named in the application papers filed under 37 CFR 1.53 or 1.495 (37 CFR 1.63 or 1.497 oath or declaration was not filed.); and
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Correspondence

Address all future communications to: **Customer No.: 10948**
Direct telephone calls to Juan Juan at (203) 925-9400
Direct facsimiles to (203) 944-0245

10/30/2013
Date

Juan Juan (Reg. No.: 60,564)
**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
(203) 925-9400



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| Application Data Sheet 37 CFR 1.76 | Attorney Docket Number | 891.0013.U4(US) |
|---|---|---|
| | Application Number | |
| Title of Invention | Portable Electronic Device | |

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

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☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

## Inventor Information:

**Inventor 1** Remove

**Legal Name**

| Prefix | Given Name | Middle Name | Family Name | Suffix |
|---|---|---|---|---|
| | Claus | H. | Jorgensen | |

**Residence Information (Select One)** ○ US Residency ◉ Non US Residency ○ Active US Military Service

| City | Bronshoj | Country of Residence i | |
|---|---|---|---|

**Mailing Address of Inventor:**

| Address 1 | Tryggevaeldevej 84 | | |
|---|---|---|---|
| Address 2 | | | |
| City | Bronshoj | State/Province | |
| Postal Code | 2700 | Country i | DK |

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

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☐ **An Address is being provided for the correspondence Information of this application.**

| Customer Number | 10948 | | |
|---|---|---|---|
| Email Address | patent@hspatent.com | Add Email | Remove Email |

## Application Information:

| Title of the Invention | Portable Electronic Device | | |
|---|---|---|---|
| Attorney Docket Number | 891.0013.U4(US) | Small Entity Status Claimed | ☐ |
| Application Type | Nonprovisional | | |
| Subject Matter | Utility | | |
| Total Number of Drawing Sheets (if any) | 6 | Suggested Figure for Publication (if any) | |

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## Publication Information:

| |
|---|
| ☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219) |
| ☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing. |

## Representative Information:

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## Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.

| Prior Application Status | Pending | | Remove |
|---|---|---|---|
| Application Number | Continuity Type | Prior Application Number | Filing Date (YYYY-MM-DD) |
| 13/741781 | Continuation of | | 2013-01-15 |

| Prior Application Status | Patented | | | | Remove |
|---|---|---|---|---|---|
| Application Number | Continuity Type | Prior Application Number | Filing Date (YYYY-MM-DD) | Patent Number | Issue Date (YYYY-MM-DD) |
| 12/860234 | Continuation of | | 2010-08-20 | 8363824 | 2013-01-29 |

| Prior Application Status | Patented | | | | Remove |
|---|---|---|---|---|---|
| Application Number | Continuity Type | Prior Application Number | Filing Date (YYYY-MM-DD) | Patent Number | Issue Date (YYYY-MM-DD) |
| 11/393510 | Continuation of | | 2009-03-29 | 7787618 | 2010-08-31 |

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|---|---|---|
| | Application Number | |
| Title of Invention | Portable Electronic Device | |

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| Application Number | Country[i] | Filing Date (YYYY-MM-DD) | Access Code[i] (if applicable) |
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## Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.

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| Application Data Sheet 37 CFR 1.76 | Attorney Docket Number | 891.0013.U4(US) |
|---|---|---|
| | Application Number | |
| Title of Invention | Portable Electronic Device | |

## Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

| | | |
|---|---|---|
| (•) Assignee | ( ) Legal Representative under 35 U.S.C. 117 | ( ) Joint Inventor |
| ( ) Person to whom the inventor is obligated to assign. | ( ) Person who shows sufficient proprietary interest | |

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

| | | | |
|---|---|---|---|
| Organization Name | Nokia Corporation | | |
| **Mailing Address Information For Applicant:** | | | |
| **Address 1** | Keilalahdentie 4 | | |
| Address 2 | | | |
| **City** | Espoo | **State/Province** | |
| **Country** | FI | Postal Code | 02150 |
| Phone Number | | Fax Number | |
| Email Address | | | |

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## Non-Applicant Assignee Information:

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| Application Data Sheet 37 CFR 1.76 | Attorney Docket Number | 891.0013.U4(US) |
|---|---|---|
| | Application Number | |
| Title of Invention | Portable Electronic Device | |

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| Prefix | **Given Name** | Middle Name | **Family Name** | Suffix |
|---|---|---|---|---|
| | | | | |

**Mailing Address Information For Non-Applicant Assignee:**

| | | | |
|---|---|---|---|
| **Address 1** | | | |
| Address 2 | | | |
| **City** | | **State/Province** | |
| **Country** i | | Postal Code | |
| Phone Number | | Fax Number | |
| Email Address | | | |

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## Signature:

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| **Signature** | | | | Date (YYYY-MM-DD) | 2013-10-30 |
|---|---|---|---|---|---|
| First Name | Juan | Last Name | Juan | Registration Number | 60564 |

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Attorney Docket No.: 891.0013.U1(US)

NC51996US

Patent Application Papers Of:

Claus H. Jorgensen

For: Portable Electronic Device

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# Portable Electronic Device

## BACKGROUND OF THE INVENTION

### Field of the Invention

[0001] The invention relates to a portable electronic device and, more particularly, to form factor configuration of a portable electronic device.

### Brief Description of Prior Developments

[0002] Ultra thin telephone products have emerged in the market, pioneering a new approach in mechanical architecture for flip-phone designs (also known a clam-shell handset). Priority for these products is mechanical thinness, allowing the feature set and industrial design to be adjusted to suit this goal. New flip-phones include the Motorola RAZR, the Motorola V3, the Motorola V3x, the Samsung SCH-V740, the NEC L1. For example, the Motorola RAZR has a thickness of about 0.54 inch. Candy-bar shaped mobile phones can have smaller thicknesses, such as the Motorola SLIVR with a thickness of about 0.45 inch and the Motorola SCALPEL with a thickness of about 0.25 inch.

[0003] There is a desire for an architecture for an ultrathin fold product, such as a flip-phone style of mobile telephone, which can maintain aesthetic balance in proportions, and allow added thickness to avoid a "squeezed" appearance as seen with the RAZR™ mobile telephone.



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## SUMMARY OF THE INVENTION

[0004] In accordance with one aspect of the invention, a portable electronic apparatus is provided comprising a first section comprising electronics; a second section movably connected to the first section by a hinge section, wherein the second section comprises a display; and an access entry provided in the hinge section adapted to allow insertion of an electrical device through the hinge section and into electrical connection with an electrical connector inside the first section.

[0005] In accordance with another aspect of the invention, a portable electronic device is provided including a first section, a second section and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.

[0006] In accordance with another aspect of the invention, a mobile telephone is provided comprising an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a battery located adjacent the engine section; and a user input section comprising a keypad located directly above the engine



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section and the battery. The user input section is located directly opposite the battery without a portion of the engine section therebetween.

[0007] In accordance with another aspect of the invention, a portable electronic device is provided comprising a first section; a second section movably connected to the first section by a hinge; and a camera. The hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section. The camera is connected to the second section. The camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of an exterior housing of the second section.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The foregoing aspects and other features of the invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

[0009] Fig. 1 is a perspective view of a mobile telephone comprising features of the invention;

[0010] Fig. 2 is a perspective view of the telephone shown in Fig. 1 is a closed configuration;

[0011] Fig. 3 is a side view of the telephone shown in Fig. 1;

[0012] Fig. 4 is a front view of the telephone shown in Fig. 2;



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[0013] Fig. 5 is a side view of the telephone shown in Fig. 2;

[0014] Fig. 6 is a rear view of the telephone shown in Fig. 2;

[0015] Fig. 7 is an exploded perspective view of the telephone shown in Figs. 1-6;

[0016] Fig. 8 is a schematic view showing the layout of the engine and the battery of the telephone shown in Figs. 1-7;

[0017] Fig. 9 is a schematic view similar to Fig. 8 showing an alternate embodiment of the layout of the engine and the battery;

[0018] Fig. 10 is a schematic view similar to Fig. 8 showing another alternate embodiment of the layout of the engine and the battery;

[0019] Fig. 11 is a schematic view showing an alternate embodiment of the layout of the engine and the battery;

[0020] Fig. 12 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery; and

[0021] Fig. 13 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] Referring to Fig. 1, there is shown a perspective view of a portable electronic device 10



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incorporating features of the invention. Although the invention will be described with reference to the exemplary embodiments shown in the drawings, it should be understood that the invention can be embodied in many alternate forms of embodiments. In addition, any suitable size, shape or type of elements or materials could be used.

[0023] In the embodiment shown, the device 10 comprises a hand-held mobile telephone. However, in alternate embodiments, features of the invention could be used in other types of portable electronic devices, such as a PDA or a hand-held gaming device for example. The telephone 10 is a flip-phone type of telephone comprising a first section 12 connected to a second section 14 by a movably connecting section 16. In this embodiment the connecting section 16 is a hinge. However, in alternate embodiments, any suitable type of movable connecting section could be provided. Fig. 1 shows the telephone 10 in an open configuration. Fig. 2 shows the telephone 10 in a closed configuration.

[0024] Referring also to Figs. 3-6, in the closed configuration, the second section 14 lies directly opposite the first section 12. The hinge 16 allows the second section 14 to pivot open to the open configuration at an angle 18 of about $165^{\circ}$. However, in alternate embodiments, the angle 18 could have any suitable angle. In the closed configuration, the telephone has a height 20 of about 88.7 mm, a width 22 of about 45 mm, and a thickness 24 of about 15 mm. In the open configuration, the telephone has a length 26 of about 166 mm. However, in alternate embodiments, any suitable dimensions could be provided. As seen with reference to Fig. 3, the



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design shown has a substantially uniform thickness lower section 12 and a substantially uniform thickness upper section 14 along their entire lengths except for at the hinge 16. As seen best in Figs. 5 and 14, when the two sections 12, 14 are closed, the telephone 10 has a block shape with grooves along the joints at the lateral sides, but with the ends of the sections 12, 14 being at the same bottom end of the closed shape.

**[0025]** Referring also to Fig. 7, there is shown an exploded perspective view of the telephone 10 for details of how the small thickness 24 of about only 15 mm in a flip-phone design can be accomplished. The first section 12 generally comprises a first housing member 28, an engine 30, a battery 32, a user input section 34, and an antenna module 36. Additional components could be provided. The first housing member 28 generally comprises a one-piece tubular member. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after it is extruded. The first housing member 28 forms a majority of opposite exterior lateral sides 38 and a rear side 40 of the first section 12 (except at top and bottom ends 42, 44 of the first section). The front side of the first housing member 28 has holes 46 therethrough for portions of the user input section 34 to be located in the holes. Because of the tubular shape of the first housing member 28, the first housing member 28 has substantially open top and bottom apertures, which are slanted in the embodiment shown.



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[0026] The antenna module 36 is located at the bottom aperture into the first housing member 28 and enclosed by the antenna cover 48. The antenna cover 48, such as made of plastic, is attached to the first housing member 28 at the bottom aperture to keep the antenna module 36 attached to the rest of the telephone. In one type of embodiment, the antenna module could be a STINGRAY antenna from RaySat, Inc. However, any suitable antenna module could be provided.

[0027] The user input section generally comprises keymats 50, an EL backlight foil 52, a keymat dome sheet 54 and a keymat stiffener 56. However, in alternate embodiments, any suitable user input section could be provided. The keymats 50 are located in the holes 46 of the first housing member 28. The other components of the user input section are located inside the first housing member 28. A cross bar portion 47 of the first housing member 28 is located between the two keymats 50.

[0028] The engine 30 generally comprises a printed circuit board, a transceiver, a processor, and a memory, among other components. Referring also to Fig. 8, the width of the engine 30 is only about less than half the width 22 of the telephone. The battery 32 is located adjacent the lateral side of the engine 30 and is also about less than half the width 22 of the telephone. Unlike conventional telephones which have the engine located above the battery, the configuration of the side-by-side engine/battery allows the battery and the engine to have a practical design thickness and still provide a reduced thickness 24 as compared to conventional flip-phones. The keypads are located above the engine section 30 and the battery 32, wherein the user input section 34



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is located directly opposite the battery 32 without a significant portion of the engine section 30 therebetween.

[0029] The connecting section 16 has a first hinge member 58 and a second hinge member 60. The first hinge member 58 is connected to the top end of the first frame member 28 to substantially close the open top end of the first frame member 28. The first hinge member 58 also comprises a door 61 for access to the battery 32 such that the battery can be removed, and a door 63 for access to the engine 30 for inserting and removing an electronic module 65, such as a SIM card or flash memory or other memory card. The doors 61, 63 are located below the shoulders 62 such that there is a path at the connecting section 16 past the second hinge member 60. In an alternate embodiment, the connecting section 16 could have only one door; for the battery or for the electronic module or both. The door(s) is preferably connected to the rest of the first hinge member 58 by a living hinge. However, in alternate embodiments any suitable type of doorway system could be provided. In other alternate embodiments any suitable access entry could be provided. In a preferred embodiment the door(s) support the electronic device (such as the battery 32 and/or electronic module 65). The engine 30 comprises electrical connectors 67 and 69 for the electronic devices 32 and 65 to connect to inside the first section 12.

[0030] The first hinge member 58 has shoulders 62 with interior facing apertures to receive ends of the hinge module 64. The hinge module 64 is mounted in the second hinge member 60. The second hinge member 60 is sized and



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shaped to pivotably fit between the shoulders 62. In an alternate embodiment any suitable type of hinge assembly could be provided, such as disclosed in U.S. Patent No. 6,900,981, and U.S. Patent Application Nos. 10/610,978, 11/055,914, 11/077,674, and 11/253,017, for example, which are hereby incorporated by reference in their entireties. In an alternate embodiment, the electronic device insertion and removal feature through a movable connection section of the invention could be used in other types of telephones having movable sections including, for example, a slide phone such as shown in U.S. Patent No. Des. 427,171 which is hereby incorporated by reference in its entirety, or could be used in other apparatus, such as a gaming device or PDA having two movable sections connected by a hinge or connecting section.

**[0031]** The second section 14 generally comprises a second housing member 66, a display module 68 and a camera 70. The second housing member 66 preferably comprises a one-piece member having a general tubular shape. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after extrusion. The second housing member 66 forms portions of opposite exterior lateral sides 72, a front side 74 and a rear side 76 of the second section 14. The front side of the second housing member 66 has a hole 78. A front portion 80 of the display module 68 can be located for viewing through the hole 78. The rear side of the second housing member 66 has a hole 82 therethrough. A rear portion 84 (see Fig. 4) of the



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display module 68 is located for viewing through the hole 82. Front portion 80 forms a main display, and rear portion 84 forms a sub-display. A window 86 can be glued onto the sub-display 84. Because of the tubular shape of the second housing member 66, the second housing member 66 has substantially open top and bottom apertures, which are slanted in the embodiment shown.

[0032] The display module 68, camera 70 and a speaker or sound transducer 88 are coupled to the engine 30 by a flex cable assembly 90 which extends through the hinge 16. A mounting bracket 92 is provided for mounting the display module 68 inside the second housing member 66 between the second hinge member 60 and a speaker cover 94 at opposite ends of the second housing member 66. An optional second camera 96 could also be provided.

[0033] The camera 70 extends to the rear side 76 of the second section 14. The camera 70 is housed at an exterior side of the portable electronic device by a junction 98 of a cutout portion 99 of the second hinge member 60 and a cutout portion 100 of the second tubular housing member 66. The cutout portions 99, 100 project slightly from the rear side of the telephone to form a protrusion 142 (see Fig. 14). By providing a projecting portion of the housing for the camera, rather than making the housing flush with the camera, this allows the rest of the telephone to have the reduced thickness 24, but still use a standard size camera.

[0034] Referring also to Figs. 9-10, alternate embodiments of configuration of the battery relative to the engine of Fig. 8 is shown. Fig. 10 shows an embodiment where the battery 102 and engine 104 are



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located in the first section 12 in a side-by-side configuration. This side-by-side configuration comprises the battery 102 being located at a top side of the engine 104 proximate the hinge end of the first section. Fig. 11 shows an embodiment where the battery 102 is located between two portions 106, 108 of the engine 110. Thus a split side-by-side configuration is provided. In both of these alternate embodiments the keypad is located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a substantial portion of the engine section therebetween.

[0035] Figs. 11-13 show other alternate embodiments of positioning the battery relative to the engine. In Fig. 11 the battery 112 is located below the engine 114. The keypad 116 is located above the engine 114. The components 112, 114, 116 are housed in a one-piece metal tubular housing member 118. The keypad is located at a hole through the front side 120 of the housing member 118. Otherwise, the housing member 118 forms enclosed lateral exterior sides 122 and rear side 124.

[0036] Fig. 12 shows an embodiment similar to Fig. 11. However, in this embodiment the battery 126 is thinner and wider than the battery 112. The tubular housing member 128 is thinner and wider than the tubular housing member 118. Fig. 13 shows another alternate embodiment. In this embodiment the battery 130 is about half the width of the tubular housing member 132. The engine 134 comprises a portion 136 located at the lateral side of the battery 130 and another portion 138 located between the battery and the keypad 140. The configurations shown



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in Figs. 11-13 could be used in candy-bar style telephone handsets as well as flip-phone style handsets.

[0037] One of the features of the invention is the use of tubular members to form the major housing components of the first and second sections of the flip-phones. The tubular housing members provide an increased strength than conventional housing designs. This allows the reduction in side of the housing components versus conventional housing components and, thus, a reduction in the thickness 24 of the telephone. In addition, the side-by-side positioning of the battery/engine can further allow a reduction in thickness of the handset versus conventional stacked battery/engine handsets.

[0038] With the present invention a user exchangeable battery and/or cards (SIM, flash and other memory cards) can be inserted and removed through the hinge end in a portable terminal. The housing of a fold phone can be extruded in one material. Extruding a housing in one material and having a user exchangeable battery (and cards) through a hinge end can be provided. With the invention a battery can be located next to the PWB on a lateral side of the phone.

[0039] It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.



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## CLAIMS

What is claimed is:

1. A portable electronic apparatus comprising:

a first section comprising electronics;

a second section movably connected to the first section by a hinge section, wherein the second section comprises a display; and

an access entry provided in the hinge section adapted to allow insertion of an electrical device through the hinge section and into electrical connection with an electrical connector inside the first section.

2. A portable electronic apparatus as in claim 1 wherein the access entry comprises a movable door on the hinge section.

3. A portable electronic apparatus as in claim 2 wherein the access entry comprises a living hinge connecting the door to the rest of the hinge section.

4. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to allow insertion of a battery through the access entry, and the electrical connector is adapted to electrically connect to the battery.

5. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to allow insertion of an electronic module through the access entry, and the electrical connector is adapted to electrically connect to the electronic module.



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6. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to at least partially support the electronic device when the electronic device is fully inserted into the portable electronic device.

7. A portable electronic device comprising:

a first section having a user input section and a first one-piece tubular housing member, wherein the first tubular housing member forms a majority of opposite exterior lateral sides of the first section;

a second section having a display and a second tubular housing member, wherein the second tubular housing member forms a majority of opposite exterior lateral sides of the second section; and

a connecting section movably connecting the second section with the first section,

wherein the first tubular housing member at least partially houses the user input section, and wherein the second tubular housing member at least partially houses the display.

8. A portable electronic device as in claim 7 wherein at least one of the first and second tubular housing members comprises a metal member.

9. A portable electronic device as in claim 8 wherein the first tubular housing members comprises an extruded member.



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10. A portable electronic device as in claim 7 wherein the connecting section comprises a hinge with a first hinge member forming a cap to an open end of the first tubular housing member and a second hinge member forming a cap to an open end of the second tubular housing member.

11. A portable electronic device as in claim 7 wherein the first section comprises:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

the user input section comprises a keypad located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

12. A portable electronic device as in claim 7 wherein the connecting section comprises a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and the portable electronic device further comprises a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of the second tubular housing member.

13. A portable electronic device as in claim 7 wherein the portable electronic device comprises a mobile telephone having a transceiver.



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14. A portable electronic device as in claim 7 wherein the connecting section comprises an access entry provided in the connecting section adapted to allow insertion of an electrical device through the connecting section and into electrical connection with an electrical connector inside the first section.

15. A mobile telephone comprising:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

a user input section comprising a keypad located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

16. A mobile telephone as in claim 15 wherein the battery is located at a lateral side of the engine section.

17. A mobile telephone as in claim 15 wherein the engine section is located at opposite sides of the battery.

18. A mobile telephone as in claim 15 wherein the mobile telephone comprises a first section comprising a first one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the first section, wherein the engine section, battery and user input section are housed in the first section.

19. A mobile telephone as in claim 18 wherein the mobile telephone comprises a second section pivotably connected to the first section, wherein the second section



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comprises a second one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the second section.

20. A mobile telephone as in claim 15 wherein the mobile telephone comprises a first section pivotably connected to a second section by a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and the mobile telephone further comprises a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of a one-piece second tubular housing member of the second section, wherein the second tubular housing member forms opposite exterior lateral sides of the second section.

21. A portable electronic device comprising:

a first section;

a second section movably connected to the first section by a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and

a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of an exterior housing of the second section.



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22. A portable electronic device as in claim 21 wherein the first section comprises:

a first tubular housing member, wherein the first tubular housing member forms a majority of opposite exterior lateral sides of the first section, and located at the first tubular section:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

a user input section comprising a keypad located directly above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

23. A portable electronic device as in claim 21 wherein the first section comprises a tubular metal housing member forming a majority of opposite exterior lateral sides of the first section, and wherein the second section comprises a tubular metal housing member forming a majority of opposite exterior lateral sides of the second section.

24. A portable electronic device as in claim 21 wherein the first and second sections each comprises tubular metal exterior housing members comprising extruded metal members.



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ABSTRACT

A portable electronic device including a first section, a second section and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.



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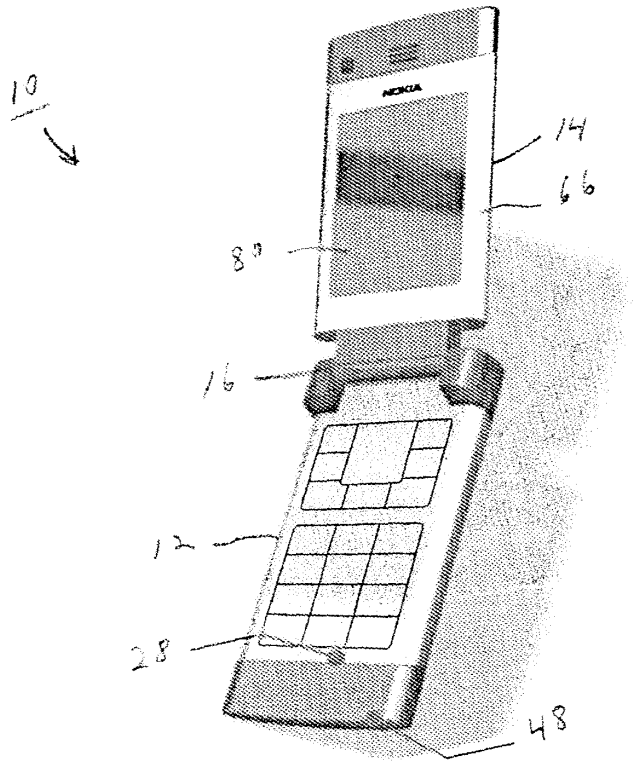



FIG. 1

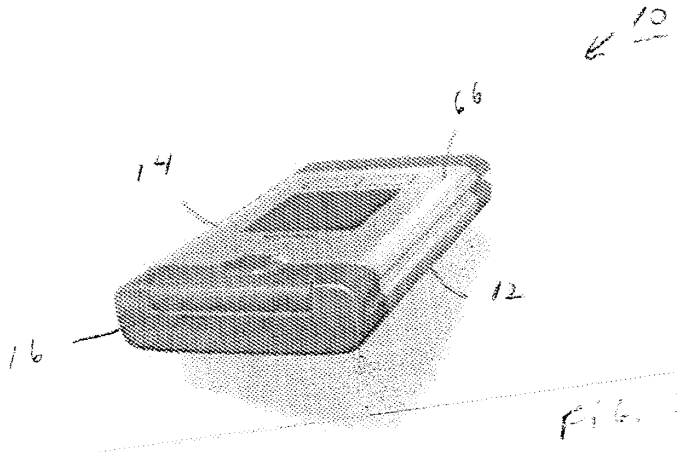



FIG. 2

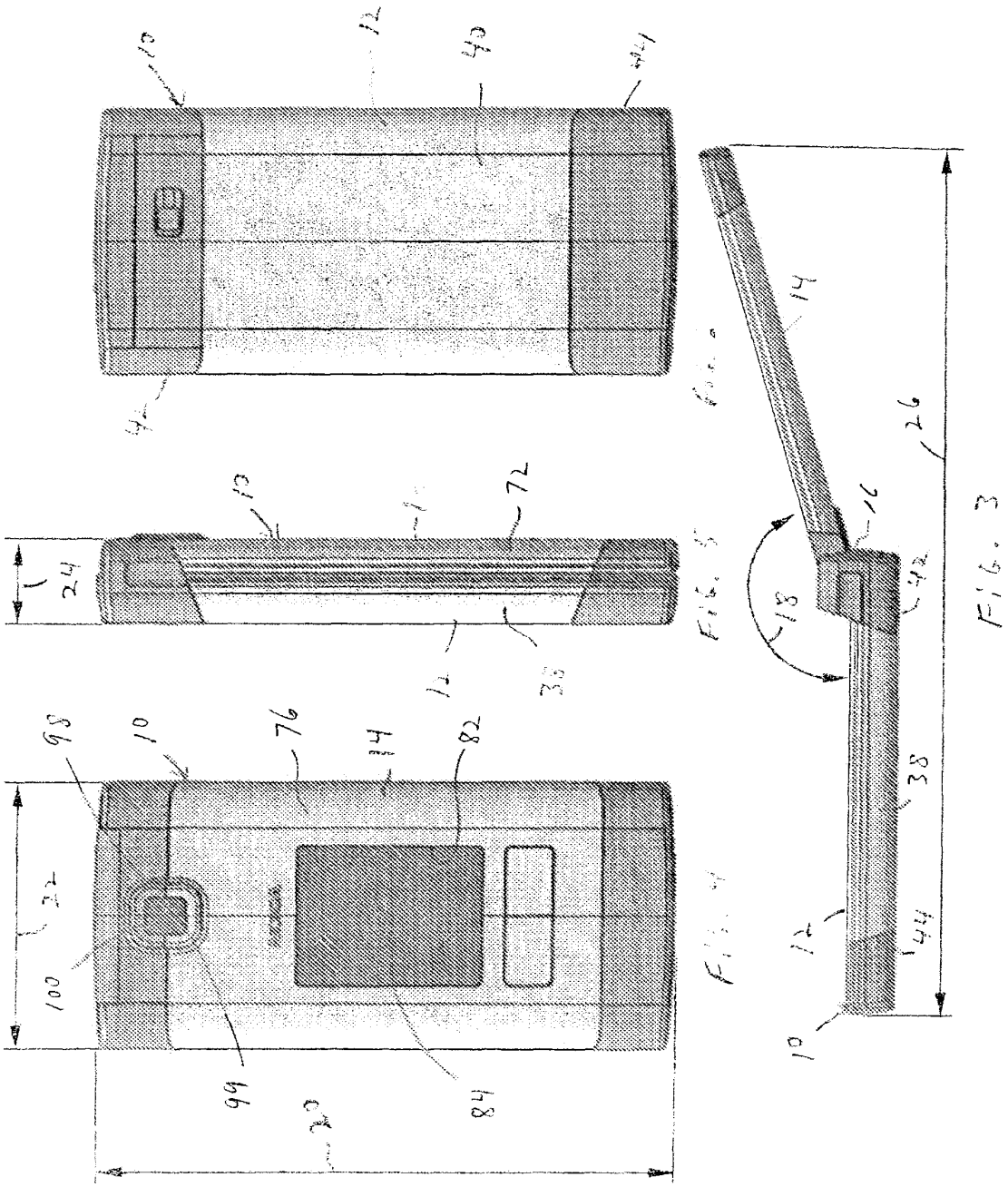



FIG. 3

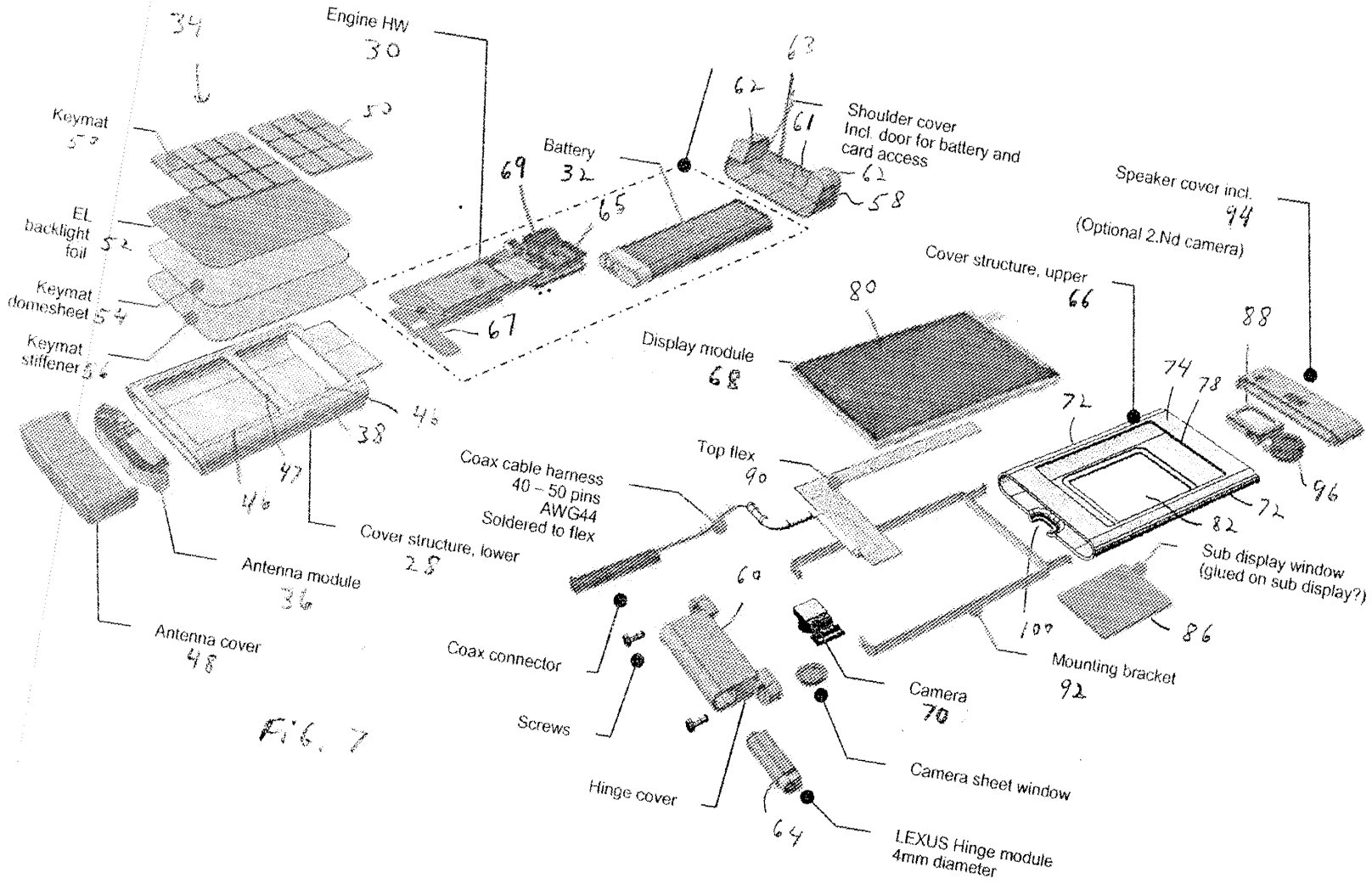



FIG. 7

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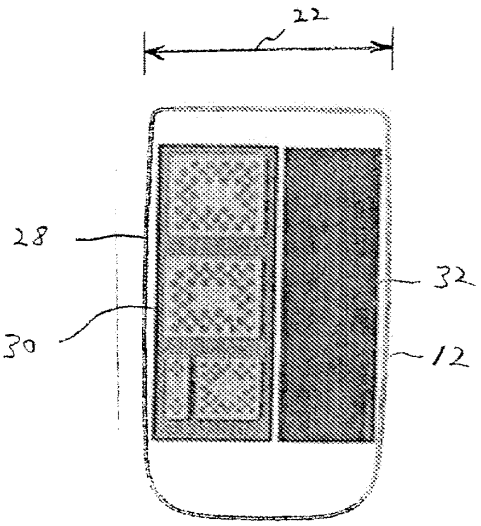



Fig. 8

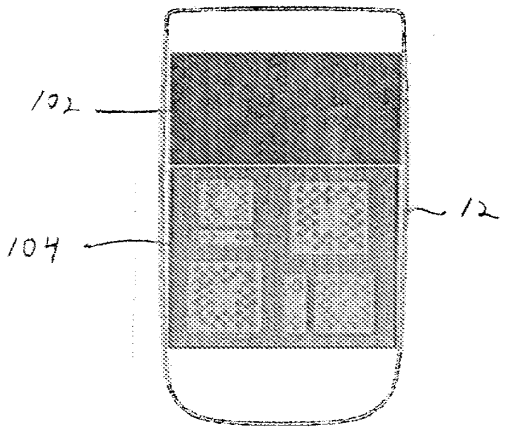



Fig. 9

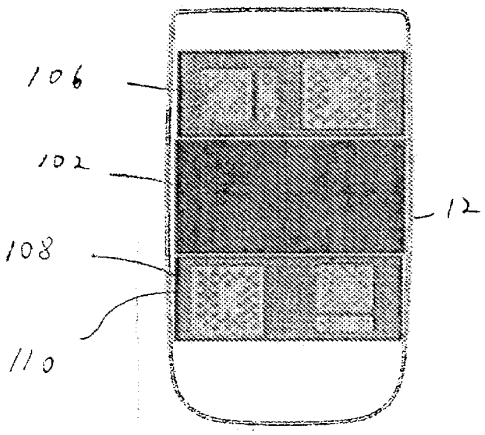
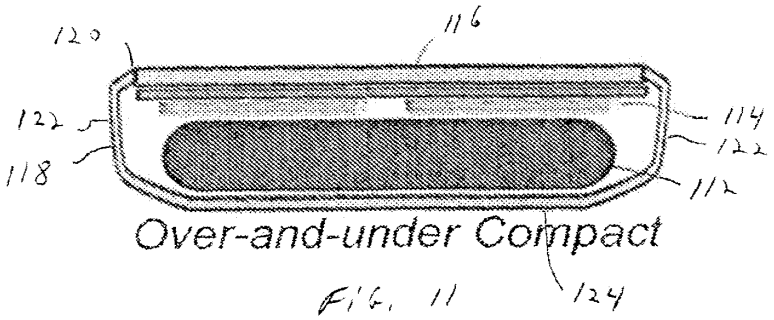
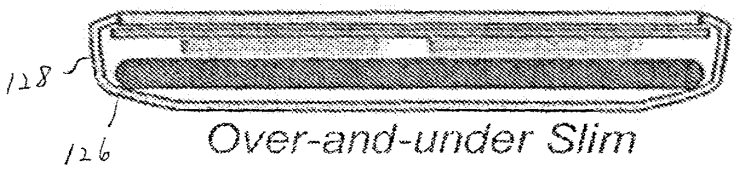



FIG. 10



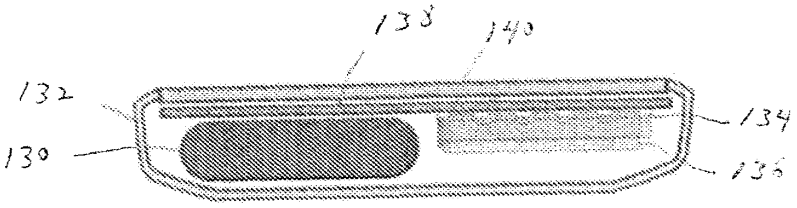

Over-and-under Compact

FIG. 11




Over-and-under Slim

FIG. 12




Semi over-and-under Compact

FIG. 13

COPY

Docket No.: **891.0013.U3(US)**

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)**

Title Of Invention: **Portable Electronic Device**

As a below named inventor, I hereby declare that:

This declaration is directed to the attached application, **or** (if the following box is checked):

☐ United States application or PCT international application number: _____ filed on _____

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the application, including the claims.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

| FULL NAME OF INVENTOR : | LAST NAME | FIRST NAME | MIDDLE NAME |
|---|---|---|---|
| | **JORGENSEN** | **Claus** | **H.** |

Signature _____ Date 9/12 2012



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: Confirmation No.:
Applicant(s): Jorgensen, Claus H.
Filed: Herewith
Art Unit:
Examiner:
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Preliminary Amendment

Sir:

Please amend the Application as indicated on the following pages.

**Amendments to the Specification** begin on page 2 of this paper.

**Amendments to the Claims** are reflected in the listing of claims which begin on page 3 of this paper.

**Amendments to the Drawings** begin on page 7 and include attached replacement sheets.

**Remarks** begin on page 8 of this paper.

An **Appendix** including amended drawing figures is attached following page 9 of this paper.

**Amendments to the Specification:**

Page 1, after the title, please add the following cross-reference section:

CROSS REFERENCE TO RELATED APPLICATION

This is a continuation patent application of U.S. Patent Application No. 13/741,781 filed January 15, 2013, which is a continuation patent application of U.S. Patent Application No. 12/860,234 filed August 20, 2010, now U.S. Patent No. 8,363,824, which is a continuation patent application of U.S. Patent Application No. 11/393,510 filed March 29, 2006, now U.S. Patent No. 7,787,618.



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**Amendments to the Claims:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

Please cancel claim(s) 1-24 without prejudice.

**Listing of Claims:**

1-24. (Canceled)

25. (New) A portable electronic device comprising:

a one piece housing forming enclosed exterior lateral sides and a rear side;

a cut out in the rear side of said housing;

a camera located in said housing and extending to said cut out at said rear side;

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a user input section located above the engine section and a battery, wherein the user input section is located adjacent the battery and the engine section;

wherein the battery and engine section are housed in the housing and the user input is located in a hole through a front side of the housing.

26. (New) A portable electronic device according to claim 25 wherein said one piece housing has a front side extending from and between the lateral sides.



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27. (New) A portable electronic device according to claim 26 wherein the front side extends parallel to the lateral edges.

28. (New) A portable electronic device according to claim 27 wherein the front side forms at least a side of the hole through which the input device is located.

29. (New) A portable device according to claim 25 wherein the user input and the front side of the housing lie in a side by side arrangement.

30. (New) A portable electronic device according to claim 29 wherein the front side of the housing and the user input form a continuous front surface of the portable electronic device.

31. (New) A portable electronic device according to claim 25 wherein the battery is located adjacent the engine section in a side by side arrangement.

32. (New) A portable electronic device according to claim 25 further comprising a cut out portion comprising the cut out wherein the cut out portion projects from the rear side of the housing.

33. (New) A portable electronic device according to claim 32 where the camera is partially located in the cut out portion.

34. (New) A portable electronic device according to claim 25 further comprising a door configured to support an electronic module.

35. (New) A portable electronic device according to claim 34 wherein the electronic module is configured to interface to the engine section.



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36. (New) A housing for a portable electronic device comprising;

a one piece housing forming enclosed exterior lateral sides and a rear side;

a cut out in the rear side of said housing, said cut out configured to receive at least part of a camera;

wherein the housing is configured to receive a battery and an engine section, wherein the battery and engine section are housed in the housing, and wherein a user input is located in a hole through a front side of the housing.

37. (New) A housing for a portable electronic device according to claim 36 further comprising;

a front side extending between the lateral edges, said lateral sides and front side forming a aperture configured to receive the user input wherein the user input and the front side of the housing form a continuous front surface of the portable electronic device.

38. (New) A housing according to claim 36 wherein the one piece housing has been extruded.

39. (New) A housing according to claim 36 wherein the one piece housing comprises a metal.

40. (New) A housing according to claim 36 wherein the housing has substantially at least one of an open top or bottom aperture.



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41. (New) A housing according to claim 40 wherein a antenna module is located at a aperture in the housing.

42. (New) A housing according to claim 41 wherein the antenna module is enclosed by a antenna cover.



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Amendments to the Drawings:

The attached sheets of drawings include formal drawings for this application.

Attachment: Replacement Sheets



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## REMARKS

This is a continuation patent application. The parent patent application has been allowed and the issue fee has been paid.

The replacement sheets of drawings correspond to formal drawings filed during the prosecution (in response to a Notice to File Corrected Application Papers) of the parent patent application. The attached six sheets of formal drawings for Figs. 1-13 replace the original sheets of drawings.

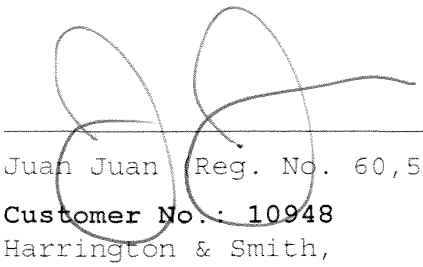
The claims of the original parent patent application have been cancelled without prejudice above and new claims have been added to further claim the features of the invention. Support for the new claims may be found throughout the originally filed specification, claims, and drawings, for example, at paragraphs [0025], [0026], [0029], and [0033], and Figs. 7-13.

Favorable consideration and allowance is respectfully requested. If there are any additional charges with respect to this Preliminary Amendment or otherwise, please charge deposit account 50-1924 for any fee deficiency. Should any unresolved issue remain, the examiner is invited to call applicant's attorney at the telephone number indicated below.



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Respectfully submitted,



10/30/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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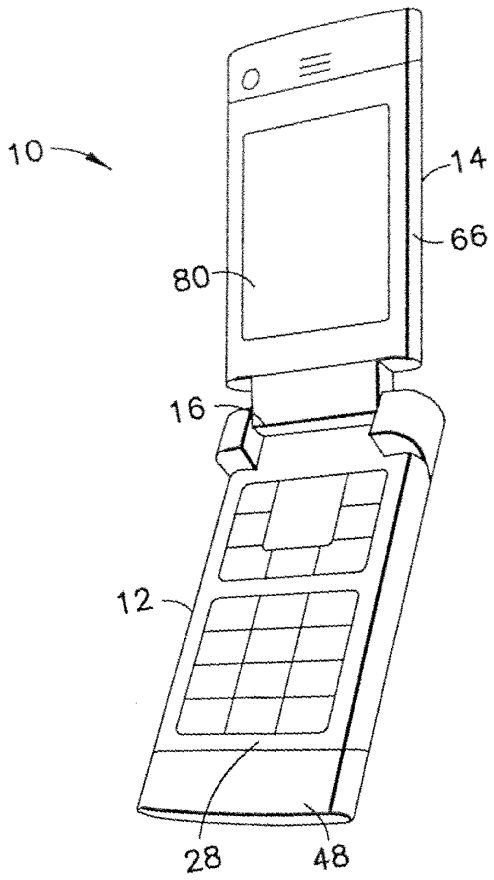



FIG.1

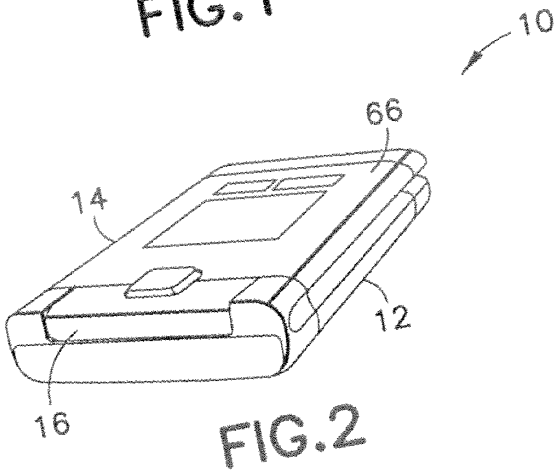



FIG.2

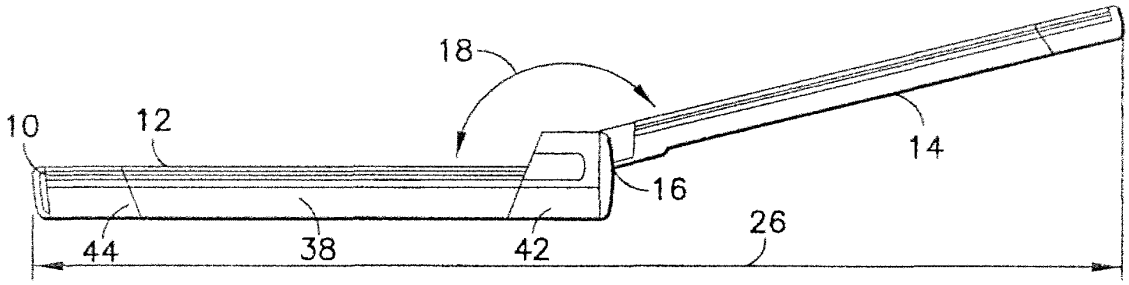



FIG.3

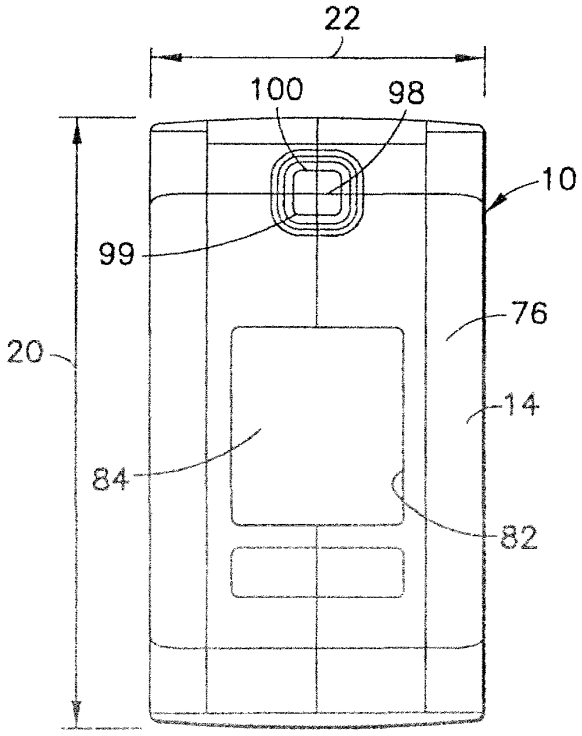



FIG.4

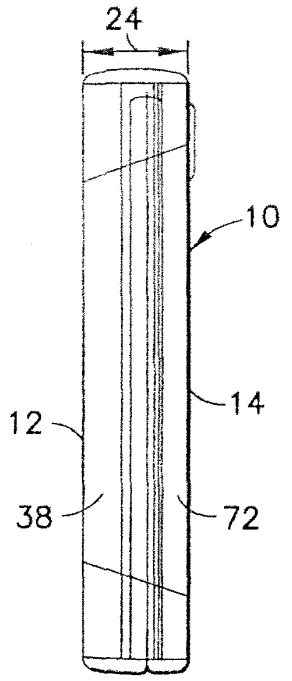



FIG.5

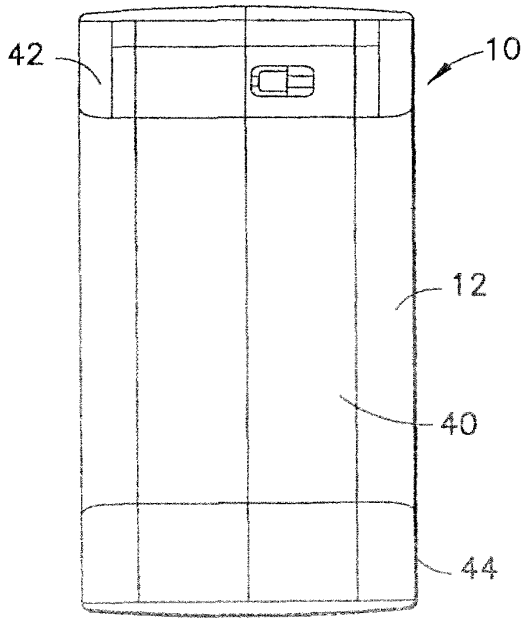



FIG.6

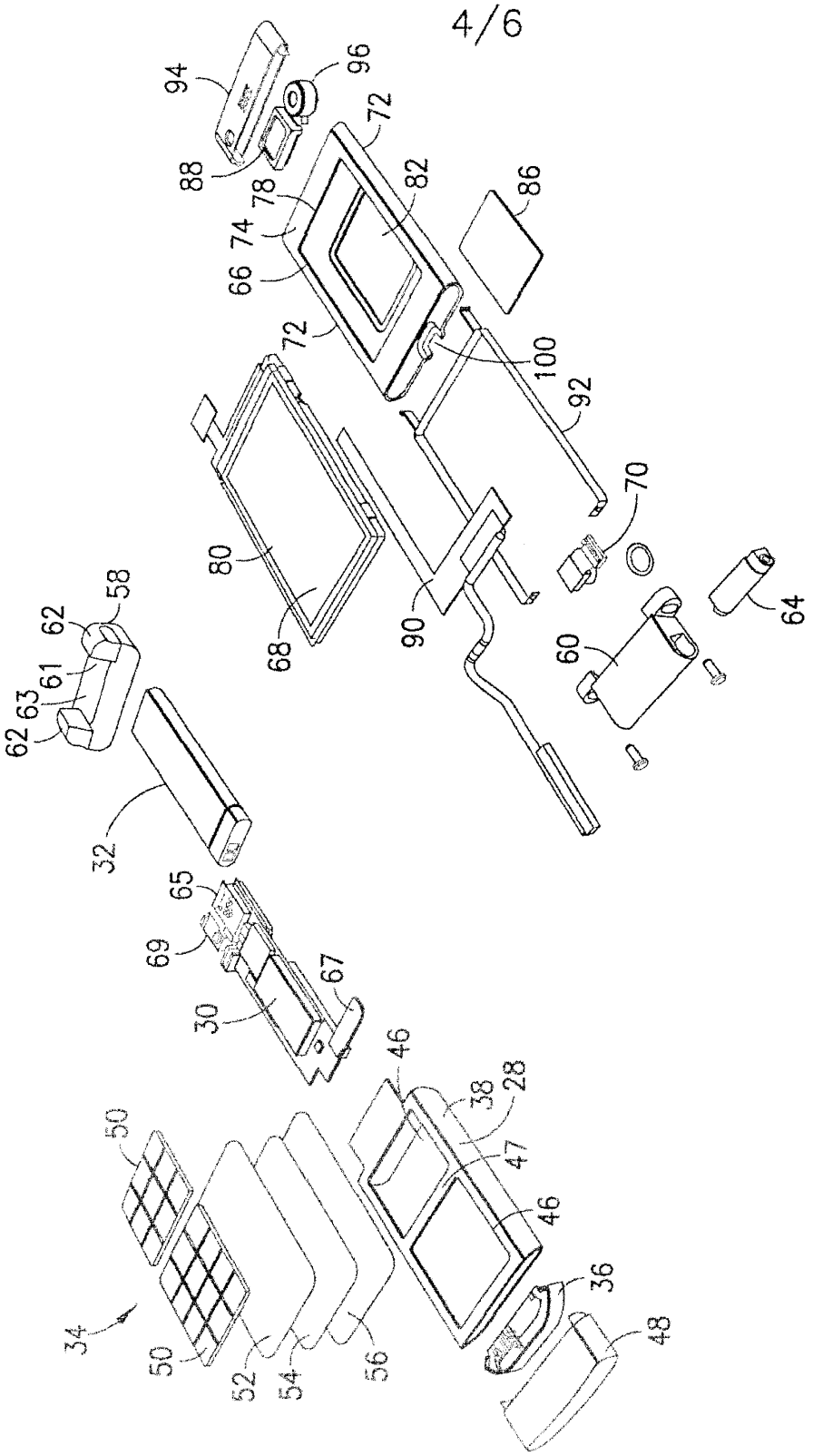

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FIG.7

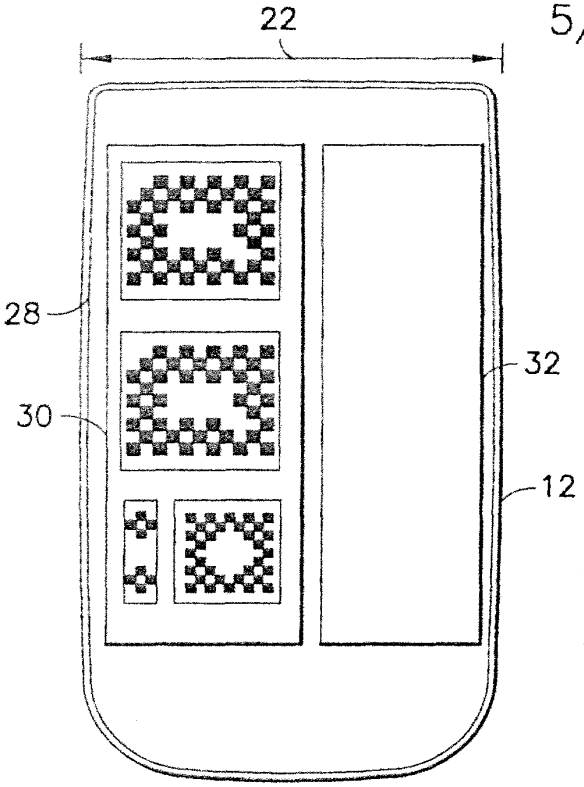



FIG.8

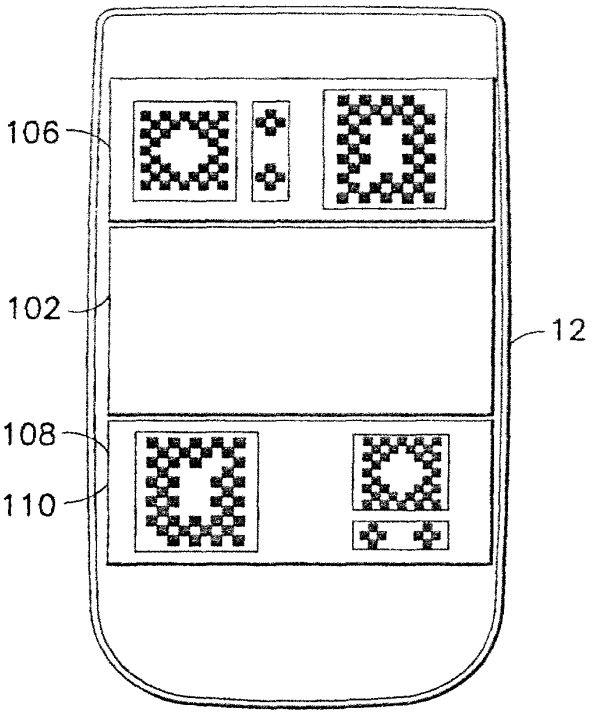



FIG.10

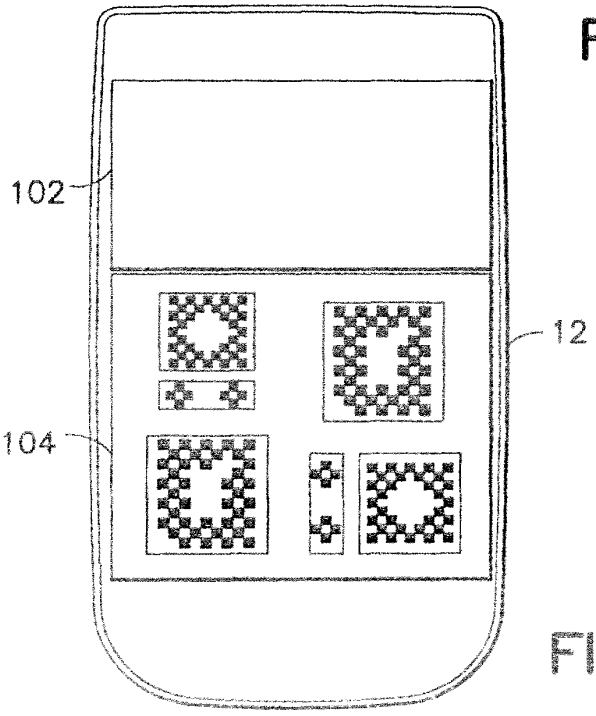



FIG.9

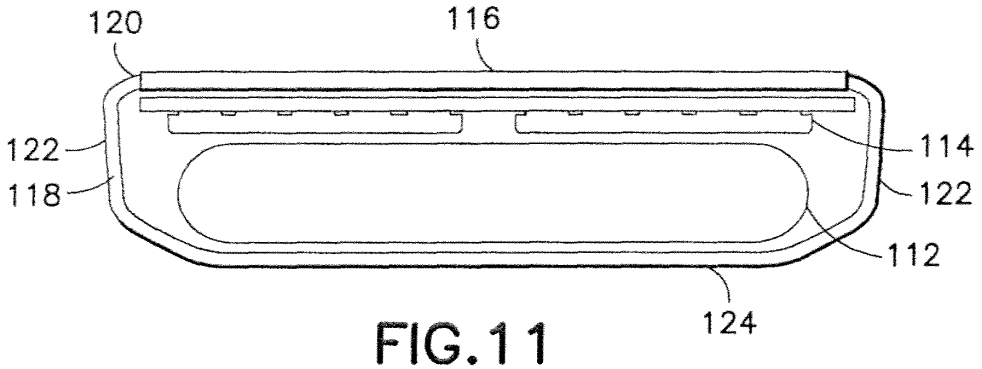



FIG. 11

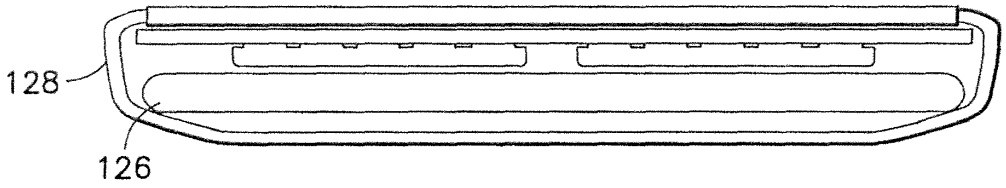



FIG. 12

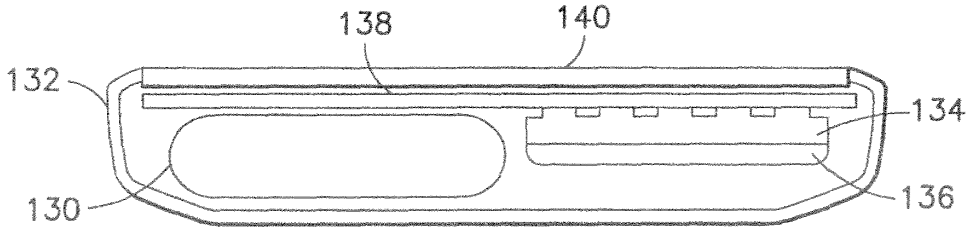



FIG. 13

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82A (07-12)
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| | |
|---|---|
| Application Number | to be assigned |
| Filing Date | herewith |
| First Named Inventor | Claus H. Jorgensen |
| Title | Portable Electronic Device |
| Art Unit | n/a |
| Examiner Name | n/a |
| Attorney Docket Number | 891.0013.U4(US) |

**SIGNATURE of Applicant or Patent Practitioner**

| | | | |
|---|---|---|---|
| Signature | | Date | October 30, 2013 |
| Name | Juan Juan | Telephone | (203) 925-9400 |
| Registration Number | 60,564 | | |

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications.

■ *Total of 1 forms are submitted.

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I am the Applicant:

☐ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient *Proprietary* Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

**SIGNATURE of Applicant for Patent**

| | | | |
|---|---|---|---|
| Signature | | Date | 26. 09. 2012 |
| Name | Harri Honkasalo | Telephone | Espoo, Finland |
| Title and Company | Director, Patenting<br>Legal and Intellectual Property | Nokia Corporation | |

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☐ *Total of _____ forms are submitted.

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Ulla James
Director, Finance & Strategic Marketing
Legal & Intellectual Property

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: Confirmation No.:
Applicant(s): Jorgensen, Claus H.
Filed: Herewith
Art Unit:
Examiner:
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

A Form PTO-1449 is enclosed for the Examiner's use which lists art cited in the parent application (Application No.: 13/741,781 [which is a continuation patent application of Application No.: 12/860,234 [now US 8,363,824], which is a continuation patent application of 11/393,510 [now US 7,787,618]). In accordance with 37 C.F.R. §1.98(d) copies of the art are not included. These can be obtained by the Examiner from the file of the parent application.

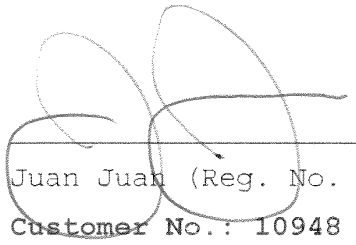


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If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



10/30/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No.: 891.0013.U4(US) Serial No.: to be assigned<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: herewith Group: n/a |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | GB 2 383 472 A | 06/25/2003 | Vertu Limited | n/a |
| | EP-1209880-A3 | 02-05-2003 | Nokia Corporation | |
| | EP-1533983-A1 | 05-25-2005 | LG Electronics Inc. | |
| | GB-2391740-A | 02-11-2004 | Matsushita Electrical Industrial Co. Ltd. | |
| | JP-2005-318064-A | 11-10-2005 | Toshiba Corp | Abstract |
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| | EP-1 617 313-A2 | 01-18-2005 | LG Electronics, Inc. | |
| | WO-95/31048-A1 | 11-16-1995 | Daniels, John J. | |

## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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# Electronic Patent Application Fee Transmittal

| | |
|---|---|
| **Application Number:** | |
| **Filing Date:** | |
| **Title of Invention:** | Portable Electronic Device |
| **First Named Inventor/Applicant Name:** | Claus H. Jogensen |
| **Filer:** | Mark F. Harrington/Jessica Capra |
| **Attorney Docket Number:** | 891.0013.U4(US) |

Filed as Large Entity

## Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a) Filing Fees

| Description | Fee Code | Quantity | Amount | Sub-Total in USD($) |
|---|---|---|---|---|
| **Basic Filing:** | | | | |
| Utility application filing | 1011 | 1 | 280 | 280 |
| Utility Search Fee | 1111 | 1 | 600 | 600 |
| Utility Examination Fee | 1311 | 1 | 720 | 720 |
| Request for Prioritized Examination | 1817 | 1 | 4000 | 4000 |
| **Pages:** | | | | |
| **Claims:** | | | | |
| **Miscellaneous-Filing:** | | | | |

| Description | Fee Code | Quantity | Amount | Sub-Total in USD($) |
|---|---|---|---|---|
| Publ. Fee- Early, Voluntary, or Normal | 1504 | 1 | 300 | 300 |
| OTHER PUBLICATION PROCESSING FEE | 1808 | 1 | 130 | 130 |
| **Petition:** | | | | |
| **Patent-Appeals-and-Interference:** | | | | |
| **Post-Allowance-and-Post-Issuance:** | | | | |
| **Extension-of-Time:** | | | | |
| **Miscellaneous:** | | | | |
| | | | **Total in USD ($)** | **6030** |

# Electronic Acknowledgement Receipt

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|---|---|
| **EFS ID:** | 17269038 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | Portable Electronic Device |
| **First Named Inventor/Applicant Name:** | Claus H. Jogensen |
| **Customer Number:** | 10948 |
| **Filer:** | Mark F. Harrington/Jessica Capra |
| **Filer Authorized By:** | Mark F. Harrington |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 30-OCT-2013 |
| **Filing Date:** | |
| **Time Stamp:** | 15:24:46 |
| **Application Type:** | Utility under 35 USC 111(a) |

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**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**
**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (03-13)

## CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

| First Named Inventor: | Jorgensen, Claus H. | Nonprovisional Application Number (if known): | |
|---|---|---|---|
| Title of Invention: | Portable Electronic Device | | |

**APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.**

1. The processing fee set forth in 37 CFR 1.17(i)(1), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, examination fee, and any required excess claims and application size fees are filed with the request or have been already been paid.

2. The application contains or is amended to contain no more than four independent claims and no more than thirty total claims, and no multiple dependent claims.

3. The applicable box is checked below:

I. ☑ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. The executed inventor's oath or declaration is filed with the application. (37 CFR 1.63 and 1.64)

II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

| Signature | Date 10/30/2013 |
|---|---|
| Name (Print/Typed) Juan Juan | Practitioner Registration Number 60,564 |

*Note: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☐ *Total of _____ forms are submitted.

## Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.



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DocCode - SCORE

# SCORE Placeholder Sheet for IFW Content

Application Number: 14067249 Document Date: 10/30/2013

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

- Drawings – Other than Black and White Line Drawings

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

To access the documents in the SCORE database, refer to instructions below.

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- Examiners may access SCORE content via the eDAN interface.
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- External customers may access SCORE content via the Public and Private PAIR interfaces.

Form Revision Date: September 30, 2013

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 11/13/2013

SDUONG ADJ #00000004 Mailroom Dt: 10/30/2013
Seq No: 2297 Sales Acctg Dt: 10/31/2013 501924 14067249
06 FC : 1808 130.00 CR

Document code: WFEE

United States Patent and Trademark Office
Sales Receipt for Accounting Date: 11/13/2013

SDUONG SALE #00000013 Mailroom Dt: 10/30/2013 501924 14067249
01 FC : 1830 140.00 DA

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) |

**CONFIRMATION NO. 7955**

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

**POA ACCEPTANCE LETTER**

*OC000000064938470*

Date Mailed: 11/15/2013

## NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/30/2013.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

/jmilani/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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UNITED STATES PATENT AND TRADEMARK OFFICE

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| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) |

**CONFIRMATION NO. 7955**

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

**FORMALITIES LETTER**

*OC000000064976521*

Date Mailed: 11/15/2013

# NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

**FILED UNDER 37 CFR 1.53(b)**

***Filing Date Granted***

**Items Required To Avoid Abandonment:**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- A mailing address for each inventor has not been submitted. A new application data sheet (ADS) in compliance with 37 CFR 1.76 or inventor's oath or declaration in compliance with 37 CFR 1.63 identifying the mailing address and residence (if the inventor lives at a location which is different from where the inventor customarily receives mail) is required. The applicant needs to satisfy supplemental fees problems indicated below.

  Claus H. Jorgensen



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Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web.
https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at **1-866-217-9197** or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

/hchin/

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Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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## PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/067,249

### APPLICATION AS FILED - PART I

| FOR | (Column 1) NUMBER FILED | (Column 2) NUMBER EXTRA | SMALL ENTITY RATE($) | SMALL ENTITY FEE($) | OR | OTHER THAN SMALL ENTITY RATE($) | OTHER THAN SMALL ENTITY FEE($) |
|---|---|---|---|---|---|---|---|
| BASIC FEE (37 CFR 1.16(a), (b), or (c)) | N/A | N/A | N/A | | | N/A | 280 |
| SEARCH FEE (37 CFR 1.16(k), (i), or (m)) | N/A | N/A | N/A | | | N/A | 600 |
| EXAMINATION FEE (37 CFR 1.16(o), (p), or (q)) | N/A | N/A | N/A | | | N/A | 720 |
| TOTAL CLAIMS (37 CFR 1.16(i)) | 18 minus 20 = | * | | | OR | x 80 = | 0.00 |
| INDEPENDENT CLAIMS (37 CFR 1.16(h)) | 2 minus 3 = | * | | | | x 420 = | 0.00 |
| APPLICATION SIZE FEE (37 CFR 1.16(s)) | If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). | | | | | | 0.00 |
| MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j)) | | | | | | | 0.00 |
| * If the difference in column 1 is less than zero, enter "0" in column 2. | | | TOTAL | | | TOTAL | 1600 |

### APPLICATION AS AMENDED - PART II

| | | (Column 1) CLAIMS REMAINING AFTER AMENDMENT | | (Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR | (Column 3) PRESENT EXTRA | SMALL ENTITY RATE($) | SMALL ENTITY ADDITIONAL FEE($) | OR | OTHER THAN SMALL ENTITY RATE($) | OTHER THAN SMALL ENTITY ADDITIONAL FEE($) |
|---|---|---|---|---|---|---|---|---|---|---|
| AMENDMENT A | Total (37 CFR 1.16(i)) | * | Minus | ** | = | x = | | OR | x = | |
| | Independent (37 CFR 1.16(h)) | * | Minus | *** | = | x = | | OR | x = | |
| | Application Size Fee (37 CFR 1.16(s)) | | | | | | | | | |
| | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) | | | | | | | OR | | |
| | | | | | | TOTAL ADD'L FEE | | OR | TOTAL ADD'L FEE | |

| | | (Column 1) CLAIMS REMAINING AFTER AMENDMENT | | (Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR | (Column 3) PRESENT EXTRA | RATE($) | ADDITIONAL FEE($) | OR | RATE($) | ADDITIONAL FEE($) |
|---|---|---|---|---|---|---|---|---|---|---|
| AMENDMENT B | Total (37 CFR 1.16(i)) | * | Minus | ** | = | x = | | OR | x = | |
| | Independent (37 CFR 1.16(h)) | * | Minus | *** | = | x = | | OR | x = | |
| | Application Size Fee (37 CFR 1.16(s)) | | | | | | | | | |
| | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) | | | | | | | OR | | |
| | | | | | | TOTAL ADD'L FEE | | OR | TOTAL ADD'L FEE | |

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NUMBER | FILING or 371(c) DATE | GRP ART UNIT | FIL FEE REC'D | ATTY.DOCKET.NO | TOT CLAIMS | IND CLAIMS |
|---|---|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | 3725 | 1900 | 891.0013.U4(US) | 18 | 2 |

**CONFIRMATION NO. 7955**

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

**FILING RECEIPT**




Date Mailed: 11/15/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

**Inventor(s)**

Claus H. Jorgensen, Residence Not Provided;

**Applicant(s)**

Nokia Corporation, Espoo, FINLAND

**Assignment For Published Patent Application**

Nokia Corporation, Espoo, FINLAND

**Power of Attorney:** The patent practitioners associated with Customer Number 10948

**Domestic Priority data as claimed by applicant**

This application is a CON of 13/741,781 01/15/2013
and is a CON of 12/860,234 08/20/2010 PAT 8363824
and is a CON of 11/393,510 03/29/2006 PAT 7787618

**Foreign Applications** for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
*Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.*

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

**If Required, Foreign Filing License Granted:** 11/13/2013
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/067,249**
**Projected Publication Date:** To Be Determined - pending completion of Missing Parts



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**Non-Publication Request:** No

**Early Publication Request:** No

**Title**

Portable Electronic Device

**Preliminary Class**

072

**Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:** No

## PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).



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## LICENSE FOR FOREIGN FILING UNDER

## Title 35, United States Code, Section 184

## Title 37, Code of Federal Regulations, 5.11 & 5.15

**GRANTED**

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

**NOT GRANTED**

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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OPAP AKIMA-16
NOV 1 8 2013
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 3725
Examiner:
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

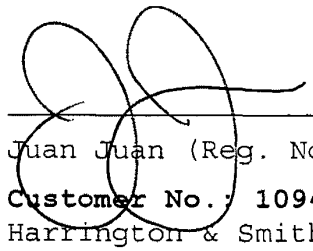


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that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



11/12/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

11/13/2013
Date

Elaine F. Mian
Elaine F. Mian



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group:3725 |
|---|---|

OPAP AKIMA-16 NOV 1 8 2013 PATENT & TRADEMARK OFFICE

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-7,499,040 B2 | 03-03-2009 | Zadesky et al. | 345 | 204 |
| | US-7,627,343 B2 | 12-01-2009 | Fadell et al. | 455 | 557 |
| | US-8,140,133 B2 | 03-20-2012 | Jung et al. | 455 | 575.3 |
| | US-7,495,659 B2 | 02-24-2009 | Marriott et al. | 345 | 173 |
| | US-7,099,709 B2 | 08-29-2006 | Hsu et al. | 455 | 575.8 |
| | US-7,374,452 B2 | 05-20-2008 | Kohri et al. | 439 | 500 |
| | US-7,046,230 B2 | 05-16-2006 | Zadesky et al. | 345 | 156 |
| | US-6,785,395 B1 | 08-31-2004 | Arneson et al. | 381 | 334 |
| | US-6,075,470 | 06-13-2000 | Little et al. | 341 | 107 |
| | US-6,271,605 B1 | 08-07-2001 | Carkner et al. | 307 | 125 |
| | US-6,278,442 B2 | 08-21-2001 | Griffin et al. | 345 | 169 |
| | US-6,317,592 B1 | 11-13-2001 | Campana, Jr. et al. | 455 | 412 |
| | US-6,754,507 B2 | 06-22-2004 | Takagi | 455 | 550.1 |
| | US-D506,476 S | 06-21-2005 | Andre et al. | D14 | 496 |
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| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
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| | - - | | | |
| | - - | | | |

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| | |

| Examiner's Signature: | Date Considered: |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

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# Bibliographic data: JP2001308992 (A) — 2001-11-02

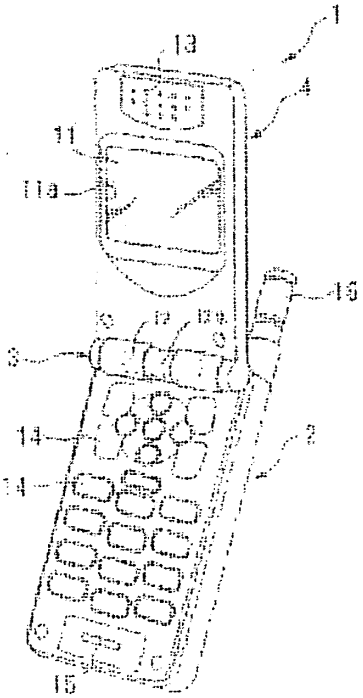
## MOBILE WIRELESS UNIT

No documents available for this priority number.

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|---|---|
| **Inventor(s):** | IWABUCHI KAZUHIRO; UCHINO AKIHIKO ± (IWABUCHI KAZUHIRO, ; UCHINO AKIHIKO) |
| **Applicant(s):** | KYOCERA CORP ± (KYOCERA CORP) |
| **Classification:** | **- international:** ***H04B1/38; H04M1/02; H04W88/02;*** (IPC1-7): H04B1/38; H04M1/02; H04Q7/32 |
| | **- cooperative:** |
| **Application number:** | JP20000124676 20000425 |
| **Priority number(s):** | JP20000124676 20000425 |
| **Also published as:** | JP4331861 (B2) |

### Abstract of JP2001308992 (A)

PROBLEM TO BE SOLVED: To obtain a small-sized and low-profile mobile wireless unit that a user can confirm indication even when the unit is folded. SOLUTION: The mobile wireless terminal is provided with 1st case 2, a 2nd case 4 that is connected to the 1st case 2 in an opening/closing available way with a hinge 3 that hinges each one-end of the two cases in a foldable way, a main display section 11 that is exposed when the 2nd case 4 is open and with a sub display section 12 that is always exposed independently of opening/closing of the 2nd case 4, and the sub display section 12 is placed in a cavity in the inside of the hinge section.




Last updated: 09.10.2013 Worldwide Database 5.8.11.5; 93p

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(19)日本国特許庁（ＪＰ）　(12)公開特許公報（Ａ）　(11)特許出願公開番号
特開2001－308992
（P2001－308992A）
(43)公開日　平成13年11月２日(2001.11.2)

| (51)Int.Cl.' | | 識別記号 | FI | | テーマコード'（参考） |
|---|---|---|---|---|---|
| H04M | 1/02 | | H04M | 1/02 | A　5K011 |
| | | | | | C　5K023 |
| H04B | 1/38 | | H04B | 1/38 | 5K067 |
| H04Q | 7/32 | | | 7/26 | V |

審査請求　未請求　請求項の数２　ＯＬ　（全４頁）

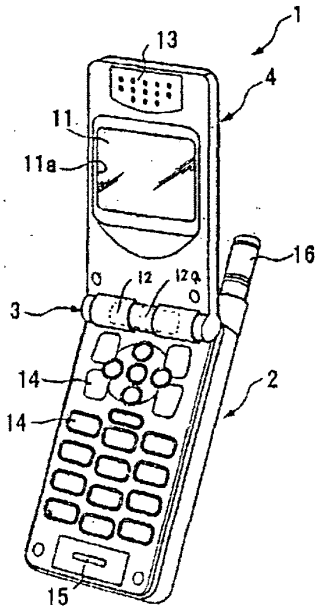
(21)出願番号　特願2000－124676(P2000－124676)
(22)出願日　平成12年４月25日(2000.4.25)

(71)出願人　000006633
京セラ株式会社
京都府京都市伏見区竹田鳥羽殿町６番地
(72)発明者　岩淵　和博
神奈川県横浜市都筑区加賀原２丁目１番１号　京セラ株式会社横浜事業所内
(72)発明者　内野　晃彦
神奈川県横浜市都筑区加賀原２丁目１番１号　京セラ株式会社横浜事業所内

Ｆターム(参考)　5K011 AA01 AA09 HA06 JA03 KA00 KA12
5K023 AA07 DD08 HH01 HH07 MM25
5K067 AA34 BB04 EE02 FF22 KK17

(54)【発明の名称】　携帯無線機

(57)【要約】
【課題】　折り畳み時にも表示を確認することができる携帯無線機の小型・薄型化を図る。
【解決手段】　第1の筐体２に開閉可能に第2の筐体４を連結させるとともに上記二つの筐体をそれぞれの一方の端部で折畳み可能に結合するヒンジ部３とを設ける。第2の筐体４を開いた際に露出されるメイン表示部１１と、第2の筐体４の開閉に関係なく露出されるサブ表示部１２を設け、このサブ表示部１２をヒンジ部内部の空洞に設けるようにする。




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【特許請求の範囲】
【請求項１】　音声を取り入れる音声入力手段と、音声を出力する音声出力手段と、各種信号を入力させる入力手段と、音声データ、文字データ、画像データ等の各種通信データの通信を行う通信手段とを有する携帯無線機であって、第１の筐体と、この第１の筐体に回動可能に連結されて第１の筐体に対して開閉可能とされた第２の筐体と、第２の筐体を開いた際に露出される第１の表示手段と、第２の筐体の開閉に関係なく露出される第２の表示手段と、上記二つの筐体をそれぞれの一方の端部で折畳み可能に結合するヒンジ部とを有し、前記ヒンジ部に前記第2の表示手段が設けられていることを特徴とする携帯無線機。
【請求項２】　前記第2の表示手段を保護する保護部材にレンズが使用されていることを特徴とする請求項１記載の携帯無線機。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、各種通信手段を用いた携帯無線機に係り、特に、折り畳み式の携帯無線機に関するものである。
【０００２】
【従来の技術】近年、データの高速伝送が可能なＰＤＣ（Personal Digital Cellular）、ＣＤＭＡ（Code Division Multiple Access）、ＧＳＭ（Global System for Mobile Communication）やＰＨＳ（Personal Handy-phone System）等の通信手段を用いた携帯無線機が広く用いられ、さらに、次世代の技術として開発されているＷＣＤＭＡ（Wide band CDMA）、ＣＤＭＡ２０００等の通信手段を用いたものが開発されつつある。この種の携帯無線機には、携帯性を高めるために、折り畳み構造のものが知られているが、このように折り畳み式の携帯無線機では、折り畳んだ際に、表示部が外部から見えなくなってしまっていた。
【０００３】このため、折り畳んだ状態でも、表示機能が損なわれない構造の携帯無線機として、特開平６－３７６９７号公報に示されているように、折り畳んだときにも外部から見ることができる第２の表示部を設けたものがある。
【０００４】
【発明が解決しようとする課題】しかしながら、この構造の携帯無線機にあっては、第２の表示部を設けることにより部品点数が多くなり、このため、筐体の大型化を招き、携帯性を損ねてしまうという問題があった。この発明は、上記事情に鑑みてなされたもので、携帯性を損ねることなく、折り畳み時にも表示を確認することができる小型化が可能な携帯無線機を提供することを目的としている。
【０００５】
【課題を解決するための手段】上記目的を達成するために、音声を取り入れる音声入力手段と、音声を出力する音声出力手段と、各種信号を入力させる入力手段と、音声データ、文字データ、画像データ等の各種通信データの通信を行う通信手段とを有する携帯無線機であって、第１の筐体と、この第１の筐体に回動可能に連結されて第１の筐体に対して開閉可能とされた第２の筐体と、第２の筐体を開いた際に露出される第１の表示手段と、第２の筐体の開閉に関係なく露出される第２の表示手段と、上記二つの筐体をそれぞれの一方の端部で折畳み可能に結合するヒンジ部とを有し、前記ヒンジ部に前記第2の表示手段が設けられていることを特徴としている。このように、ヒンジ部に第２の表示手段を設けているために、小型・薄型化を図ることができ、表示機能が充実しさらに携帯性が向上された携帯無線機とすることができる。
【０００６】請求項２記載の携帯無線機は、前記第2の表示手段を保護する保護部材にレンズが使用されていることを特徴としている。つまり、第2の表示手段を保護するための保護部材にレンズを設けることにより表示文字が拡大されて表示されるために老眼の人であっても表示文字を明瞭に判読することができる。
【０００７】
【発明の実施の形態】以下、本発明の実施の形態の携帯無線機を図面を参照して説明する。
【０００８】図１及び図２において、符号１は、携帯無線機である。この携帯無線機１は、第１の筐体２と、この第１の筐体２の上端部に、ヒンジ３によって回動可能に連結された第２の筐体４とを有しており、ヒンジ３による連結箇所にて第２の筐体４を回動させることにより、第２の筐体４が第１の筐体２に対して開閉されるようになっている。
【０００９】つまり、第２の筐体４が閉じた状態（図２の状態）から第２の筐体４を回動させることにより、第２の筐体４が開いた状態（図１の状態）とされ、これとは逆に、第２の筐体４が開いた状態から第２の筐体４を逆方向へ回動させることにより、第２の筐体４が閉じた状態とされるようになっている。
【００１０】第２の筐体４には、閉じることにより第１の筐体２と合わされる側である正面側に、メイン表示部（第１の表示手段）１１が設けられ、また、ヒンジ３に、サブ表示部（第２の表示手段）１２が設けられている。第２の筐体４には、その正面側における上端部にスピーカ（音声出力手段）１３が設けられている。
【００１１】第１の筐体２には、第２の筐体４によって閉ざされる正面側に操作用の複数の操作キー（入力手段）１４が配設されており、これら操作キー１４から各種の入力を行うことができるようになっている。また、第１の筐体２には、その正面側における下端部にマイク（音声入力手段）１５が設けられており、さらに、上端には、その背面側に、伸縮可能なアンテナ１６が設けら

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れ、このアンテナを介して音声データ、文字データ、画像データ等の各種通信データの通信が行われるようになっている。そして、この携帯無線機１によれば、第２の筐体４を開いた状態にて、そのマイク１５にて音声入力が行われ、スピーカ１３から相手方の音声、着信音、アラーム等が発せられるようになっている。

【００１２】次に、上記携帯無線機１の機能について図３に示す機能ブロック図を参照して説明する。図において、符号２１は、表示デバイスであり、この表示デバイス２１は第２の筐体４内に配設されている。また、この表示デバイス２１には、その一端に表示ドライバ２４が設けられており、この表示ドライバ２４によって表示デバイス２１に表示されるようになっている。この表示ドライバ２４は、第１の筐体２に設けられた制御部２５に接続されており、この制御部２５から制御信号が出力されるようになっている。また、無線部（通信手段）２６は、アンテナ１６を介して相手方端末との間にて、無線通信回線を用いて音声データ、文字データ、画像データ等の各種通信データの送受信を行うものである。

【００１３】そして、この無線部２６にて受信された通信データは、図示しない音声処理部にて音声データが取り出されてスピーカ１３から音声を出力させるようになっている。また、マイク１５より入力された音声は、音声信号として音声処理部に入力され、この音声処理部から音声データに変換されて通信データとして無線部２６へ送信され、無線部２６からアンテナ１６を介して相手方端末へ送信されるようになっている。なお、符号２７は、この携帯無線機１の全ての電力をまかなうバッテリーである。

【００１４】そして、上記の携帯無線機１では、制御部２５からの制御信号により表示ドライバ２４が駆動されて、表示デバイス２１に各種文字情報や画像情報が表示される。第２の筐体４を開いた状態では、メイン表示部１１及びサブ表示部１２にて、その表示内容を確認することができ、第２の筐体４を閉じた状態では、サブ表示部１２にて、その表示内容を確認することができる。

【００１５】第２の筐体４の表面に形成されたメイン表示部用窓１１ａ及び裏面に形成されたサブ表示部用窓１２ａから、第２の筐体４内に配設した表示デバイス２１の表示内容を容易に確認することができる。しかも、サブ表示部用窓１２ａがレンズによって構成されているために表示文字が拡大されて表示されるために老眼の人であっても表示文字を明瞭に判読することができる。

【００１６】

【発明の効果】以上、説明したように、本発明の携帯無線機によれば、下記の効果を得ることができる。請求項１記載の携帯無線機によればヒンジ内部の空洞を利用して第2の表示手段が設けられている構成としたことにより小型・薄型化を図ることができ、表示機能が充実しさらに携帯性が向上された携帯無線機とすることができる。

【００１７】請求項２記載の携帯無線機によれば、第2の表示手段を保護するための保護部材にレンズを設けたことにより表示文字が拡大されて表示されるために老眼の人であっても表示文字を明瞭に判読することができる。

【図面の簡単な説明】

【図１】　本発明の実施の形態の携帯無線機の構成及び構造を説明する携帯無線機の斜視図である。

【図２】　本発明の実施の形態の携帯無線機の構成及び構造を説明する折り畳んだ状態の携帯無線機の斜視図である。

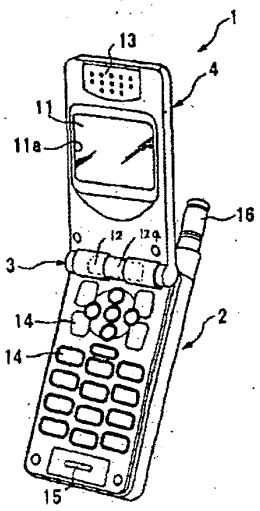
【図３】　本発明の実施の形態の携帯無線機の機能を説明する機能ブロック図である。

【符号の説明】

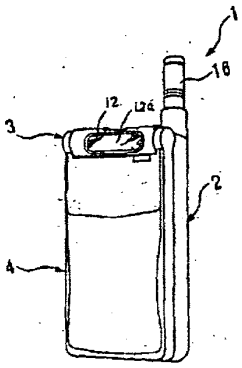
１　携帯無線機
２　第１の筐体
４　第２の筐体
１１　メイン表示部（第１の表示手段）
１１ａ　メイン表示部用窓（第１の表示手段用窓）
１２　サブ表示部（第２の表示手段）
１２ａ　サブ表示部用窓（第２の表示手段用窓）
１３　スピーカ（音声出力手段）
１４　操作キー（入力手段）
１５　マイク（音声入力手段）
２１　表示デバイス
２５　無線部（通信手段）

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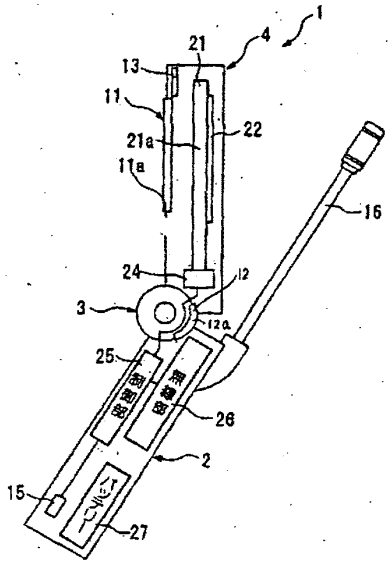
【図1】


1
13
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11a
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12a
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【図2】


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【図3】


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| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) |

CONFIRMATION NO. 7955

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

FORMALITIES LETTER

1-15-14
11-15-13
5-15-14

*OC000000064976521*

Date Mailed: 11/15/2013

## NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

**FILED UNDER 37 CFR 1.53(b)**

***Filing Date Granted***

**Items Required To Avoid Abandonment:**

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- A mailing address for each inventor has not been submitted. A new application data sheet (ADS) in compliance with 37 CFR 1.76 or inventor's oath or declaration in compliance with 37 CFR 1.63 identifying the mailing address and residence (if the inventor lives at a location which is different from where the inventor customarily receives mail) is required. The applicant needs to satisfy supplemental fees problems indicated below.

  Claus H. Jorgensen



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Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

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Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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Attorney Docket No.: 891.0013.U4(US)
Application No.: 14/067,249

# Supplemental Application Data Sheet

## *(1) Inventor information*

**(1) Inventor:**

| FULL NAME OF INVENTOR: | LAST NAME | FIRST NAME | MIDDLE NAME |
|---|---|---|---|
| | **JORGENSEN** | **Claus** | **H.** |

| RESIDENCE & CITIZENSHIP: | CITY & STATE OR COUNTRY | CITIZENSHIP |
|---|---|---|
| | Bronshoj, DK | DK |

POST OFFICE ADDRESS: **Tryggevaeldevej 84; Bronshoj, DK 2700**

***Signature:***

Signature: _____ Date: 11/22/2013

First Name: Juan Last Name: Juan Registration No.: 60,564



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# Electronic Acknowledgement Receipt

| | |
|---|---|
| **EFS ID:** | 17477861 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | Portable Electronic Device |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Robert J. Mauri/blair ribeiro |
| **Filer Authorized By:** | Robert J. Mauri |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 22-NOV-2013 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 13:06:22 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

| | |
|---|---|
| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
|---|---|---|---|---|---|
| 1 | | NC51996US-8910013U4US-ResponsetoMSPandADS-11-22-2013.PDF | 128309<br>c1507277df6e40d57c2e2407fdaff950a8523203 | yes | 4 |

| | Multipart Description/PDF files in .zip description | | |
|---|---|---|---|
| | **Document Description** | **Start** | **End** |
| | Transmittal Letter | 1 | 1 |
| | Miscellaneous Incoming Letter | 2 | 3 |
| | Application Data Sheet | 4 | 4 |

**Warnings:**

The page size in the PDF is too large. The pages should be 8.5 x 11 or A4. If this PDF is submitted, the pages will be resized upon entry into the Image File Wrapper and may affect subsequent processing

**Information:**

| **Total Files Size (in bytes):** | 128309 |
|---|---|

**This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.**

**<u>New Applications Under 35 U.S.C. 111</u>**
**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

**<u>National Stage of an International Application under 35 U.S.C. 371</u>**
**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**<u>New International Application Filed with the USPTO as a Receiving Office</u>**
**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

**IN THE U.S. PATENT AND TRADEMARK OFFICE**

APPLICANTS: Claus H. Jorgensen
SERIAL NO.: 14/067,249
EXAMINER: N/A
ATTORNEY'S DOCKET NO.: 891.0013.U4(US)
TITLE: Portable Electronic Device

CONFIRMATION NO.: 7955
FILING DATE: 10-30-2013
ART UNIT: 3725

VIA EFS

**Response to Notice to File Missing Parts of Non-Provisional Application and Correction Submission**

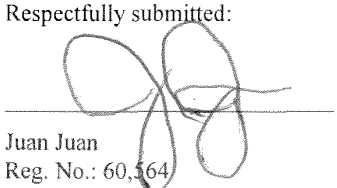
Sir:

In response to the Notice to File Missing Parts in a Non-Provisional Application dated November 15, 2013 (copy included), the applicant hereby submits a corrective submission. Upon review of papers relating to this case, it was noticed that the "Country of Residence" was not provided for the sole inventor, Claus H. Jorgensen on the previously submitted Application Data Sheet. The "Country of Residence" for the inventor is:

**DENMARK (DK)**

Attached is a Supplemental Application Data Sheet listing the omitted "Country of Residence." Please charge deposit account 50-1924 any fee necessary for correction of the inventor's name. A new Filing Receipt with the inventor's residency information listed is requested.

Respectfully submitted:



11/22/13

Juan Juan
Reg. No.: 60,564
Customer No.: 10948
Harrington and Smith, Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
Telephone: (203)925-9400
Facsimile: (203)944-0245

Date

## PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/067,249

### APPLICATION AS FILED - PART I

| FOR | (Column 1) NUMBER FILED | (Column 2) NUMBER EXTRA | SMALL ENTITY RATE($) | SMALL ENTITY FEE($) | OR | OTHER THAN SMALL ENTITY RATE($) | OTHER THAN SMALL ENTITY FEE($) |
|---|---|---|---|---|---|---|---|
| BASIC FEE (37 CFR 1.16(a), (b), or (c)) | N/A | N/A | N/A | | | N/A | 280 |
| SEARCH FEE (37 CFR 1.16(k), (i), or (m)) | N/A | N/A | N/A | | | N/A | 600 |
| EXAMINATION FEE (37 CFR 1.16(o), (p), or (q)) | N/A | N/A | N/A | | | N/A | 720 |
| TOTAL CLAIMS (37 CFR 1.16(i)) | 18 minus 20 = | * | | | OR | x 80 = | 0.00 |
| INDEPENDENT CLAIMS (37 CFR 1.16(h)) | 2 minus 3 = | * | | | | x 420 = | 0.00 |
| APPLICATION SIZE FEE (37 CFR 1.16(s)) | If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s). | | | | | | 0.00 |
| MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j)) | | | | | | | 0.00 |
| * If the difference in column 1 is less than zero, enter "0" in column 2. | | | TOTAL | | | TOTAL | 1600 |

### APPLICATION AS AMENDED - PART II

| | | (Column 1) CLAIMS REMAINING AFTER AMENDMENT | | (Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR | (Column 3) PRESENT EXTRA | SMALL ENTITY RATE($) | SMALL ENTITY ADDITIONAL FEE($) | OR | OTHER THAN SMALL ENTITY RATE($) | OTHER THAN SMALL ENTITY ADDITIONAL FEE($) |
|---|---|---|---|---|---|---|---|---|---|---|
| AMENDMENT A | Total (37 CFR 1.16(i)) | * | Minus | ** | = | x = | | OR | x = | |
| | Independent (37 CFR 1.16(h)) | * | Minus | *** | = | x = | | OR | x = | |
| | Application Size Fee (37 CFR 1.16(s)) | | | | | | | | | |
| | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) | | | | | | | OR | | |
| | | | | | | TOTAL ADD'L FEE | | OR | TOTAL ADD'L FEE | |

| | | (Column 1) CLAIMS REMAINING AFTER AMENDMENT | | (Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR | (Column 3) PRESENT EXTRA | RATE($) | ADDITIONAL FEE($) | OR | RATE($) | ADDITIONAL FEE($) |
|---|---|---|---|---|---|---|---|---|---|---|
| AMENDMENT B | Total (37 CFR 1.16(i)) | * | Minus | ** | = | x = | | OR | x = | |
| | Independent (37 CFR 1.16(h)) | * | Minus | *** | = | x = | | OR | x = | |
| | Application Size Fee (37 CFR 1.16(s)) | | | | | | | | | |
| | FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j)) | | | | | | | OR | | |
| | | | | | | TOTAL ADD'L FEE | | OR | TOTAL ADD'L FEE | |

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
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www.uspto.gov

| APPLICATION NUMBER | FILING or 371(c) DATE | GRP ART UNIT | FIL FEE REC'D | ATTY.DOCKET.NO | TOT CLAIMS | IND CLAIMS |
|---|---|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | 3725 | 1900 | 891.0013.U4(US) | 18 | 2 |

**CONFIRMATION NO. 7955**

**UPDATED FILING RECEIPT**

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484




Date Mailed: 11/29/2013

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

**Inventor(s)**

Claus H. Jorgensen, Bronshoj, DENMARK;

**Applicant(s)**

Nokia Corporation, Espoo, FINLAND

**Assignment For Published Patent Application**

Nokia Corporation, Espoo, FINLAND

**Power of Attorney:** The patent practitioners associated with Customer Number 10948

**Domestic Priority data as claimed by applicant**

This application is a CON of 13/741,781 01/15/2013
and is a CON of 12/860,234 08/20/2010 PAT 8363824
and is a CON of 11/393,510 03/29/2006 PAT 7787618

**Foreign Applications** for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
*Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.*

Permission to Access - A proper **Authorization to Permit Access to Application by Participating Offices** (PTO/SB/39 or its equivalent) has been received by the USPTO.

**If Required, Foreign Filing License Granted:** 11/13/2013
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/067,249**
**Projected Publication Date:** 03/13/2014



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**Non-Publication Request:** No

**Early Publication Request:** No

**Title**

Portable Electronic Device

**Preliminary Class**

072

**Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications:** No

## PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

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## Title 37, Code of Federal Regulations, 5.11 & 5.15

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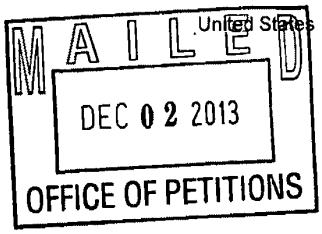

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Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton CT 06484




Doc Code: TRACK1.GRANT

| ***Decision Granting Request for Prioritized Examination (Track I or After RCE)*** | Application No.: 14/067,249 |
|---|---|

1. THE REQUEST FILED October 30, 2013 IS **GRANTED.**

The above-identified application has met the requirements for prioritized examination

A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;
B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;
C. filing a **request for continued examination**;
D. filing a notice of appeal;
E. filing a request for suspension of action;
F. mailing of a notice of allowance;
G. mailing of a final Office action;
H. completion of examination as defined in 37 CFR 41.102; or
I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to Brian W. Brown at 571-272-5338.

/Brian W. Brown/
[*Signature*]

Petitions Examiner, Office of Petitions
(Title)



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OPAP AKIMA-10
DEC 3 0 2013
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249
Applicant(s): Jorgensen
Art Unit: 2642
Title: Portable Electronic Device

Confirmation No.: 7955
Filed: October 30, 2013
Examiner: N/A

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement
(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

A search report has issued in a counterpart foreign application (EP 13187465.3-1858), mailed on December 4, 2013. Copies of the art are enclosed with a Form PTO-1449 for the Examiner's use. Also included is a copy of the search report.

☒ Each item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Statement, or

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the statement after making reasonable inquiry, no item of information contained in this Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing of this Statement.

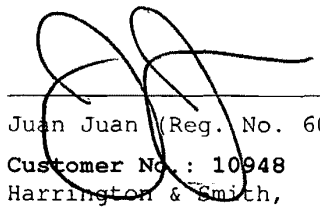


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The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



12/23/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

12/23/13

Date



Blair Ribeiro



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2642 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-20050282593-A1 | 12-22-2005 | Spence, et al. | 455 | 575.3 |

OPAP AKIMA-10 DEC 30 2013 PATENT & TRADEMARK OFFICE

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | EP-1209880-A2 | 05-29-2002 | Nokia Corp. | N/A |
| | EP-1496672-A1 | 01-12-2005 | Matushita Electric Ind. Co. | N/A |
| | GB-2383472-A | 06-25-2003 | Nokia Mobile Developments, et al. | N/A |
| | GB-2391740-A | 02-11-2004 | Matushita Electric Ind. Co. | N/A |

**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

| | |
|---|---|
| | |
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| Examiner's Signature: | Date Considered: |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

(12) UK Patent Application (19) GB (11) 2 391 740 (13) A

(43) Date of Printing by UK Office 11.02.2004

(21) Application No: 0324057.9

(22) Date of Filing: 04.02.2003

(30) Priority Data:
(31) 2002026479 (32) 04.02.2002 (33) JP

(86) International Application Data:
PCT/JP2003/001091 Jp 04.02.2003

(87) International Publication Data:
WO2003/067857 Jp 14.08.2002

(71) Applicant(s):
Matsushita Electrical Industrial Co Ltd
(Incorporated in Japan)
1006 Oaza Kadoma, Kadoma-shi,
Osaka 571-8501, Japan

(72) Inventor(s):
Koichi Yamamoto
Hidehiro Yanagibashi

(74) Agent and/or Address for Service:
J A Kemp & Co.
14 South Square, Gray's Inn, LONDON,
WC1R 5JJ, United Kingdom

(51) INT CL[7]:
H04M 1/02

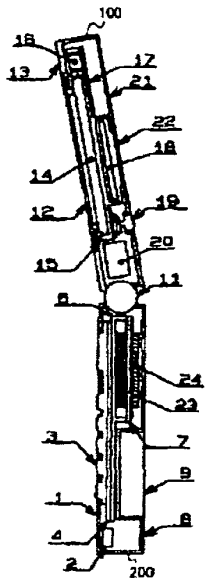
(52) UK CL (Edition W ):
H4J JK J36Q

(56) Documents Cited by ISA:
JP 100276249 A JP 080153986 A
JP 060053880 A JP 040012589 A
JP 2000151138 A

(58) Field of Search by ISA:
INT CL[7] H04M
Other: Jitsuyo Shinan Koho 1922-1996; Toroku Jitsuyo Shinan Koho 1994-2003; Kokai Jitsuyo Shinan Koho 1971-2003; Jitsuyo Shinan Toroku Koho 1996-2003

(54) Abstract Title: **Foldable cell phone device**

(57) A foldable cell phone device, comprising an operating part (3) installed on the opposed surface of a lower casing (200) opposed to an upper casing (100) when folded up, a circuit substrate (7) installed in the lowar casing (200), and a plate-like spacer (5) installed between the operating part (3) and the circuit substrate (7) and supported by a rib.




GB 2 391 740 A

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000098

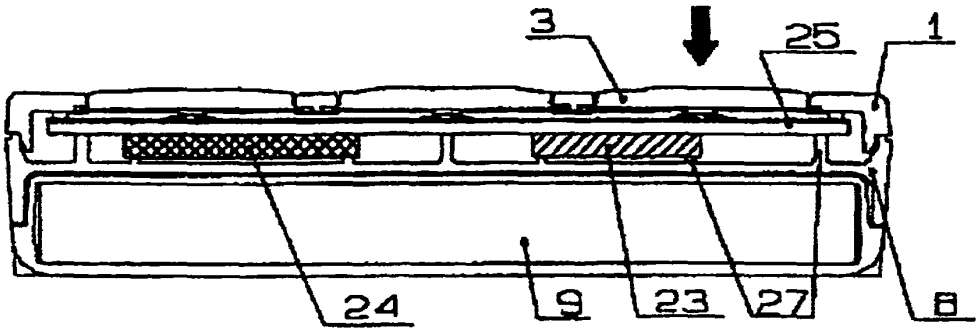



FIG. 1

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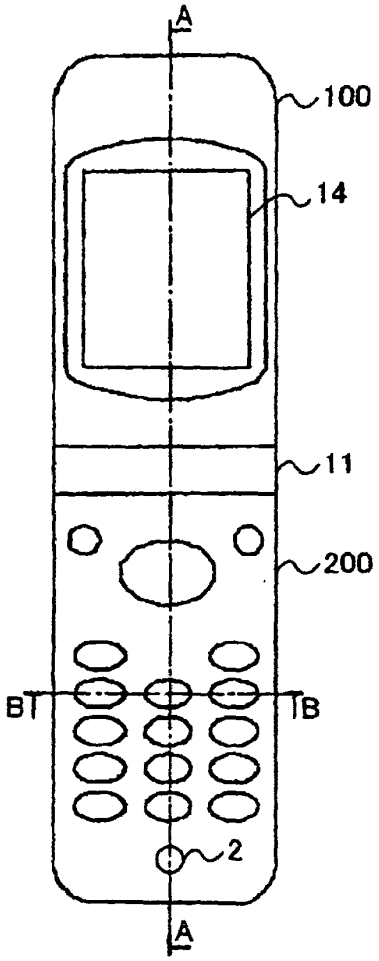



FIG. 2

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000100

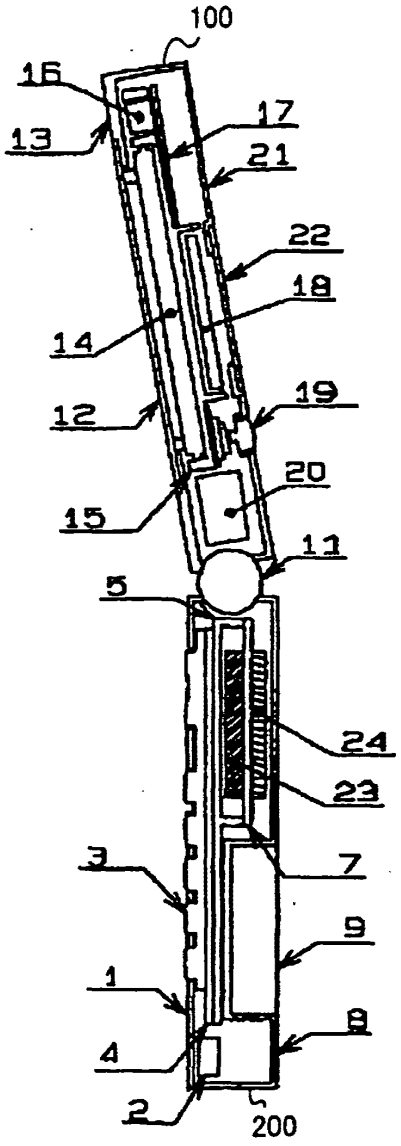



FIG. 3

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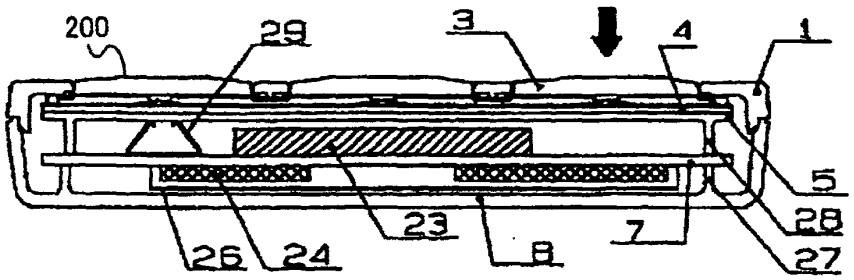



FIG. 4

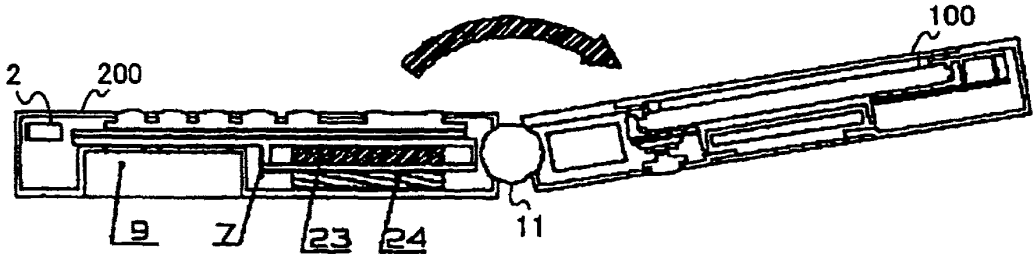



FIG. 5

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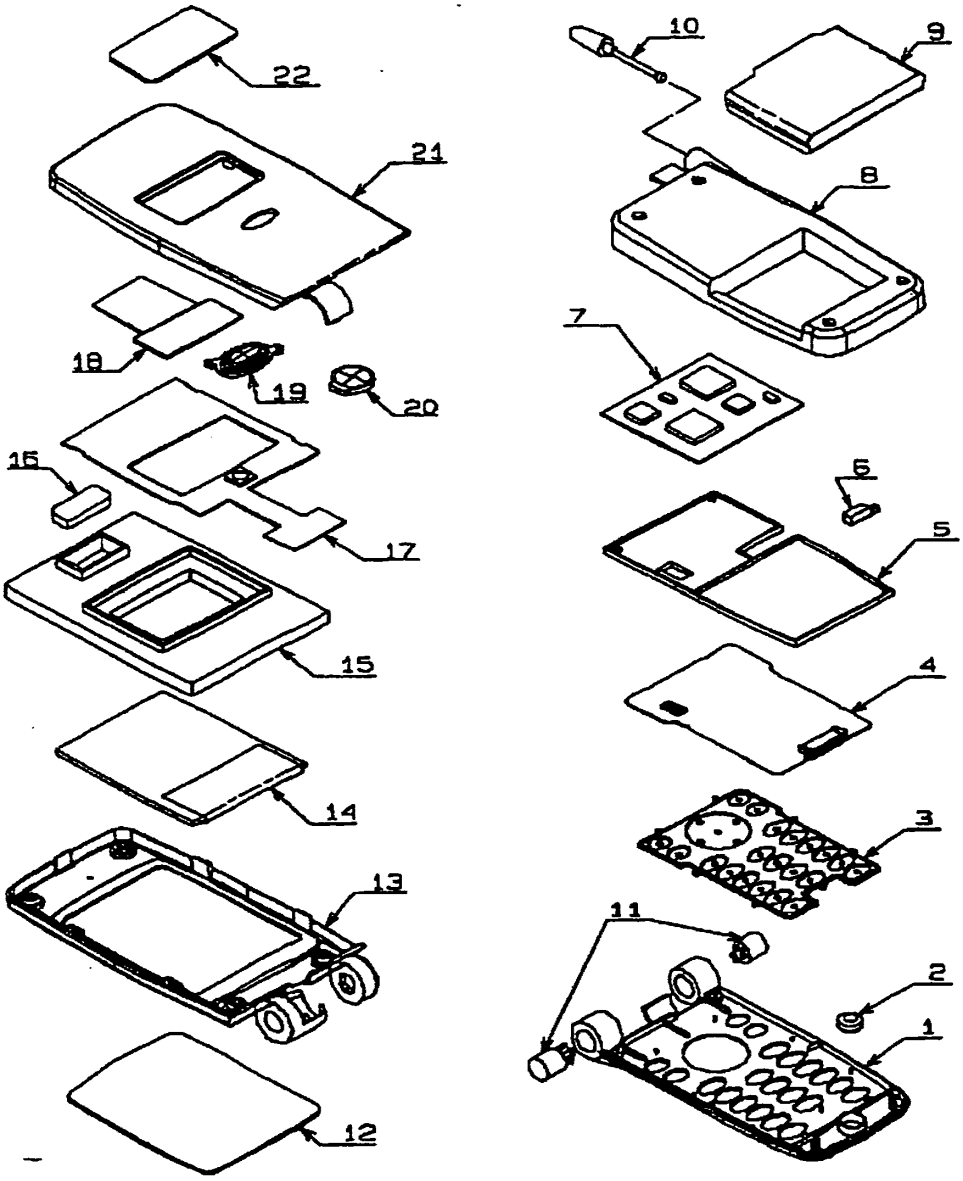



FIG. 6

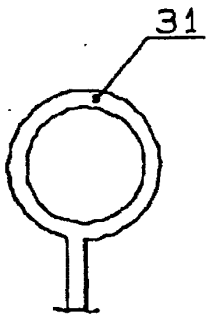



FIG. 7

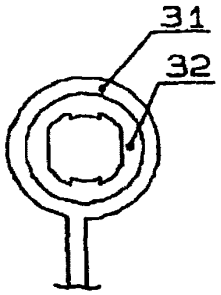



FIG. 8

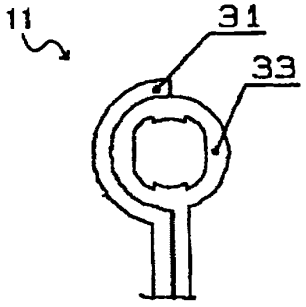



FIG. 9

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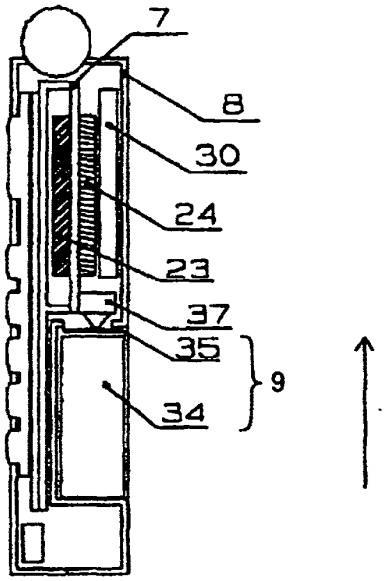



FIG. 10

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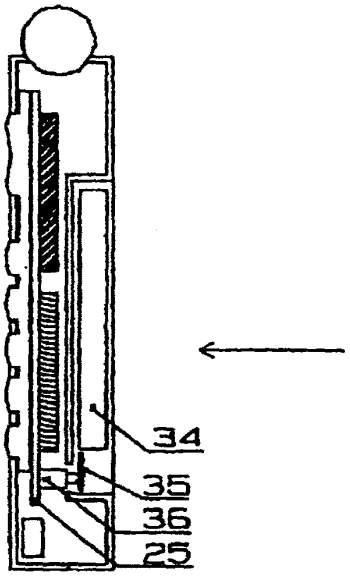



FIG. 11

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# DESCRIPTION

## FOLD MOBILE PHONE APPARATUS

### Technical Field

The present invention relates to mobile phones, and more specifically, to fold mobile phone apparatus.

### Background Art

In recent years, small, thin, and fold-type mobile phone apparatus have become the majority. However, miniaturization and thin modeling has led to decreased mechanical strength and rigidity, and there have been many occurrences of damaging the installation parts. Especially, with the single-board that has key operating sections on the front plane and the installation parts on the rear plane, the stress from key pressing transmits directly to the installation parts, and there is a high likelihood of damaging the installation parts. Moreover, the configuration makes it difficult to take measures when the problem of damage arises. Furthermore, the spread of e-mail functions has led to the enlargement of main display sections and the mounting of sub display sections that can be used when the apparatus is closed, and as a result, the weight of the upper chassis of a fold mobile phone apparatus has increased, and the upper chassis and the lower chassis tend to have a poor weight balance.

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FIG.1 is a sectional diagram showing a part of a configuration of a conventional fold mobile phone apparatus. Control circuit 23 and radio circuit 24 are formed on the side of the opposite plane from the operating plane of key circuit board 25, and the installation parts of key circuit board 25, control circuit 23, and radio circuit 24 are supported by means of lower rear case rib 27 formed in lower rear case 8.

As to the operation of key pressing, when key sheet 3 is pressed in the direction of the arrow, the stress from the operating section side of key circuit board 25 transmits to the installation parts on the opposite plane side from the operating section side. Next, this stress is received in lower rear case rib 27 formed in lower rear case 8. Moreover, this stress is received in battery 9 attached to lower rear case 8. Especially, in case the edge portions of the installation parts are situated right underneath the keys, little force of key pressing causes substantial stress to the solder joint portion of the installation parts, and the likelihood of damaging the solder joint portion is high.

Moreover, conventional fold mobile phone apparatus have the installation parts on the side of the opposite plane from the operating side of a key circuit board, and the likelihood of damaging the installation parts by key pressing, bending, and twisting is high. Moreover, a further problem is that miniaturization and thin

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modeling make the likelihood even higher.

Furthermore, since parts are implemented on the opposite plane side from the operating section side of the key circuit board, when development to new models is considered, miniaturizing a circuit board along with miniaturization of installation parts naturally miniaturizes the operating part as well, thereby leading to the problem of poor operationality.

## Disclosure of Invention

It is therefore an object of the present invention to provide a fold mobile phone apparatus that is small and thin yet strong and rigid.

The above object can be achieved by providing a flat spacer between an operating section and a circuit board and by receiving stress that results from key pressing operations, bending, and twisting of the operating section by the spacer.

## Brief Description of Drawings

FIG.1 is a sectional diagram, showing a configuration inside a lower chassis of a conventional fold mobile phone apparatus;

FIG.2 is a front view diagram, showing an external view of a fold mobile phone apparatus according to an embodiment of the present invention;

FIG.3 shows an A-A sectional view of FIG.2;

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FIG.4 shows a B-B sectional view of FIG.2;

FIG.5 is a sectional diagram, showing a configuration of the fold mobile phone apparatus of the embodiment of the present invention as laid on a desk;

FIG.6 is a decompositional perspective view, showing a configuration of the fold mobile phone apparatus of the embodiment of the present invention;

FIG.7 is a sectional view, showing a configuration of a hinge section of a conventional fold mobile phone apparatus for comparison with the embodiment;

FIG.8 is a sectional view, showing another configuration of a hinge section of a conventional fold mobile phone apparatus for comparison with the present embodiment;

FIG.9 is a sectional view, showing a configuration of a hinge section of the fold mobile phone apparatus of the embodiment of the present embodiment;

FIG.10 is sectional view, showing a configuration inside the fold mobile phone apparatus according to another embodiment of the present embodiment; and

FIG.11 is a sectional view, showing a configuration inside a lower chassis of a conventional fold mobile phone apparatus for comparison with the embodiment.

## Best Mode for Carrying Out the Invention

Embodiments of the present invention will be described now with reference to the accompanying

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drawings.

FIG.2 is a front view diagram, showing an external view of a fold mobile phone apparatus according to one embodiment of the present invention; FIG.3 shows an A-A sectional view of FIG.2; FIG.4 shows an B-B sectional view of FIG.2; and FIG.6 is a decompositional perspective view, showing a configuration of the fold mobile phone apparatus of the present embodiment of the present invention.

As shown in FIG.2 and FIG.3, the folding mobile phone apparatus of this embodiment comprises upper chassis 100 and lower chassis 200. Upper chassis 100 and lower chassis 200 are rotatably mounted via hinge section 11.

Upper chassis 100 is provided with main display section 14 and sub display section 18 for display sections. Main display 14 functions as a display section when the folding mobile phone apparatus is open, and sub display 18 functions as a display section when the folding mobile phone apparatus is closed. Main display 14 and sub display 18 are both electrically connected to flexible board 17 and held by means of holder 15.

Incidentally, sub display 18 has the functions of displaying the battery level, the signal condition, and the time, and displaying the number and the name of the caller upon an incoming call, thereby realizing a folding mobile phone apparatus that is highly convenient even while it is closed. Additionally, receiver 16 is also

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held by holder 15.

Upper chassis 100 is formed with upper front case 13 and upper rear case 21. Inside upper rear case 21, speaker 20 and rear key 19 are provided. Moreover, main display panel 12 is provided on upper front case 13 and sub display panel 22 is provided on upper rear case 21, thereby protecting main display section 14 and sub display section 18. Rear key 19 is provided with the function of switching the display content on sub display section 18 while the folding mobile phone apparatus is closed, the function of recording the caller's voice while the folding mobile phone apparatus is open and a call is in progress, and the function of playing the recorded content.

On the other hand, lower chassis 200 is formed with lower front case 1 and lower rear case 8. Lower chassis 200 is provided with key sheet 3 and key board 4 as the operating section. No installation parts are mounted on the opposite plane side from the operating section of key board 4. Control circuit 23 and radio circuit 24 are formed on circuit board 7, and flat spacer 5 is provided between key board 4 and circuit board 7.

Radio circuit 24 is provided with shield case 26 to prevent the intrusion of electromagnetic waves and maintain electrical performance, and such conductive material as phosphor copper, beryllium copper, spring nickel silver, and spring stainless, or

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electroless-plated resin material is used.

Spacer 5 is provided with spacer rib 28 that protrudes in the direction of circuit board 7. Moreover, low rear case 8 is provided with lower rear case rib 27 that protrudes in the direction of circuit board 7. These spacer rib 28 and lower rear case rib 27 are formed in such positions that they face each other over circuit board 7. In this way, circuit board 7 is sandwiched between spacer rib 28 and lower rear case rib 27 and held parallel to key board 4. Moreover, spacer 5 is fixed by lower rear case 8.

Spacer 5 is formed of conductive magnesium, which, as in the case of radio circuit 24, makes it possible to prevent the intrusion of electromagnetic waves to control circuit 23 and maintain electrical performance. Incidentally, in case of insufficient electrical performance, by installing ground spring 29 made of such conductive material as phosphor copper, beryllium copper, spring nickel silver, and spring stainless on circuit board 7, and by pressing both spacer 5 and circuit board 7 against each other by the compression of ground spring 29, it is possible to strengthen the electrical connection and maintain more stable electrical performance.

Referring to circuit board 7, control circuit 23 is formed on the spacer side and radio circuit 24 is formed on the lower rear case 8 side, so that radio circuit 24, where the intrusion of electromagnetic waves is

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substantial, is covered with shield case 26, and control circuit 23, where the intrusion of electromagnetic waves is less compared to radio circuit 24, can utilize conductive spacer 5 as a shield case, thereby making it unnecessary to provide a dedicated shield case and thus realizing an ideal configuration.

If, on circuit board 7, control circuit 23 is formed on the lower rear case 8 side and radio circuit 24 is formed on the spacer 5 side, spacer 5 alone is insufficient for the measure against the intrusion of electromagnetic waves, and an additional shield case is necessary. Additionally, referring to control circuit 23, if lower rear case 8 is aluminum deposited in lower rear case 8 for the measure against the intrusion of electromagnetic waves, the likelihood of insufficient electrical performance, which makes it likely that an additional shield case needs to be provided. In other words, two shield cases are likely to be necessary, which then results in an increase in product cost and body size.

Lower chassis 200 is provided with additional components including battery 9, vibrator 6, antenna 10, and microphone 2, and these components are accommodated in lower front case 1 and in lower rear case 8.

As to the operation of key pressing, when key 3 is pressed in the direction of the arrow, the force from key board 4 first transmits to spacer5. However, provided that spacer 5 is made of high rigid material such as

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magnesium, it is possible to reduce the stress from key board 4. Additionally, since no installation parts are provided on the plane of key board 4 opposite from the operating side, the stress of key pressing does not transmit to the installation parts. Although the stress that has transmitted to spacer 5 then transmits to circuit board 7, given the configuration in which lower rear case rib 27 formed on lower rear case 8 receives this stress and supports circuit board 7, it is still possible to reduce shape changes of circuit board 7 and stress upon the installation parts.

FIG. 5 is a structural diagram showing the fold mobile phone apparatus of the present embodiment laid on a desk. When the fold mobile phone apparatus is used while laid on a desk or a table, by providing battery 9, which has the heaviest relative weight, at a position near microphone 2 apart from hinge section 11, the center of gravity of the body moves to a more remote position from hinge section 11, so that even when upper case 100 rotates in the direction of the arrow, it will not have a fall and remain stably set.

FIG. 7 is a sectional diagram, showing an example of the configuration of a hinge section of a conventional fold mobile phone apparatus, in which lower front case hinge section 31 is formed in lower front case 1. Usually, lower front case 1 is formed of magnesium material to improve the rigidity of the body. FIG. 8 is a sectional

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diagram, showing another configuration of a hinge section of a conventional fold mobile phone apparatus. Lower front case 1 is formed of general resin material such as ABS, and insert fitting 32, formed of metal system by insert molding, is provided in lower front case 1. In this case, the rigidity of the body is secured by insert fitting 32.

FIG. 9 is a sectional diagram showing a configuration of hinge section 11 of the fold mobile phone apparatus of the present embodiment of the present invention, and hinge section 33 is formed in spacer 5 made of metal material such as magnesium. By this means, it is possible to maintain the rigidity of the body and form lower front case 1 of general resin material such as ABS. In this way, it is not necessary to form the lower front case of magnesium, which is an external component, so that it is possible to improve the appearance and enhance manufacturability and costs.

FIG.10 is a sectional diagram showing a configuration of a lower chassis of a fold mobile phone apparatus of another embodiment of the present invention. Recent years have seen the emergence of products such as mobile phone apparatus mounting media cards including SD cards, and the growth of current consumed due to high-functionalizations such as TV telephones and moving-image playback, and the term of battery tends to shorten. With fold mobile phone apparatus, considering

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the weight balance of an upper chassis and a lower chassis, an SD card should ideally be mounted in the lower chassis. Taking this into consideration, the mobile phone apparatus of the present embodiment retains the basic configuration of the above described embodiment, and SD card connector 30 is provided between lower rear case 8 and radio circuit section 24. As obvious from FIG.10, key board 4 and circuit board 7 retain the basic configuration with little change, and so SD card connector 30 can be situated between circuit board 7 and lower rear case 8. Although the thickness of SD card connector is added to the body, this also thickens battery 9 as well so that a high-capacity battery can be used.

Next, a battery connector section for supplying power from battery 9 will be described. Battery 9 comprises battery cell 34 and battery protection circuit board 35. Horizontal battery connector 37 is mounted to circuit board 7. Horizontal battery connector 37 operates in horizontal directions with respect to circuit board 7 as shown in the figure by the arrow. Consequently, it is possible to situate battery protection circuit board 35, attached to horizontal battery connector 37 for electrical connection, parallel to the side plane of battery cell 34, that is, vertically.

Next, FIG.11 shows an example of a configuration of a lower chassis of a conventional fold mobile phone apparatus. Vertical battery connector 36 is mounted on

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the opposite side from the operating side of key circuit plane 25, and vertical battery connector 36 operates in vertical directions with respect to key circuit board 25 as shown in the figure by the arrow. Consequently, battery protection circuit board 35, attached to vertical battery connector 36 for electrical connection, can be situated longitudinally with respect to the side plane of battery cell 34, that is, horizontally, and naturally the battery becomes long in the length direction.

The present embodiment is by no means limited to the above described embodiments and various changes and modifications can be applied for implementation.

The mobile phone apparatus of the present invention adopts a configuration of a fold mobile phone apparatus comprising an upper chassis, having a display section, and a lower chassis, having an operating section, rotatably mounted via a hinge section, the apparatus comprising: an operating section, provided on an opposing plane of the lower chassis that opposes the upper chassis when folded; a circuit board, provided inside the lower chassis; and a spacer, flat and provided between the operating section and the circuit board and supported by means of a rib.

In this configuration, the stress from key pressing, bending, and twisting is supported by means of the flat spacer, so that it is possible to maintain a small and thin size and prevent damage to the circuit board and

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such.

The mobile phone apparatus of the present invention adopts a configuration of a fold mobile phone apparatus, wherein a battery is situated on a side of a circuit board seen from a spacer, and near a microphone, the microphone being in a position more remote from a hinge section than the circuit board.

In this configuration, in the lower chassis, the center of gravity becomes far from the hinge section, which improves the weight balance when held in hand, so that even a long call can be carried out without fatigue. Moreover, when the fold mobile phone apparatus has TV telephone functions and is used as laid on a desk or a table, the center of gravity becomes far from the hinge section, so that, without worry that the apparatus might tumble into the direction of the upper-situated upper chassis, a stable, fold mobile phone apparatus of a good weight balance can be obtained.

The mobile phone apparatus of the present invention adopts a configuration, wherein, on a circuit board, a control circuit is provided on a plane on a side of an operating section a radio circuit is provided on a plane of an opposite side of the operating section.

In this configuration, the control circuit is formed on the operating section side and the radio circuit is formed on the lower rear case side, so that the radio circuit, where the intrusion of electromagnetic waves

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is substantial, is covered with a shield case, and as to the control circuit, where the intrusion of electromagnetic waves is less than in the radio circuit, it can utilize the spacer, which is conductive, as a shield case, making it unnecessary to provide a dedicated shield case.

The mobile phone apparatus of the present invention adopts a configuration, wherein a spacer rib that protrudes in a direction of a circuit board is formed in a spacer and a rear case rib that protrudes in the direction of the circuit board is formed in a rear case of the lower chassis, the spacer rib and the rear case rib formed in opposing positions over the circuit board.

In this configuration, the stress on the spacer is supported by both the spacer rib and the lower rear case rib, so that it is possible to completely prevent damage to the circuit board and such.

The mobile phone apparatus of the present invention adopts a configuration, wherein a connector is installed on a circuit board, the connector supplying d power from a battery and attached to a side plane of the battery.

In this configuration, making the battery connector horizontal makes it possible to situate a battery protection circuit board vertically and shorten the length of the length direction of the battery, thereby further miniaturizing the fold mobile phone apparatus.

As described above, according to the present

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invention, by providing a flat spacer between an operating section circuit board, and by receiving the stress from key pressing operations of the operating section, bending, and twist, it is possible to realize a fold mobile phone apparatus that is small and thin yet strong and rigid.

Moreover, when new models are developed, it is relatively easy to make common basic configurations, and when a circuit board is miniaturized, the battery can be made longer that much and a high-capacity battery can be realized. Then, furthermore, there is no need to change the size of a key board, and it is possible to realize a key sheet of a handy size that takes operability into consideration and provide a highly convenient fold mobile phone apparatus.

Furthermore, considering the possibilities of further high-functionalizations such as the mounting of media cards, TV telephones, moving image playback, and music distribution, the relationship of a circuit board and a battery in the configuration enables effective use of space, which makes various developments possible.

The present invention relates to Japanese Patent Application No.2002-26479 filed on February 4, 2002, entire content of which is expressly incorporated herein by reference.

Industrial Applicability

The present invention suits for use in fold mobile

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phone apparatus.

CLAIMS

1. A fold mobile phone apparatus comprising an upper chassis, having a display section, and a lower chassis, having an operating section, rotatably mounted via a hinge section, said apparatus comprising:

an operating section, provided on an opposing plane of said lower chassis that opposes said upper chassis when folded;

a circuit board, provided inside said lower chassis; and

a spacer, flat and provided between said operating section and said circuit board and supported by means of a rib.

2. The fold mobile phone apparatus of claim 1, wherein a battery is situated on a side of said circuit board seen from said spacer, and near a microphone, the microphone being in a position more remote from said hinge section than said circuit board.

3. The fold mobile phone apparatus of claim 1, wherein, on said circuit board, a control circuit is provided on a plane on a side of said operating section, while a radio circuit is provided on a plane of an opposite side of said operating section.

4. The fold mobile phone apparatus of claim 1, wherein

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a spacer rib that protrudes in a direction of said circuit board is formed in said spacer and a rear case rib that protrudes in said direction of said circuit board is formed in a rear case of said lower chassis, said spacer rib and said rear case rib formed in opposing positions over said circuit board.

5. The fold mobile phone apparatus of claim 2, wherein a connector is installed on sad circuit board, said connector supplying power from said battery and attached to a side plane of said battery.

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# INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/01091

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H04M1/02

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)
Int.Cl[7] H04M1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

| | | | |
|---|---|---|---|
| Jitsuyo Shinan Koho | 1922-1996 | Toroku Jitsuyo Shinan Koho | 1994-2003 |
| Kokai Jitsuyo Shinan Koho | 1971-2003 | Jitsuyo Shinan Toroku Koho | 1996-2003 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | JP 2000-151136 A (Matsushita Electric Industrial Co., Ltd.), 30 May, 2000 (30.05.00), Fig. 3 & EP 1001585 A2 & US 6396923 B1 | 1-5 |
| Y | JP 10-276249 A (Sanyo Electric Co., Ltd.), 13 October, 1998 (13.10.98), Fig. 1 (Family: none) | 1-5 |
| Y | JP 8-153986 A (Toshiba Corp.), 11 June, 1996 (11.06.96), Fig. 1 (Family: none) | 1-5 |

[x] Further documents are listed in the continuation of Box C. [ ] 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
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
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"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 |
|---|---|
| 06 May, 2003 (06.05.03) | 27 May, 2003 (27.05.03) |
| Name and mailing address of the ISA/ Japanese Patent Office | Authorized officer |
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Form PCT/ISA/210 (second sheet) (July 1998)

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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP03/01091

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
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Form PCT/ISA/210 (continuation of second sheet) (July 1998)

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(12) UK Patent Application (19) GB (11) 2 383 472 (13) A

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(22) Date of Filing 21.12.2001

(71) Applicant(s)
Vertu Limited
(Incorporated in the United Kingdom)
51 East-cheap, LONDON, EC3M 1JP,
United Kingdom

(72) Inventor(s)
Mark Hutchison

(74) Agent and/or Address for Service
Nokia IPR Department
Nokia House, Summit Avenue,
Southwood, FARNBOROUGH, Hampshire,
GU14 0NG, United Kingdom

(51) INT CL[7]
H05K 7/12 // H04M 1/02 , H05K 5/02

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H1R RBP

(56) Documents Cited
JP 110331333 A
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JP 2001007550 A
US 5541448 A

(58) Field of Search
UK CL (Edition T ) H1R RBG RBP RBS RBV
INT CL[7] H04M 1/02, H05K 5/00 5/02 7/12 7/14
Other: Online: WPI, EPODOC, JAPIO

(54) Abstract Title
**A PCB mounting**

(57) A printed circuit board (50) for mounting within an electronic device has a plurality of resilient mounting members (505) such that the board may be mounted in the device without the device requiring complementary mounting members. The board with mounting members enables the device casing to be reused with future technology boards as the boards are easily replaceable within the device. Such devices are typically mobile phones, electronic diaries and notepads.

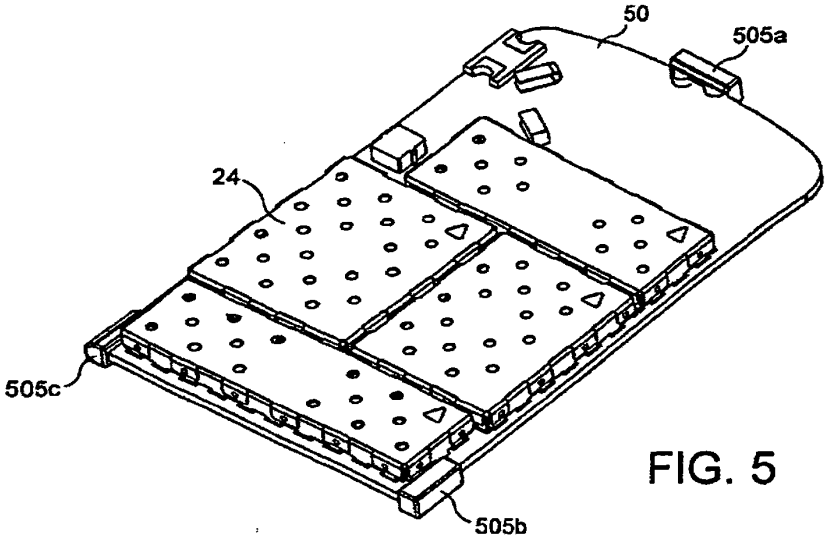



FIG. 5

GB 2 383 472 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The print reflects an assignment of the application under the provisions of Section 30 of the Patents Act 1977.

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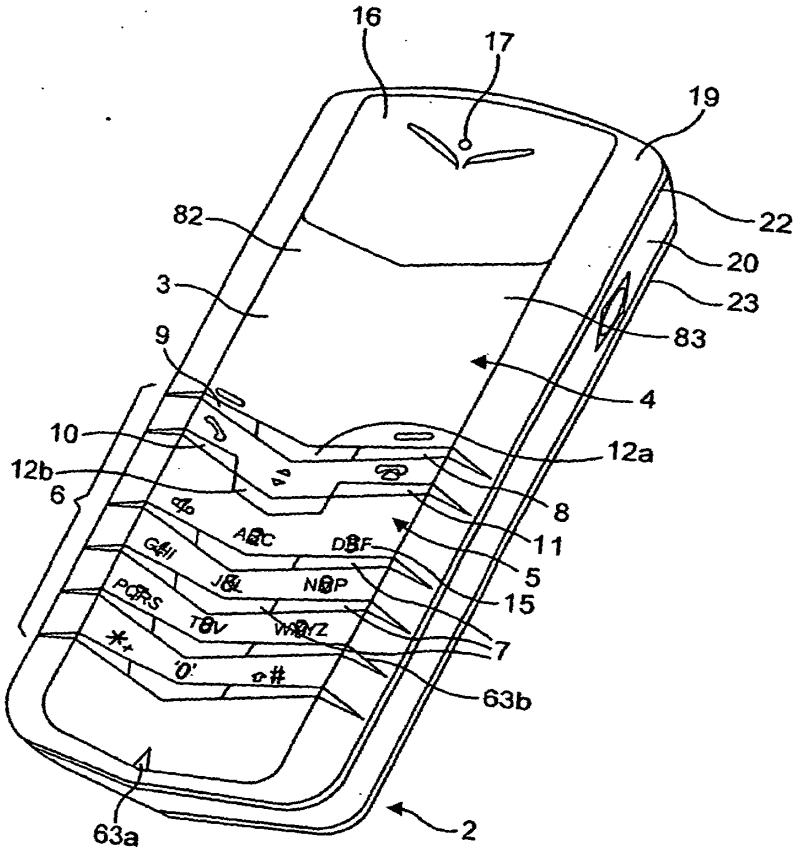



FIG. 1

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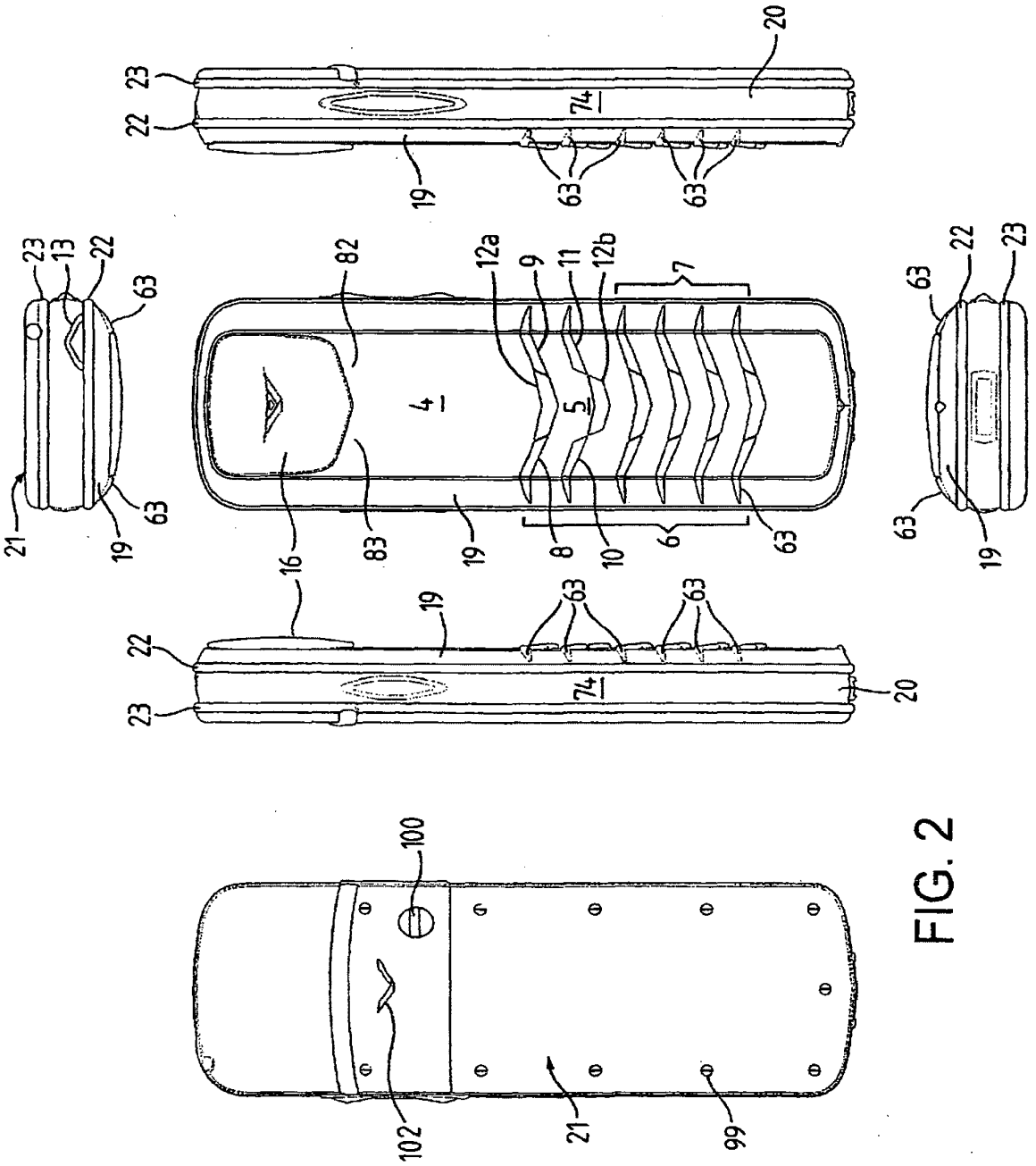

20
23
22
74
19
63
63
23
13
22
63
82
12a
9
11
12b
7
4
5
63
22
23
21
19
16
83
19
8
10
6
63
63
19
16
19
63
63
22
23
74
20
100
102
21
99

FIG. 2

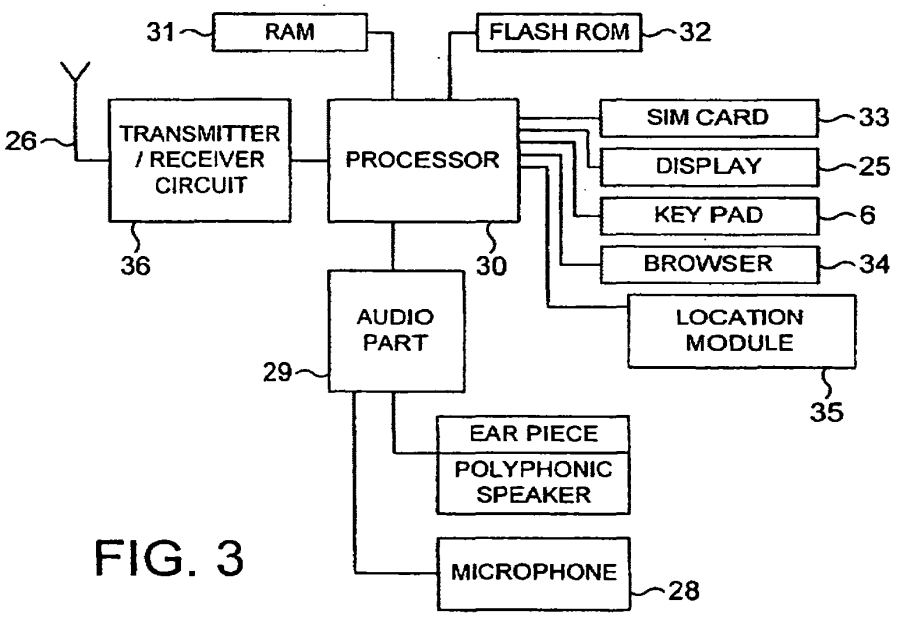

31
RAM
FLASH ROM
32
26
TRANSMITTER / RECEIVER CIRCUIT
PROCESSOR
SIM CARD
33
DISPLAY
25
KEY PAD
6
BROWSER
34
LOCATION MODULE
35
36
30
AUDIO PART
29
EAR PIECE
POLYPHONIC SPEAKER
MICROPHONE
28

FIG. 3

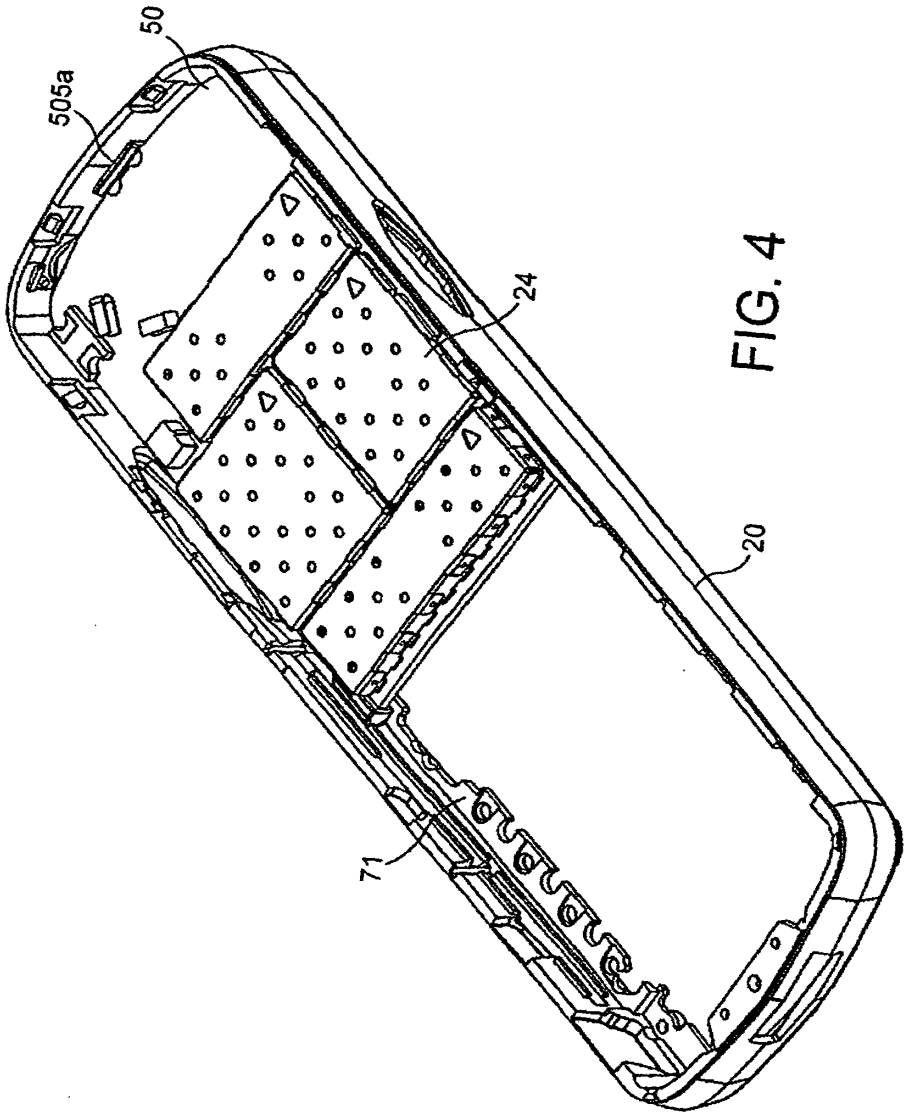



FIG. 4

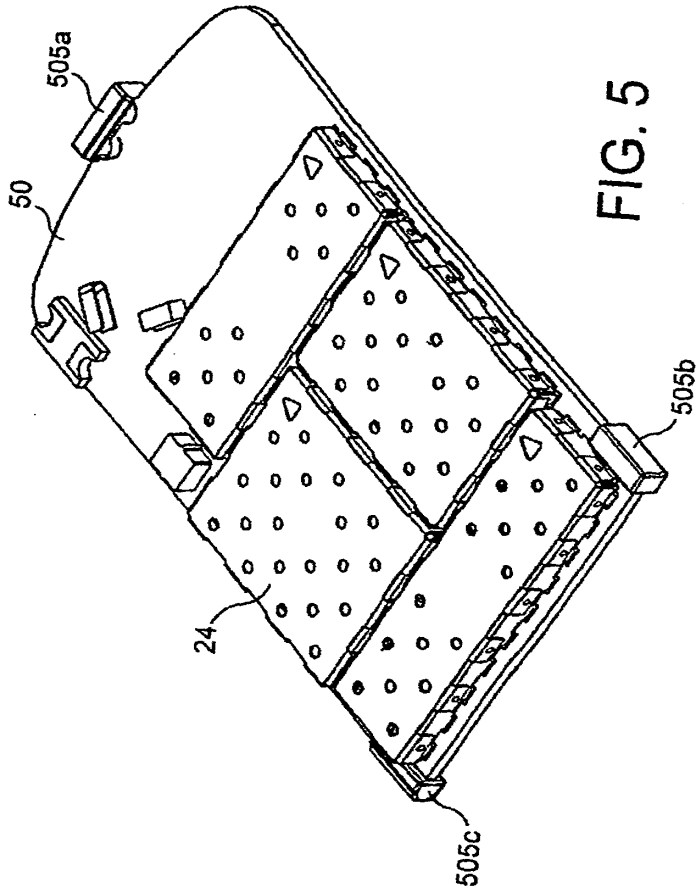



FIG. 5

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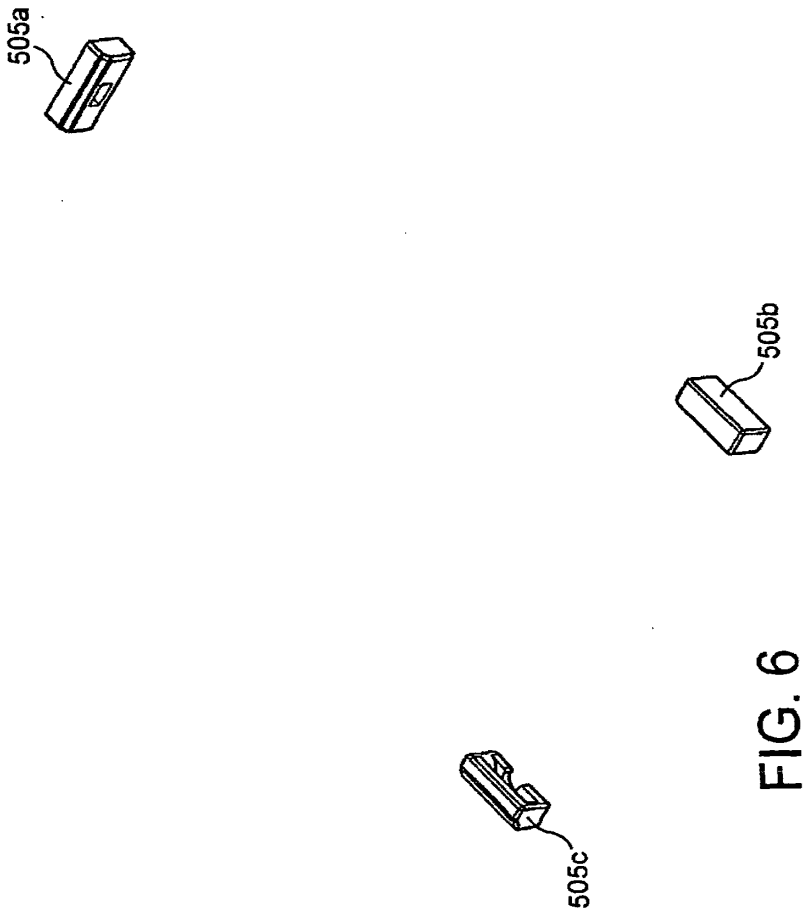



FIG. 6

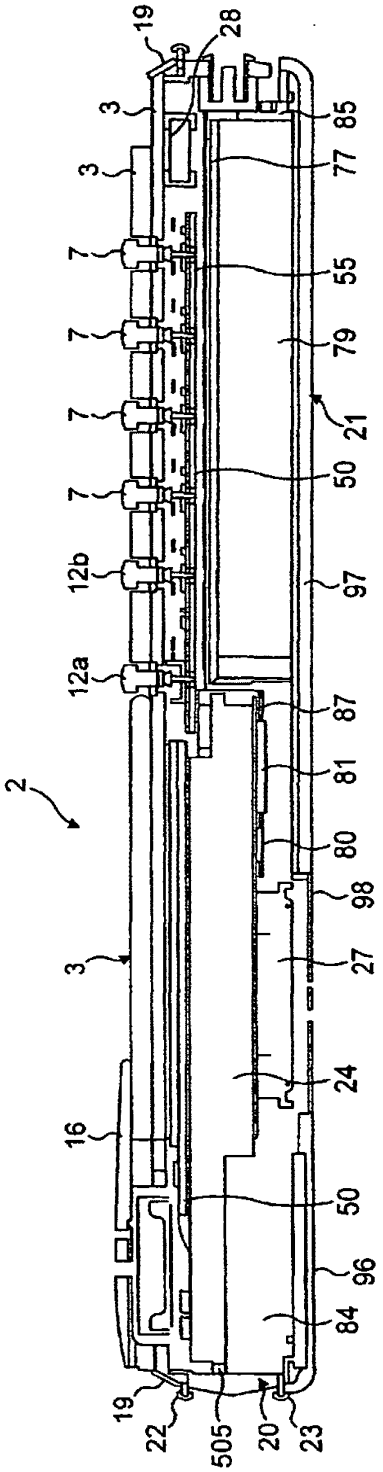



FIG. 7

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A Mounting

The invention relates to portable communication devices and in particular to mountings for such devices and associated methods.

Items of technical equipment are generally bought for their functionality. They are quickly superseded and replaced when a faster, cheaper to operate, smaller, or higher specification alternative is released onto the market, the previous model being discarded. The value of the product to its user is in what it can achieve, and perhaps to an extent the image that attaches to the owner of such an item. As fashion is constantly changing so is the image promoted by owning an individual item particularly in a fast moving technical area. What may have been the height of fashion can swiftly become out moded.

In fast moving technical areas changes are prompted by, amongst other things, the requirement to make the product smaller, cheaper, cheaper to use, have greater functionality, make use of emerging technologies or move with the latest tastes in design.

Generally when a radically new technical product is brought onto the market, for an initial period the product is elite and expensive. Consequently only limited numbers are produced. In the early years, because of the inherent rarity and the cost of components, there is a propensity to repair as much as possible. Despite the economic requirement for repair, as soon as a better product is launched, the previous item is soon obsolete and abandoned. The drive for innovation is the challenge of technical advancement and reduction of costs. This pattern has been followed with many items including the first colour televisions, and the first mobile phones.

In other products such as personal computers upgrading is a possibility, but these upgrades are possible only within carefully predefined limits. The

casings are retained as a matter of convenience, it being the retention of the maximum amount of the existing technological hardware that drives the changes.

In accordance with a first aspect of the present invention there is provided a printed circuit board for mounting within an electronic device, the board having a plurality of resilient members to mount the board within the device without requiring complementary mounting members on the device.

Thus the PCB may be mounted in a device without requiring further attachment means. This allows the electronics of an electronic device to be upgraded without requiring any changes to the casing of the device. The electronic device may be any electronic device although the invention is particularly suitable for use in portable devices or in electronic devices in which the hardware may be upgraded relatively regularly.

Preferably the resilient members are compressible. The resilient members may be made from natural or synthetic rubber.

Preferably the mounts are designed to hold the board within the casing by means of force between the mounts and surfaces of the device. The mounts may be designed to exert a force laterally against the sides of the board. Additionally or alternatively the mounts may be designed to exert a force perpendicular to the major plane of the board.

The total amount that the mounts extend around the perimeter of the board is preferably less than 25% of the perimeter of the board and may be less than 10% or 5%.

The invention also relates to a reusable casing for a personal portable communication device having an operating face carrying a user interface including a plurality of user input elements, the casing comprising housing elements defining a cavity for receiving an engine providing the electronic

functionality of the device and a battery for powering the engine and a printed circuit board according to the invention.

The casing may include elements made from precious material.

The invention also relates to a personal portable communication device including a printed circuit board according to the invention and the device may include precious material.

Devices such as mobile phones and computers have historically been designed with the foreknowledge that, within periods as short as months, more desirable products with vastly greater functionality will have overtaken the current models. The devices are accordingly built with these periods of time in mind.

The various aspects of the present invention result from a radically different approach to portable communication devices. A reusable casing for a portable communication device that may be precious, and customisable with sentimental value, turns the drives for previous innovation on their heads. In embodiments of the present invention it is the casing that is the more enduring element of a technical device.

When creating a reusable casing there are new considerations. Future engines as yet undesigned need to be accommodated. Future technologies need to be factored in. One result is that the engine size will probably not remain the same. To account for this in embodiments of the present invention the means for defining the battery cavity may be replaceable to provide different respective volumes for the battery and engine cavities. In this way as engines with greater functionality become smaller a larger battery can be utilised should this be desirable to fill the vacant space and provide a longer battery life.

By displacing the battery and the engine along the length of the casing, end-to end reductions in the size of the engine, for example, can be directly

translated into an increase in size for the battery. In conventional devices where the engine and battery are back to back, this direct correspondence does not occur as the battery size is determined by the casing itself rather than the engine size.

The casing in embodiments of the invention will be the most enduring feature of the device. It will perhaps out live a succession of engines. The display may be a replaceable module as is the engine and the battery. Alternatively the display may be one of the enduring elements of the design.

To be flexible enough for future developments the casing may be provided with external connectors allowing for greater capability than is provided for by the functionality of a current engine. This allows higher data capacity, for example, to be provided in the future when the processing capability of the engines increases. This may mean that one or more of the electrical connectors provided on the casing is not arranged to convey signals. In the interim the connector could be used for another purpose.

The casing may be a conventional one part casing or a clam shell, or other two or more part arrangement, where the user input elements or keys may be located on a different face to a display. In such two part arrangements generally respective casing portions are fixed such that one is movable relative to the other. The movement may be rotational or lateral.

When a casing is to be reusable it can be made from more valuable materials as these will not be redundant and cast aside when the next best technology comes along. A vast range of materials become available for customisation of elements of the device in fact there are virtually no bounds. Embodiments of the invention may use precious and semi precious materials including gem stones, other jewels and minerals, metals including those ranging from gold, silver, and platinum through to alloys such as steel. Materials such as ceramics in their various forms are also available for use in embodiments of the invention, the brittle nature of these materials, being able to be accommodated by the design of some embodiments. In addition, materials

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not generally considered in the context of technological devices, such as skins (leather being a particular example), wood and similar materials can also be utilised in embodiments of the invention.

As well as the materials themselves individual elements can be customised with surface decoration that could include veneers of desired materials on plastic or other subframes. The elements could have instead, or in addition, surface texture provided by a particular finish or an engraving or encrustation with gems or other stones or materials.

Embodiments of the invention will now be described in more detail with reference to Figures 1 to 7 of the accompanying drawings of which:

Figure 1 is a perspective view of a communication device showing one embodiment of the invention;

Figure 2 shows front, rear, sides and top views of the communication device of figure 1;

Figure 3 is a schematic representation of a communication device suitable for embodiments of the present invention;

Figure 4 is a perspective view of a circuit board according to the invention mounted in a casing of a portable communications device.

Figure 5 is a perspective view of a circuit board according to the invention;

Figure 6 is a perspective view of the mounts of the circuit board shown in Figure 5; and

Figure 7 is a longitudinal cross-section of the device shown in Figure 1.

Embodiments of the invention will be described in greater detail below with exemplary materials being given for some specific or individual elements of

the device. Where a material or veneer is discussed in relation to an element, the particular character of the element described is one of many or several that may be provided as options to a party commissioning a personalised device in accordance with the invention. In addition the exact material or surface decoration of the element could be individually commissioned. Although a communication device is described, the invention is applicable to any electronic device.

The embodiment illustrated in Figure 1 is a communication device 1 with a precious retainable casing 2. The casing 2 of the device has been designed to be customisable to individual taste with precious materials. To enable individual devices to be created, the number of external parts that the casing is formed from is relatively large in contrast to existing communication devices.

The casing 2 has an optically permeable front face 3 that includes a key array 6. The key array 6 includes a first group of alphanumeric keys 7, for entering telephone numbers, writing text messages (SMS), writing names (associated with phone numbers), etc. Each of the twelve alphanumeric keys 7 is provided with a figure "0-9" or a sign "#" or "*", respectively. In an alpha mode each key is associated with a number of letters and special signs used in text editing. The key array 6 additionally comprises two soft keys 8, 9, two call handling keys 10, 11, two scroll keys 12, and an on/off key 13.

The functionality of the soft keys 8, 9 may depend on the state of the communication device and position within the menu accessed using the scroll keys 12. The current functionality of the soft keys 8, 9 can be shown in separate fields in the display region 4 just above the respective keys 8, 9.

The two call handling keys 10, 11 are used for establishing a call or a conference call, terminating a call or rejecting an incoming call.

The two direction keys or scroll keys 12, in the handset illustrated, are placed centrally on the front surface of the communication device between the

display region 4 and the group of alphanumeric keys 7 and perform a scrolling function.

The seamless face 3 is formed from an optically seamless light guide providing light to illuminate the display region 4 and key legends 15 located on the light guide and associated with individual keys of the key array 6.

The front face 3 is overlaid with a pillow 16 providing apertures 17 to channel sound from a loud speaker 18 and providing an appropriate feel for an element of the device that will be located close to the user's ear. The front face 3 is surrounded by a bezel 19 that can be made from a precious metal. This acts to protect the edges of the light guide 14 and can help in some embodiments in securing the elements of the casing 2 together.

The keys of the key array in this particular embodiment are arranged to provide particular sensory guidance to the user. Aspects of the design also allow the light guide 14 to be made from a wide range of materials including those that are brittle and so need to be carefully handled and protected from shattering.

The casing 2 is formed from the front face 3 surrounded by the bezel 19, a side frame 20 and a back cover 21. The interface between the side frame 20 and the bezel 19 and the side frame 20 and the rear cover 21 are shielded by rails 22, 23 in this embodiment. The rails 22, 23 hide raw edges from view and exposure to ensure that the device 1 is both long lasting and elegant. The construction of the casing 2 enables the casing 2 to be opened with ease to update the engine 24 inside when desired. The casing 2 is also designed to allow the device to accommodate different sized and shaped engines 24, which may be necessary through its life.

Other elements of the design will be discussed in greater detail with reference to the later drawings. By way of introduction, the device will be briefly discussed with reference to its functional elements.

The communication device 1, includes the key array 6, a display 25, an antenna 26, an ear piece speaker 18, a polyphonic speaker 27, and a microphone 28. The communication device 1 is adapted for communication via a wireless telecommunication network, e.g. a wireless network. However, the communication device could also have been designed for a cordless network. Fig. 3 shows schematically and functionally elements of the communication device 1. The microphone 28 records the user's speech, and the analogue signals formed thereby are A/D converted by an A/D converter before the speech is encoded in an audio part 29. The encoded speech signal is transferred to processor 30. The processor 30 may support software in the phone. The processor 30 also forms the interface to peripheral units of the apparatus. These may include a Random Access Memory (RAM) 31 and a Flash Read Only Memory (ROM) 32, a SIM card 33, the display 25, and the key array 6, and perhaps a browser application 34, and a location module 35.

The browser application 34 can be used to request and receive information from the Internet. The location module 35 enables the terminal 1 to determine its current position.

The processor 30 communicates with a transceiver 36, e.g. a circuit, which is adapted to send and receive messages in a telecommunication network. The telecommunications network may be a GSM or W-CDMA network, but the invention may also be applied in connection with any other network, including but not limited to other kinds of wireless networks and various forms of cordless phone systems or in dual band phones accessing sets of these systems or networks. The audio part 29 speech-decodes the signal, which is transferred from the processor 30 to the earpiece 18 via a D/A converter.

The display 25 may form a permanent part of the casing or, to increase the potential for upgrading the engine throughout the life of the casing it may be a module that can be replaced to, for example, account for the inevitable improvements in graphics that may occur.

The constructed casing 2 provides a housing for the printed circuit board 50 holding the engine components 24, and a battery 79 (see Figure 7). When the device 1 is a radio telephone, the casing 2 may also provide a SIM card holder to accommodate a SIM card. For operation under some radio protocols this will clearly not be necessary. The casing 2 is completed by assembling the back cover 21 to the side frame 20.

In the embodiment described the front 3 and rear 21 casing elements are secured to the side frame 20. A silicon sealant may be extruded around the inside of the back cover 21 to prevent unwanted ingress of dirt and fluid.

The skilled man will be aware that the character described above in relation to specific elements of the device can be mixed and matched to suit many distinct design options.

Further aspects of the invention will now be described with reference to Figures 4 to 7.

Figure 4 is a perspective view of a printed circuit board (PCB) 50 according to the invention mounted in a casing of a portable communications device. The circuit board 50 is mounted in the casing in a removable manner as will be described below. The casing comprises a frame member 20 that forms the side of the device. The side frame member 20 may be visible to an end user or other side elements of a more attractive nature may cover the side frame member.

The side frame member 20 has a flange 71 that forms a rest for the PCB. The PCB is held within the casing by mounts 505 a, b, c. These mounts can be seen more clearly in Figures 5 and 6. Figure 5 shows a printed circuit board having mounts in accordance with the invention. The printed circuit board 50 has engine components 24 mounted on one or both surfaces and is of a suitable size to fit within the recess provided by the side frame member 20.

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Figure 6 shows the mounts 505 in more detail. The mounts are resilient and preferably slightly compressible and are preferably formed of a natural or synthetic rubber material. The mounts hold the PCB within the casing by means of the force between the mounts and the sides 20 of the casing. In the embodiments illustrated, this force is exerted laterally against the sides of the PCB. However it is also envisaged that additionally or alternatively the mounts may result in a force exerted perpendicular to the major plane of the PCB.

The mounts as shown are rectangular in cross-section. It is believed that this provides the optimum compression forces for the least number of mounts. However other shaped mounts may be used, for instance ones of a circular cross section. A reduction in contact area between the mounts and the device surface may mean that an increased number of mounts is necessary.

It should be noted that the resilient mounts 505 provide shock absorbency for the PCB as well as being the only means of mounting the PCB within the casing. The PCB is not held with screw fittings or the like. This provides the advantages that the PCB itself does not have to be designed to fit snugly within particular sized recesses within the casing or to match screw holes provided on the side member frame of the casing. Thus the PCB and hence the engine can be easily upgraded without having to re-design or reproduce the casing for the phone. The resilient mounts 505 simply need to be of such as size and have sufficient resilience to hold the PCB within the casing by compression forces.

The mounts only extend for a small proportion of the perimeter of the PCB, for instance less than 25% and more likely less than 10% of the perimeter.

Although the drawings show three mounts it should be clear to a person skilled in the art that any suitable number may be used. For instance two or more mounts may be used as required, so long as the board is held within the casing as required.

As shown in Figures 1 and 7, the reusable casing 2 for a personal portable communication device has a user interface 6 including a plurality of user input elements 7. The casing has housing elements 3, 19, 20, 21, an engine 24 for providing the electronic functionality of the device and a battery 79 for powering the engine. The housing elements are releasably attached one to another to provide access to the interior of the casing. A dividing member 87 defines a battery cavity 85 accessible to the user and an engine cavity 84. The dividing member 87 also accommodates a connection between the battery 79 and the engine 24. The mounts 505 (only one of which is shown in Figure 7) mount the engine PCB 50 within the engine cavity 84 in a removable manner. The device also includes a PCB 55 for the key array 6. This PCB is also held within the casing by rubber mounts as described above with reference to PCB 50. The battery 79 may also be provided with similar mounts.

The casing 2 has a rear cover 21 and internal compartments 84, 85 suitable for retaining the engine 24, the battery 79 and in this embodiment a SIM card 81. The device illustrated, in common with many other radio telephones, advantageously allows access to the battery compartment 85 as the battery 79 may periodically need replacement. Along side the battery compartment 85 in this embodiment is the SIM card holder 80. Under protocols where a SIM card 81 is used to hold subscription information, the user may wish to remove the SIM card 81. For this reason it is convenient for the back cover 21 to be removable to expose both the battery 79 and the SIM card 81. The battery compartment 85 and SIM card holder 80 are provided by an internal dividing element in the form of casing element 87 that is secured to the side frame 20. This may be formed from plastic or one of many other suitable materials. In one embodiment the compartments are formed from stamped metal sheet. Titanium and aluminium are two from the numerous suitable materials.

The portable communication device may be modified by removing the engine 24 from the casing and replacing the engine with another engine having hardware providing a different predetermined processing capability. This may

mean that the dividing element 87 is moved to allow for an engine and/or a battery of a different size e.g. a larger engine 24 and a smaller battery 79 or vice versa. The invention means that this new PCB does not have to be manufactured to fit with any existing fixing means (e.g. screw holes) on the casing. In a conventional arrangement, where the PCB is screwed or clipped into the housing, it would be necessary to ensure that the new PCB has screws or fixing means in positions that corresponded to the complementary fixing means on the casing. However this is not the case with the present invention in which resilient mounts are provided which do not require complementary parts on the casing. Thus if the dividing element 87 is moved, this does affect the mounting means used.

Aspects of the invention have been discussed with reference to a radio telephone function. It will be clear to the skilled man that these aspects apply equally to other electronic devices, such as (but not limited to) other portable communications devices supporting in addition or as an alternative other functions, such as, amongst others electronic diaries, and electronic notepads.

In the future, although the casing will probably be maintained in substantially the same condition, the engine could be replaced with an engine that perhaps has greater processing power or allows for different functionality, for example improved graphics. To replace the engine will be a relatively simple manner of removing the existing engine and replacing it with a new one. The battery and internal casing walls may be changed at the same time if greater battery volume is then possible.

The present invention includes any novel feature or combination of features disclosed herein either explicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention.

**Claims**

1. A printed circuit board for mounting within an electronic device, the board having a plurality of resilient members to mount the board within the device without requiring complementary mounting members on the device.

2. A board as claimed in claim 1 wherein the resilient members are compressible.

3. A board as claimed in claim 1 or 2 wherein the resilient members are made from natural or synthetic rubber.

4. A board as claimed in claim 1, 2 or 3 wherein the mounts are designed to hold the board within the casing by means of force between the mounts and surfaces of the device.

5. A board as claimed in claim 4 wherein the mounts are designed to result in a force exerted laterally against the sides of the board.

6. A board as claimed in claim 4 or 5 wherein the mounts are designed to result in a force exerted perpendicular to the major plane of the board.

7. A board as claimed in any preceding claim wherein the total amount that the mounts extend around the perimeter of the board is less than 25% of the perimeter of the board.

8. A board as claimed in any preceding claim wherein the total amount that the mounts extend around the perimeter of the board is less than 10% of the perimeter of the board.

9. A board as claimed in any preceding claim wherein the total amount that the mounts extend around the perimeter of the board is less than 5% of the perimeter of the board.

10. A reusable casing for a personal portable communication device having an operating face carrying a user interface including a plurality of user input elements, the casing comprising:

housing elements defining a cavity for receiving an engine providing the electronic functionality of the device and a battery for powering the engine;

a printed circuit board as claimed in any preceding claim.

11. A casing according to claim 10 wherein the casing further comprises means for attaching the housing elements one to another to provide access to the cavity for receiving the engine;

a dividing member for defining a battery cavity accessible to the user and an engine cavity, the dividing member accommodating a connection between the battery and the engine;

12. A reusable casing according to claim 11 wherein the means for defining the battery cavity is replaceable to provide different respective volumes for the battery and engine cavities.

13. A reusable casing according to claim 10, 11 or 12 wherein the battery and the engine are displaced along the length of the casing.

14. A reusable casing according to any of claims 10 to 13 wherein the design of a replacement means for receiving the engine and battery is dependent upon the size and shape of a second engine and battery pair.

15. A reusable casing according to any of claims 10 to 14 wherein the casing includes elements made from precious material.

16. A personal portable communication device including a printed circuit board as claimed in any of claims 1 to 9.

17 A personal portable communication device according to claim 15 wherein the device includes precious material.

18 A personal portable communication device comprising an engine and a reusable casing according to any of claims 10 to 15.

19. A printed circuit board substantially as hereinbefore described with reference to figures 3 to 6 of the accompanying drawings.

20. A casing substantially as hereinbefore described with reference to figures 1 to 6 of the accompanying drawings.

21. A portable communication device substantially as hereinbefore described with reference to figures 1 to 6 of the accompanying drawings.

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**Application No:** GB 0130746.1 **Examiner:** S M Colcombe
**Claims searched:** 1-18 **Date of search:** 11 September 2002

# Patents Act 1977
# Search Report under Section 17

**Databases searched:**

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.7): H04M, H05K

Other: Online: WPI, EPODOC, JAPIO

**Documents considered to be relevant:**

| Category | Identity of document and relevant passage | | Relevant to claims |
|---|---|---|---|
| A | US 5541448 | (CARPENTER) | |
| A | US 5537294 | (SIWINSKI) | |
| X | JP 2001007550 | (NIPPON ELECTRIC) Abstract | 1, 2 at least |
| X | JP 2000133973 | (NIPPON ELECTRIC) Abstract | 1, 2 at least |
| X | JP 110331333 | (NEC) Abstract | 1, 2 at least |

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(71) Applicant: **Nokia Corporation**
**02150 Espoo (FI)**

(72) Inventors:
- **Hinge, Kevin**
  **Woking, Surrey GU24 9SR (GB)**
- **Boman, Petri**
  **Farnborough, Hants GU14 0RH (GB)**

(74) Representative: **Read, Matthew Charles et al**
**Venner Shipley & Co.**
**20 Little Britain**
**London EC1A 7DH (GB)**

## (54) Housing for an electronic device

(57) A housing for an electronic device is disclosed and comprises a unitary tubular body (1) having an open end (2) for insertion of electronic componentry therein. Preferably, the housing is for a mobile telecommunications device.

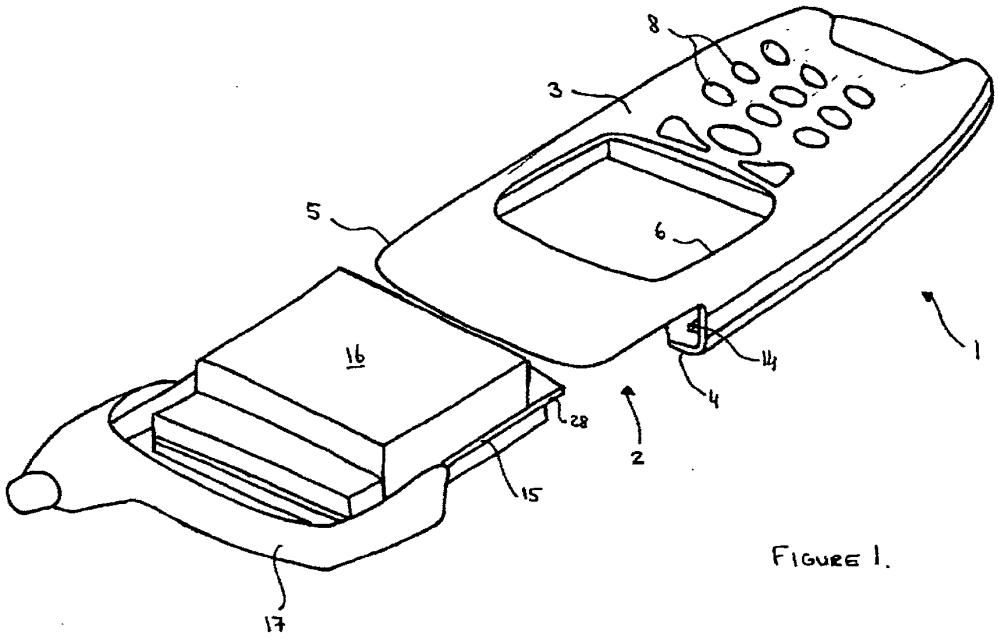



FIGURE 1.

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## Description

**[0001]** The present invention relates to a housing for an electronic device and, particularly but not exclusively, to a housing for a mobile telecommunications device such as a mobile telephone.

**[0002]** A housing for a mobile telephone generally comprises a front and a rear casing. The electronic circuitry and other components of the telephone are mounted on one casing and the other casing part fits over it in a back-to-back relationship to form an enclosure around the circuitry and components. The two casing halves are attached to each other and are separable to enable access to the interior of the telephone for maintenance and other requirements such as insertion or removal of a SIM card. Additionally, design conscious consumers often prefer to personalise their telephone by replacing one or both parts of the casing with another of a different colour so it is important that a consumer can separate the casing portions without difficulty. Screws or clips may be used to attach the two casing halves together.

**[0003]** A disadvantage with a conventional housing such as that described above is that the join between the two housing portions extends all the way around the assembled telephone housing and is clearly visible. This compromises the design and appearance of the telephone thereby reducing the overall quality and feel of the product to consumers. Furthermore, the housing of a mobile telephone is subject to considerable wear and must not break too readily when inadvertently dropped. As the conventional housing is formed in two back-to-back parts releasably joined together, the overall strength and rigidity of the housing is reduced thereby increasing the likelihood that one or both parts will break on impact. It is possible to increase the strength and rigidity of a conventional housing by increasing the thickness of the materials from which the casing is made. However, this results in an increase in overall weight which also needs to be kept to a minimum.

**[0004]** It is one object of the present invention to overcome or alleviate the aforementioned disadvantages associated with a conventional housing for an electronic device.

**[0005]** According to the present invention, there is provided a housing for an electronic device comprising a unitary tubular body having an open end for insertion of electronic components therein.

**[0006]** The housing preferably includes a member for closing the open end of the tubular body.

**[0007]** The member is advantageously configured to support electronic components thereon. The electronic components may include a printed circuit board.

**[0008]** In a preferred embodiment, a portion of the inner peripheral wall of the member includes a recess to receive a transducer module.

**[0009]** A guide is formed on the body to receive and support electronic components mounted on the member. In one embodiment, the guide means is a rail.

**[0010]** Preferably, the body includes a plurality of apertures in one face to receive the keys of a keymat mounted on an inner wall of the body, and an opening in the other face opposite the apertures to receive a battery pack.

**[0011]** The body preferably also includes means to releasably secure a keymat retaining plate over the keymat.

**[0012]** In a preferred arrangement, a portion of the body overlaps the member, said body and member including co-operating means to mount the member on the body.

**[0013]** The co-operating means conveniently includes a flange on the member that forms an interference fit with the body.

**[0014]** Preferably, a lock is provided for releasably securing the member mounted to the body. The lock can include an aperture in the member and a boss in the body, fastening means being insertable through the aperture for engagement in the boss.

**[0015]** The present invention also relates to an electronic device incorporating the housing of the invention. Most preferably, the electronic device is a mobile telecommunications device.

**[0016]** The electronic device preferably includes a keymat, a keymat retaining plate and a battery pack, the retaining plate being configured such that the keymat is biased against the housing by the retaining plate when the battery pack is mounted in the housing.

**[0017]** In a preferred embodiment, the retaining plate includes resiliently deformable regions raised out of the plane of the plate, said regions being deflected back towards the plane of the plate by the battery pack when mounted in the housing, thereby biasing the keymat against the housing.

**[0018]** The resiliently deformable regions are preferably a plurality of spaced parallel ribs.

**[0019]** The present invention also relates to a method of forming a housing according to the invention for an electronic device according to the invention by permanently attaching at least two housing portions together.

**[0020]** The housing portions may be attached to each other by welding.

**[0021]** Alternatively, the housing portions may be attached by adhesive bonding.

**[0022]** The present invention also relates to a method of forming a housing for an electronic device both according to the invention, including the step of forming the housing in one piece.

**[0023]** In one embodiment, the housing is formed by extrusion.

**[0024]** In another embodiment, the housing is formed from sheet metal.

**[0025]** Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings, in which:



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FIGURE 1 illustrates a perspective view of the housing of a mobile telephone of the invention together with a module shown removed from the open end of the housing, the module carrying the electronic componentry of the telephone;

FIGURE 2 illustrates a perspective view of the underside of the housing shown in Figure 1 together with the keymat, keymat retaining plate before insertion into the housing;

FIGURE 3 illustrates a perspective view of the underside of the module shown in Figure 1;

FIGURE 4 illustrates a perspective view of the transducer module for fitting to the module illustrated in Figure 3; and

FIGURE 5 illustrates a partial cross-section through the housing with the keymat, retaining plate and battery fitted thereto.

**[0026]** Referring now to the drawings, there is shown in Figure 1 and 2 a housing for a mobile telephone comprising a rigid unitary tubular body 1 open at one end 2. The front face 3 extends forward of the rear face 4 to form an overhang 5. The front face includes an aperture 6 for attachment of a transparent window 7 by laser welding ( part of the window is shown fitted in the aperture 6, in Figure 2). Beneath the aperture 6 on the front face 3 is an array of smaller openings 8 through which the keys 9 of a keymat 10 may protrude. The rear face 4 has a rectangular aperture 11 therein opposite the array of smaller openings 8 in the front face 3 for insertion of a keymat 10, a keymat retaining plate 12 and a battery pack 13 in the order and direction shown by arrow A in Figure 2. These components will be explained in more detail hereinafter.

**[0027]** The body 1 includes integrally moulded guide rails 14 formed along each inside edge between the front and rear faces 3,4 to support a printed circuit board 15 and other electronic components 16 such as a liquid crystal display within the body 1. These components are mounted to a module 17 that fits over the open end 2 of the body 1 and interfaces with the edge of the open end 2 to close the body 1. The module 17 has an integrally moulded "U"-shaped clip 18 to receive and support the edge of the printed circuit board 15 and a spigot 16 to support its underside. Other electronic components are mounted to the PCB 15.

**[0028]** The module 17 includes an integrally formed boss 18 therein through which the antenna of the mobile telephone may extend. A portion 19 of the inner peripheral wall 20 of the module 17 is recessed to receive a transducer module 21 illustrated in Figure 4, and has a first elongate port 22 to allow for the transmission of infra-red waves through the module 17 from an emitter (not shown) mounted to the rear face 23 of the transducer module 21 that has a corresponding opening 24. Two further circular openings 25,26 are provided in the recess to receive an on/off key (not shown) and to allow for transmission of sound through the module 17 from a transducer (not shown). The transducer and on/off key are both mounted to the rear face 23 of the transducer module 21 which is provided with openings 25a,26a that correspond to the openings in the module 17.

**[0029]** The transducer module 21 is "L" shaped to fit the recess 19 in the peripheral wall 20 of the module 17 and has a reinforcing web 21a to increase its rigidity. A flexible electrical connector 27 extends from the transducer module 21 which connects to an interface on the printed circuit board 15.

**[0030]** The edge 28 of the printed circuit board 15 mounted to the module 17 locates on the top surface of the guide rails 14 and is slideably received within the body 1. When fully inserted into the body 1, the overhang 5 covers the electronic components and PCB 15 on the module 17 and closes the open end 2 of the body 1. The liquid crystal display is visible through the window 7 in the aperture 6 when the module 17 is located on the body 1. The module 17 includes a pair of apertures 29 therein and the body 1 has a pair of corresponding bosses 30 that are in alignment when the module 17 is fitted to the body 1. Conventional screws 31 (not shown) extend through the apertures 29 and are threadingly engaged in the bosses 30 to releasably secure the module 17 to the body 1.

**[0031]** Referring now to Figure 2 and Figure 5, the keymat 10 is disposed within the body 1 such that the keys 9 protrude through the apertures 8 in the front face 3. The keymat 10 is maintained in position using a layer of adhesive 32 interspersed between the body 1 and the keymat 10. The keymat 10 is positioned within the body 1 by inserting it through the rectangular aperture 11 in the rear face 4. To further retain the keymat 10 in position, the retaining plate 12 is positioned above the keymat 10 and locates under tabs 34 integrally formed on the body 1 between the front and rear faces 3,4. The retaining plate 12 is made from a resilient plastics material such as polyurethane and is a snap-fit under tabs 34.

**[0032]** The retaining plate 12 comprises an end portion 35 bent at right angles to the plane of the plate 12. A support block 36 is mounted to end portion 35 and cooperates with the closed end of the casing to further hold the retaining plate 12 in position in the body 1. Three ribs 40 are deformed out of the plane of the plate 12 directly above the keys 9. As is clearly shown in Figure 5, when the battery pack 13 is inserted into the aperture 11, the ribs 40 are compressed (see rib 40a in Figure 5) by the underside 41 of the battery pack 13 to urge the plate 12 against the keymat 10, and the keymat 10 against the body 1. When the battery pack 13 is removed, the resilient nature of the material from which the plate 12 is made causes the ribs 40 to spring back into their original shape, as shown by rib 40 in Figure 5.

**[0033]** The retaining plate 12 includes an arm 45 that extends laterally from the other end of the plate 12. The printed circuit board 15 contacts the arm 45 when inserted into the body 1 to provide additional support for the



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printed circuit board 15 and the retaining plate 12.

**[0034]** The battery pack 13 is inserted into the body 1 through the aperture 11 from above (in the direction shown by arrow A in Figure 2) and the outer cover 46 of the back of the battery pack 13 locates within the edges of the aperture 11. A moulded lip 47 on the cover 46 engages beneath the rear face 4 of the body 1 to retain the battery pack 13 in position.

**[0035]** The body 1 of the housing may be formed using a number of different methods. For example, it may be made in two parts which are subsequently permanently attached together by laser or ultrasonic welding, MIG or TIG welding or by using adhesive along their interface. Alternatively, the body 1 can be formed in one piece by extrusion, by injection moulding or by sheet metal forming. The body 1 can be made from either plastics material or metal.

**[0036]** Many modifications and variations of the invention falling within the terms of the following claims will be apparent to those skilled in the art and the foregoing description should be regarded as a description of the preferred embodiments only.

## Claims

1. A housing for an electronic device comprising a unitary tubular body having an open end for insertion of electronic components therein.

2. A housing according to claim 1, including a member for closing the open end of the tubular body.

3. A housing according to claim 2, wherein the member is configured to support electronic components thereon.

4. A housing according to claim 3, wherein the member includes a support for locating and retaining a printed circuit board thereon.

5. A housing according to claim 4, wherein said support includes an integrally moulded clip to receive the edge of a printed circuit board and a location spigot to support the underside thereof.

6. A housing according to any of claims 2 to 5, wherein a portion of the inner peripheral wall of the member includes a recess to receive a transducer module.

7. A housing according to any of claims 2 to 6, including a guide on the body to receive and support electronic components mounted on the member.

8. A housing according to claim 7, wherein the guide is a rail.

9. A housing according to any preceding claim, wherein the body includes a plurality of apertures in one face to receive the keys of a keymat mounted on an inner wall of the body, and an opening in the other face opposite the apertures to receive a battery pack.

10. A housing according to claim 9, wherein the body includes means to releasably secure a keymat retaining plate over the keymat.

11. A housing according to claim 10, wherein said means comprises an integrally formed tab on the body for location of the retaining plate thereunder.

12. A housing according to claim 11, wherein the retaining plate is formed from a resilient flexible material and is a snap fit beneath the integrally formed tab on the body.

13. A housing according to any of claims 2 to 12, wherein a portion of the body overlaps the member, said body and member including co-operating parts to mount the member on the body.

14. A housing according to claim 13, wherein the co-operating parts includes a flange on the member that forms an interference fit with the body.

15. A housing according to claim 13, including a lock for releasably securing the member mounted to the body.

16. A housing according to claim 15, wherein said lock includes an aperture in the member and a boss in the body, fastening means being insertable through the aperture for location in the boss.

17. An electronic device incorporating the housing according to any preceding claim.

18. An electronic device according to claim 17, comprising a mobile telecommunications device.

19. An electronic device according to claim 18, including a keymat, a keymat retaining plate and a battery pack, the retaining plate being configured such that the keymat is biased against the housing by the retaining plate when the battery pack is mounted in the housing.

20. An electronic device according to claim 19, wherein the retaining plate includes resiliently deformable regions raised out of the plane of the plate, said regions being deflected back towards the plane of the plate by the battery pack mounted in the housing, thereby biasing the keymat against the housing.

21. An electronic device according to claim 20, wherein



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said resiliently deformable regions are a plurality of spaced parallel ribs.

22. A method of forming a housing comprising a unitary tubular body having an open end for insertion of electronic components therein, the method including the step of permanently attaching at least two housing portions together to form said unitary body.

23. A method according to claim 22, wherein the portions are attached by welding.

24. A method according to claim 22, wherein the portions are attached by adhesive bonding.

25. A method of forming a housing according to any of claims 1 to 16 for an electronic device according to any of claims 17 to 21, including the step of forming the housing in one piece.

26. A method according to claim 25, wherein the housing is extruded.

27. A method according to claim 25, wherein the housing is formed from sheet metal.



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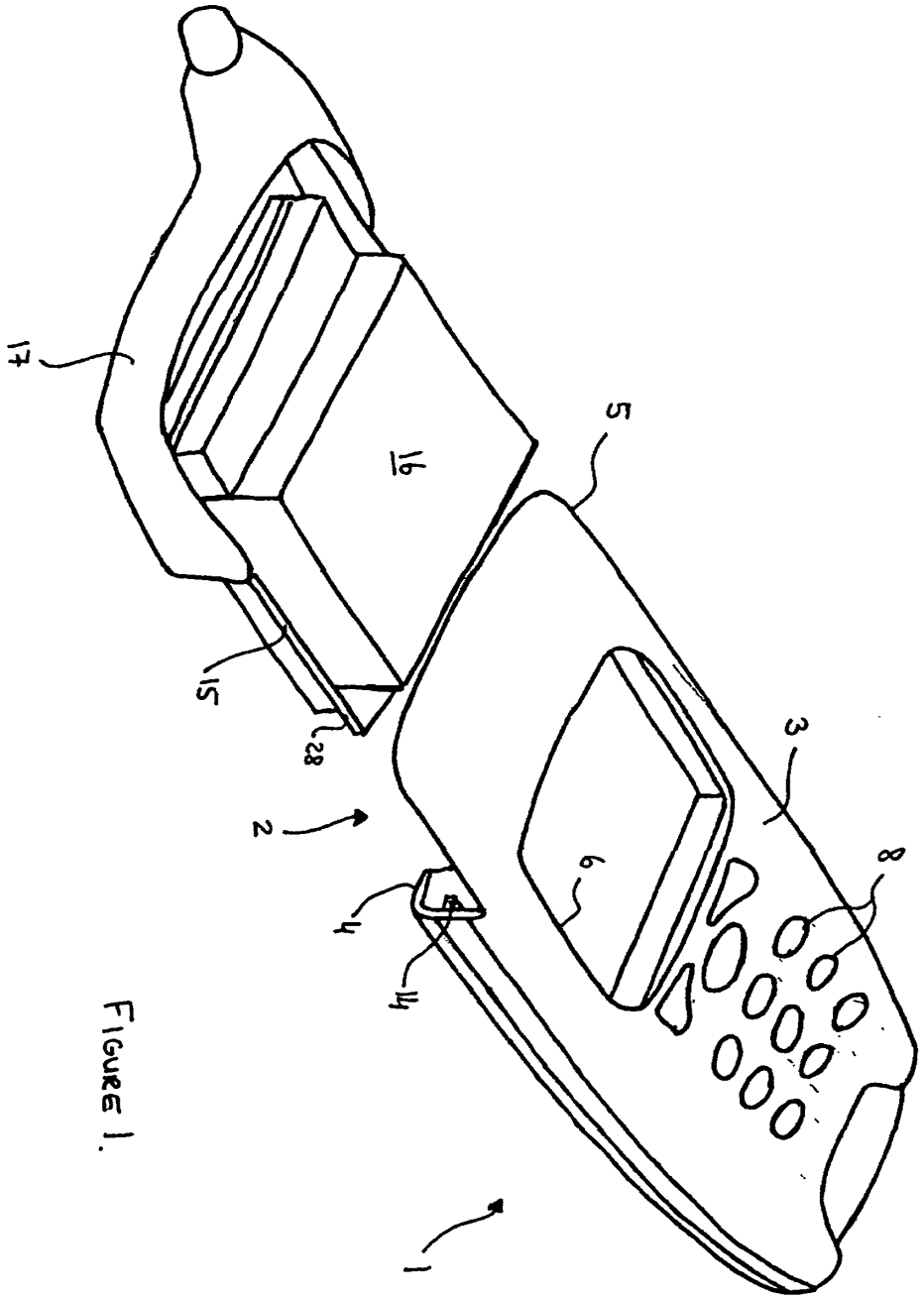



FIGURE 1.



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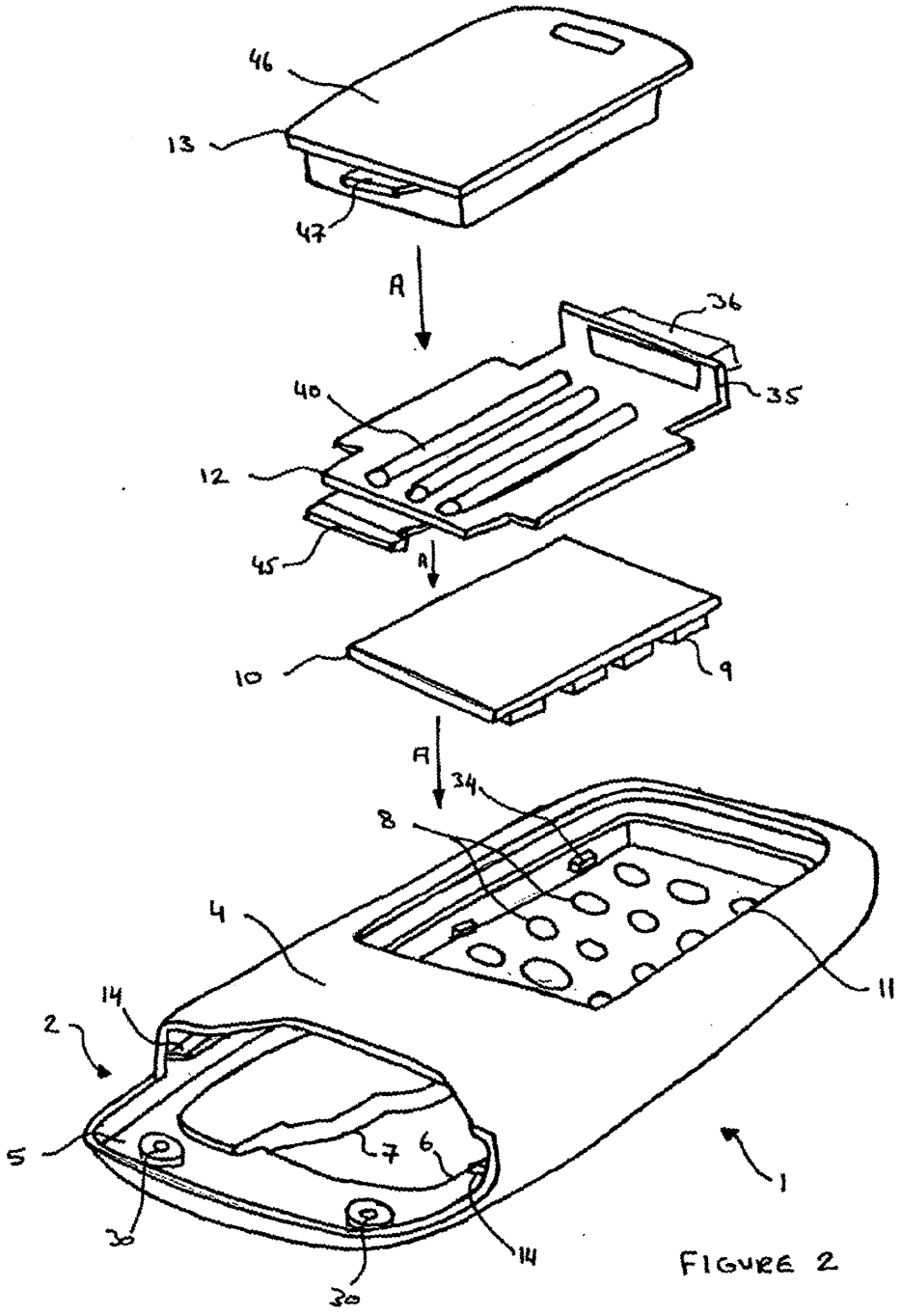



FIGURE 2



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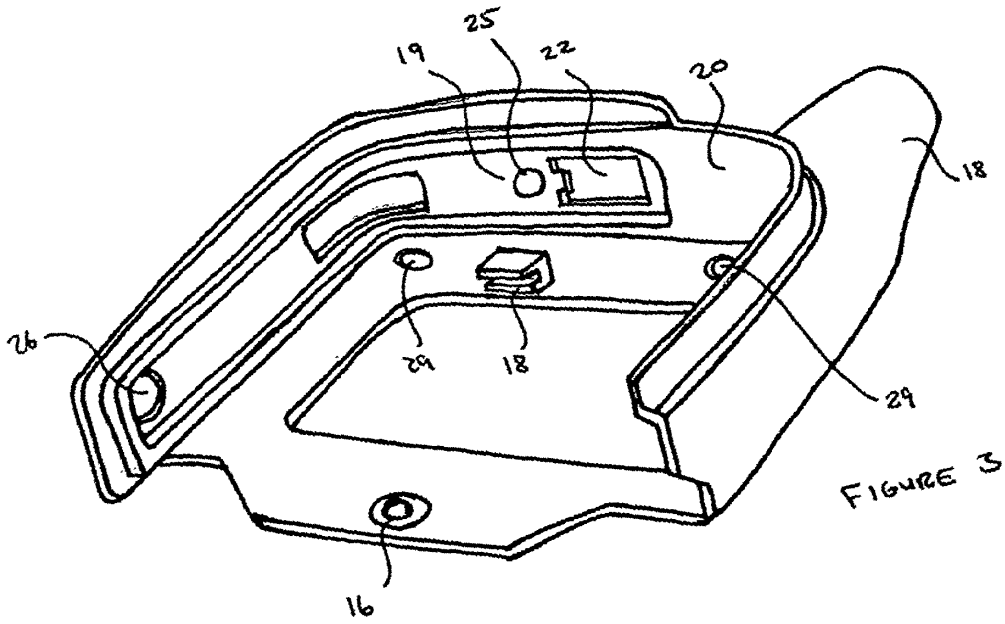



FIGURE 3

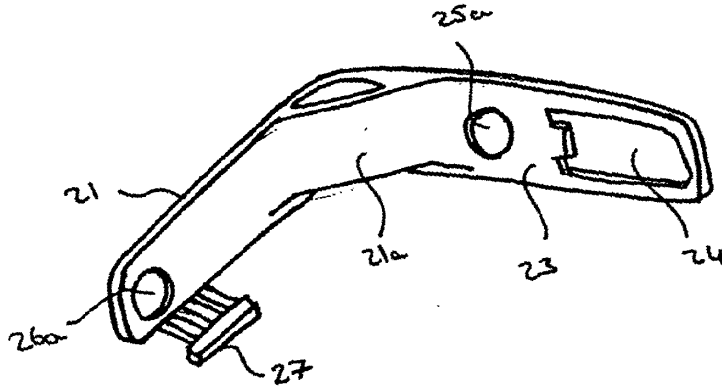



FIGURE 4



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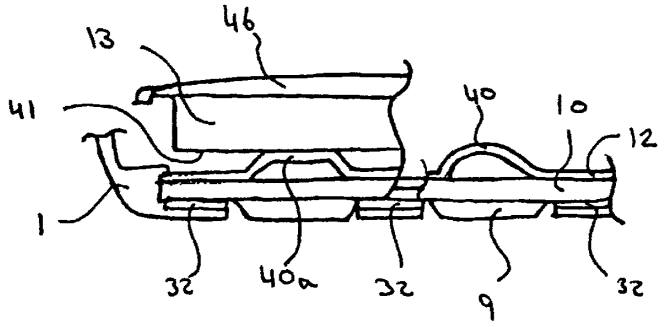



FIGURE 5



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(71) Applicant: **MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.**
**Kadoma-shi, Osaka 571-8501 (JP)**

(72) Inventors:
- **SATOH, Noriyoshi**
  **Yokohama-shi, Kanagawa 223-0056 (JP)**
- **YAMAGUCHI, Seiya**
  **Yokohama-shi, Kanagawa 222-0001 (JP)**
- **TANAKA, Yasuyuki**
  **Yokohama-shi, Kanagawa 224-0054 (JP)**

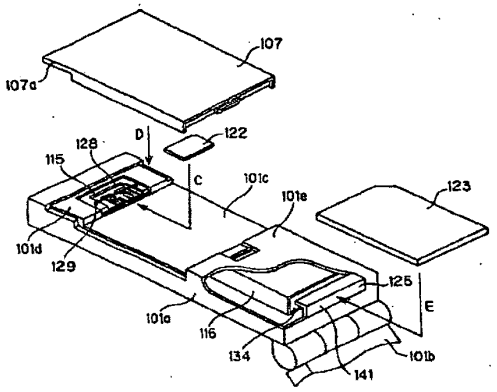
(74) Representative: **Grünecker, Kinkeldey,**
**Stockmair & Schwanhäusser Anwaltssozietät**
**Maximilianstrasse 58**
**80538 München (DE)**

# (54) PORTABLE TERMINAL

(57) An object of the invention is to provide a portable telephone which is easily detachable an information recording medium while avoiding the enlargement of its size.

The portable telephone according to the invention includes a battery attachment portion (101c) of a concave shape to which a battery (107) is attached, a step portion (101d) protruded in the drawing-out direction (opposite direction to an arrow D in the figure) of the battery (107) with respect to the bottom surface of the battery attachment portion (101c), a UIM card connector (115) which is disposed near the surface extending across the corners of the step portion 101d and has a configuration that the one major surface of a UIM card (122) exposes on the surface of the step portion (101d) at the time of attaching the UIM card (122), and a battery cover (107a) which covers the step portion (101d) and the battery attachment portion (101c) at the time of attaching the battery (107).

*FIG. 7*




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## Description

<Technical Field>

**[0001]** The present invention relates to a portable terminal capable of attaching an information recording medium thereto.

<Background Art>

**[0002]** In recent years, devices accorded to the W-CDMA system employed in the third generation portable telephones have been developed and commercialized. A portable telephone accorded to the W-CDMA system is arranged so that an IC card (subscriber identification information card) such as a SIM (Subscriber Identity Module) card or a UIM (User Identity Module) card in which information (telephone number, ID and charging information etc. of a subscriber) is recorded can be attached to the telephone. By using the information recorded in the IC card, a portable phone can be used always in the same circumstance without depending on the hardwares different at every kinds of portable phones.

**[0003]** As a conventional portable phone to which the subscriber identification information card can be attached, there is a portable phone disclosed in JP-A-10-336292.

**[0004]** Fig. 11 is a rear vies of a conventional portable phone.

**[0005]** As shown in the figure, a portable telephone 200 has a battery attachment portion 203 of a concave shape. The battery attachment portion 203 is configured by a bottom surface 204 and a vertical wall 205 erected vertically from the bottom surface 204. An opening 206 which is protruded with respect to the bottom surface 204 is formed at the lower end side of the vertical wall 205. A card holder to which the subscriber identification information card is attached is inserted into the opening 206. The opening 206 is provided with finger insertion recess portions 208a and 208b at the both ends of the front panel portion 207 of the card holder, respectively, which is disposed at the center of the opening. When a user of the portable telephone 200 inserts the thumb 209a into the finger insertion recess portion 208a and inserts the forefinger 209b into the finger insertion recess portion 208b thereby to fasten and draw out the front panel portion 207 by both the fingers, the subscriber identification information card can be drawn out.

**[0006]** However, in the conventional portable telephone, the subscriber identification information card can not be drawn out without inserting the fingers near the bottom surface 204 of the battery attachment portion 203. Thus, for a person having large hands or a woman having long nails etc., the fingers can hardly be inserted into the finger insertion recess portions 208a and 208b, so that the subscriber identification information card can not be drawn out easily. In order for any person to draw out the subscriber identification information card easily, the finger insertion recess portions 208a and 208b are required to be made larger in their sizes and so there arises a problem that the portable telephone 200 is inevitably made large in its size.

**[0007]** Further, in recent years, a digital video camera and a notebook computer etc. to each of which a information recording card such as a MMC (Multi Media Card: trade mark) or a SD (Super Density: trade mark) card capable of recording audio information, image information and character information etc. therein can be attached have been commercialized. Thus, hereinafter, the third generation portable telephone has been desired to have the structure capable of also being attached with these information recording cards.

**[0008]** The invention has been made in view of the aforesaid problem of the conventional technique and an object of the invention is to provide a portable telephone which is easily detachable an information recording medium while avoiding the enlargement of its size, and also to provide a portable telephone which can house two information recording mediums therein while avoiding the enlargement of its size.

<Disclosure of the invention>

**[0009]** The portable terminal according to the invention is arranged to include:

a battery attachment portion to which a detachable battery is attached;
an information recording medium storage portion for storing in a detachable manner an information recording medium in which information is recorded; and
a battery housing portion, for storing the battery, which is constituted by the battery attachment portion and the information recording medium storage portion, wherein
the information recording medium storage portion is disposed in a state of exposing one major surface of the information recording medium.

**[0010]** According to the invention, since the information recording medium storage portion is disposed in the state of exposing the one major surface of the information recording medium, the information recording medium can be drawn and inserted by touching the one surface of the information recording medium with fingers. Thus, the information recording medium can be easily attached and detached. Further, since the information recording medium storage portion is provided at the battery housing portion, the information recording medium storage portion can be disposed using the existing space. Therefore, it is not necessary to secure a new space for disposing the information recording medium storage portion, at a portion other than the battery housing portion. Accordingly, the enlargement of the portable



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terminal can be prevented.

**[0011]** Further, the battery housing portion is provided in a housing of an almost rectangular parallelepiped, and a second information recording medium storage portion, for storing in a detachable manner an information recording medium in which information is recorded, is disposed in adjacent to the battery housing portion along a longitudinal direction of the housing within the housing.

**[0012]** According to the invention, since the second information recording medium storage portion and the battery housing portion are disposed in adjacent to each other along the longitudinal direction of the housing, it is possible to house two kinds of the information recording mediums within the housing. Thus, the enlargement of the portable terminal capable of housing the two kinds of the information recording mediums can be prevented.

**[0013]** Further, the portable terminal is arranged to further include the housing, a second housing, and a hinge portion for coupling the housing and the second housing in a manner of capable of being folded.

**[0014]** According to the invention, since the second information recording medium storage portion and the battery housing portion are disposed in one of the housings, it is possible to house the two kinds of the information recording mediums within the one housing in the portable terminal arranged to be able to fold the two housings.

**[0015]** Further, each of the information recording medium and the second information recording medium has an almost rectangular parallelepiped shape,

the information recording medium storage portion is disposed in a manner that a longitudinal direction of the information recording medium coincides with a direction orthogonal to the longitudinal direction of the housing, and

the second information recording medium storage portion is disposed in a manner that a longitudinal direction of the second information recording medium coincides with the longitudinal direction of the housing.

**[0016]** According to the invention, since the information recording medium storage portion is disposed in a manner that the longitudinal direction of the information recording medium coincides with the direction orthogonal to the longitudinal direction of the housing, it is not necessary to make the longitudinal direction of the housing longer. Further, since the second information recording medium storage portion is disposed in a manner that the longitudinal direction of the second information recording medium coincides with the longitudinal direction of the housing, it is not necessary to make the direction orthogonal to the longitudinal direction of the housing longer. Thus, the enlargement of the housing capable of housing the information recording medium and the second information recording medium can be prevented.

**[0017]** Further, the housing has an opening portion for storing the second information recording medium within the second information recording medium storage portion, and

the opening portion is covered by an open/close lid in a manner that the lid moves in a direction orthogonal to a housing direction of the second information recording medium and rotates in a freely closing and opening manner with respect to the housing.

**[0018]** According to the invention, since the open/close lid is constituted in a manner that the lid moves in the direction orthogonal to the housing direction of the second information recording medium and rotates in a freely closing and opening manner with respect to the housing, the open/close lid is not opened even when a shock is applied to the housing and so the second information recording medium collides with the open/close lid. Thus, the second information recording medium can be prevented from being ejected outside.

**[0019]** Further, the information recording medium storage portion and an input/output portion for inputting and outputting information are disposed in an overlapped manner at a side of the information recording medium opposite to a surface of the information recording medium being exposed.

**[0020]** According to the invention, since the information recording medium storage portion and the input/output portion are disposed in the overlapped manner, the space for providing the information recording medium storage portion and the input/output portion can be reduced, so that the enlargement of the portable terminal can be prevented. Further, even when a force is applied to the information recording medium storage portion, the influence on the input/output portion can be reduced.

<Brief Description of the Drawings>

**[0021]**

Figs. 1(a) to 1(c) are a perspective view showing a closed state of the portable telephone according to the embodiment of the invention, a perspective view showing an opened state, and a perspective view of the opened state seen from the rear surface side.

Fig. 2 is a plan view of the portable telephone according to the embodiment.

Fig. 3 is a cross sectional view of the portable telephone shown in Fig. 2.

Fig. 4 is a perspective view of the housing member which is housed within the portable telephone according to the embodiment.

Fig.5 is a perspective view showing the rear surface side of the open/close cover 141.

Fig. 6 is a block diagram showing the inner structure of the portable telephone according to the embodiment.

Fig. 7 is an exploded perspective view of the lower housing 101a of the portable telephone according to the embodiment.

Figs. 8(a) to (d) are sectional diagrams showing the



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open/close lid 125 of the portable telephone according to the embodiment.

Fig. 9 is a rear view of a conventional portable telephone.

**[0022]** Incidentally, in the figures, a reference numeral 101 refers to a housing, 101a to a lower housing, 101b to an upper housing, 101c to a battery attachment portion, 101d and 101e to step portions, 102 to an antenna, 103 to a transceiver portion, 104 to a vibrator portion, 105 to an operation portion, 106 to an information recording portion, 107 to a battery, 108 a to receiver portion, 109 a to transmission portion, 110 to a camera portion, 111 to a hall element, 112 and 113 to display portions, 114 to an I/O connector, 115 to an UIM card connector, 116 to a SD card connector, 117 and 118 to print circuit boards, 119 to a control portion, 120 to a permanent magnet, 121 to an I/O plug, 122 to an UIM card, 123 to a SD card, 124 to a hinge portion, 125 an open/close lid, 126 a holder, 127 a contact terminal, 128 to a housing portion, 129 to a cover portion, 130a and 130b to connection lands, 131 to a signal terminal, 132 to a housing, 133 to a terminal, 134 to an opening portion, 135 to a housing portion, 136 to a holder, 137 and 138 to bearing shafts, 139a, 139b and 140 to coupling plates, 141 to an open/close cover, 142 and 143 to torsion coil spring, 144 to an elongated hole, 145 to a flange, 146 to an engagement nail, 147 to an engagement projection, 148 a projection portion, 149 a spring groove, 150 to a fixing hole, 151 to a hook hole, 152 to a rectangular hole, 153 to a projection portion, 200 to portable telephone, 203 to a battery attachment portion, 204to a bottom surface, 205 to a vertical wall, 206 to an opening, 207 to a front surface panel portion, 208a and 208b to finger insertion recess portion, 209a to a thumb, and 209b to a forefinger.

<Best Mode for Carrying Out the Invention>

**[0023]** Hereinafter, an embodiment of the invention will be explained with reference to the drawings. The embodiment will be explained as to a portable telephone as an example of a portable terminal such as a portable information terminal or a portable telephone.

**[0024]** Fig. 1(a) is a perspective view showing a closed state of the portable telephone according to the embodiment of the invention. Fig. 1(b) is a perspective view showing an opened state of the portable telephone according to the embodiment of the invention.. Fig. 1(c) is a perspective view of the portable telephone seen from the rear surface side in Fig. 1(b). Fig. 2 is a plan view of the portable telephone according to the embodiment of the invention. Fig. 3 is a cross sectional view of the portable telephone shown in Fig. 2. Fig. 4 is a perspective view of the housing member which is housed within the portable telephone according to the embodiment of the invention. Fig.5 is a perspective view showing the rear surface side of the open/close cover 141. Fig. 6 is a block diagram showing the inner structure of the portable telephone according to the embodiment of the invention. Fig. 7 is an exploded perspective view of the lower housing of the portable telephone according to the embodiment of the invention. Hereinafter, the embodiment according to the invention will be explained as a case where a UIM card of an almost rectangular parallelepiped is used as the subscriber identification information card and a SD card of an almost rectangular parallelepiped is used as the information recording card.

**[0025]** In the portable telephone 100, the housing 101 is constituted by the lower housing 101a and the upper housing 101b, and the lower housing 101a and the upper housing 101b are coupled to be rotatable through the hinge portion 124. The portable telephone 100 is used in a closed state (folded state) where the lower housing 101a is adjacent and opposed to the upper housing 101b when being carried.

**[0026]** The upper housing 101b is provided with the antenna 102, the transceiver portion 103, the vibrator portion 104, the receiver portion (receiver) 108, the camera portion 110, the hall element 111, the display portion 112 and the display portion 113.

**[0027]** The lower housing 101a is provided with the operation portion 105, the information receiving portion 106, the detachable battery 107, the transmission portion (microphone) 109, the I/O connector 114, the UIM card connector 115 corresponding to an information recording medium storage portion recited in claims, the SD card connector 116 corresponding to a second information recording medium storage portion recited in claims, the printed circuit board 117, the printed circuit board 118 and the control portion 119. The housing 101 is adapted to be attached from the outside with the I/O plug 121, the UIM card 122 corresponding to an information recording medium recited in claims, and the SD card 123 corresponding to a second information recording medium recited in claims.

**[0028]** As shown in Fig. 6, the transceiver portion 103 is connected to the antenna 102. The portion 118 is connected to the transceiver portion 103, the vibrator portion 104, the operation portion 105, the information receiving portion 106, the battery 107 corresponding to a battery recited in claims, the receiver portion 108, the transmission portion 109, the camera portion 110, the hall element 111, the display portion 112, the display portion 113, the I/O connector 114, the UIM card connector 115, and the SD card connector 116 and controls these constituent elements. The portion 118 is connected to the battery 107 and supplied with electric power therefrom.

**[0029]** The antenna 102 receives a radio signal and transmits the received signal to the transceiver portion 103. The transceiver portion 103 processes the received signal from the antenna 102 and transmits the received signal thus processed to the receiver portion 108. The receiver portion 108 outputs sound or voice in response to the received signal from the transceiver por-



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tion 103. The transmission portion 109 receives voice, then converts the voice into a transmission signal and transmits the transmission signal to the antenna 102. The antenna 102 receives the transmission signal from the transceiver portion 103 and transmits as a radio signal.

**[0030]** On the printed circuit board 117, the transceiver portion 103, the operation portion 105 and the information receiving portion 106 are formed and the I/O connector 114 is mounted. The SD card connector 116 is mounted on the printed circuit board 118.

**[0031]** The vibrator portion 104 is used to vibrate and notify an incoming call through vibration. The operation portion 105 is used to input characters, symbols, numerals and operation signals etc. and to operate the camera portion 110. The information receiving portion 106 is arranged to record therein telephone number information, voice information, non-voice information and image information etc.

**[0032]** Each of the display portion 112 and the display portion 113 is configured by a liquid crystal display and displays characters, symbols, numerals and images etc. thereon. The display portion 112 is provided at the surface of the lower housing 101a which is exposed when the upper housing 101b is opened. The display portion 113 is provided at the surface in opposite to the surface where the display portion 112 is provided. The camera portion 110 is provided at the same surface of the upper housing 101b where the display portion 112 is provided and disposed so as to photograph the forward portion of the display portion 112.

**[0033]** The permanent magnet 120 is provided at the same surface where the display portion 112 of the upper housing 101b is provided. The hall element 111 is provided at the surface of the upper housing 101b which opposes to the surface of the lower housing 101a when the lower housing 101a and the upper housing 101b are closed. When the lower housing 101a and the upper housing 101b are closed, the permanent magnet 120 approaches the hall element 111, which in turn detects the permanent magnet 120 and transmits a detection signal to the control portion 119.

**[0034]** When the lower housing 101a and the upper housing 101b are opened (shown in Figs. 2 and 3), the permanent magnet 120 is separated from the hall element 111, so that the hall element 111 can not detect the permanent magnet 120 and so the detection signal is not generated.

**[0035]** The portion 118 can recognize the open/close state of the lower housing 101a and the upper housing 101b in accordance with the non-presence and the presence of the detection signal from the hall element 111, respectively.

**[0036]** The I/O plug (a contact plug for a radio signal system and an audio or image signal system) 121 is a plug for inputting and outputting data from and to an external device and is attached to the I/O connector (an interface connector) 114 from the outside of the housing 101. The UIM card 122 is attached to the UIM card connector 115 from the outside of the housing 101. The UIM card connector 115 is covered by a battery cover 117a which is attached to the battery 107.

**[0037]** The battery attachment portion 101c is a portion to which the battery 107 is attached and has a concave shape with respect to the lower housing 101a. The step portions 101d and 101e are portions protruded in the attachment direction of the battery 107 with respect to the bottom surface of the battery attachment portion 101c. Incidentally, the portions (the battery attachment portion 101c and the step portion 101d) covered by the battery cover 117a when the battery 107 is attached to the lower housing 101a corresponds to a battery housing portion recited in claims. The SD card 123 is attached to the SD card connector 116 from the outside of the housing 101. The opening portion 134 of the SD card connector 116 is arranged to be covered by the open/close lid 125 which can be opened and closed with respect to the lower housing 101a.

**[0038]** The UIM card connector 115 is provided with the holder 126 and the contact terminal 127. An IC contained in the UIM card 122 records therein information such as telephone numbers, a user ID and charges for calls. The UIM card 122 has a size of 12mm in width, 25mm in length and 0.76mm in thickness. The holder 126 is formed in a reverse-L shape and provided with the housing portion 128 in which the UIM card 122 is housed and the cover portion 129 for preventing the UIM card 122 thus inserted from separating from the housing portion 128. The UIM card 122 is inserted between the housing portion 128 and the cover portion 129 from the battery attachment portion 101c side and attached to the UIM card connector.

**[0039]** The UIM card connector 115 is disposed near the external appearance surface extending across the corner portions of the step portion 101d protruded in the attachment direction of the battery 107 with respect to the bottom surface of the battery attachment portion 101c in a manner that the longitudinal direction of the UIM card 122 to be attached coincides with the direction orthogonal to the longitudinal direction of the lower housing 101a.

**[0040]** Six contact terminals 127 are provided in correspondence to Vcc, Vdd, GND, RST, CLK and I/O, respectively. The one end of each of these contact terminals 127 abuts against the contact portion (not shown) of the UIM card 122 thus attached, whilst the other end thereof abuts against the connection land 130a on the printed circuit board 117 contained within the lower housing 101a thereby to electrically connect the UIM card 122 to the printed circuit board 117.

**[0041]** The I/O connector 114 of an almost box shape is disposed so as to be overlapped with the UIM card connector 115 and surface-mounted near the end surface of the printed circuit board 117. The signal terminals 131 of the I/O connector 114 are connected through the soldering to the connection lands 130b which are



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formed near the connection lands 130a and on the end surface side of the printed circuit board 117.

**[0042]** Explanation will be made as to the inspection method in an assembling factory.

**[0043]** In general, whether an electronic part surface-mounted on a printed circuit board is normally soldered or not is determined through inspecting the presence or non-presence of a fillet by means of a dedicated robot. In order to facilitate this inspection and also to facilitate the repair using a soldering iron (to secure a space for inserting the soldering iron) when the inspection result is determined to be failure, a space for a part of a predetermined length or more is required between the connection land 130a and the connection land 130b.

**[0044]** According to the embodiment, in order to miniaturize the portable telephone by closely disposing parts (narrowing the space between the connection land 130a and the connection land 130b) each having a large height and many terminals to be soldered, the terminals of the parts on one side (the signal terminals 131 of the I/O connector 114) are automatically mounted and the terminals of the parts on the other side (the contact terminals 127 of the UIM card connector 115) are formed as spring contacts. Thus, the parts on the one side are automatically inspected by the robot and the sufficient space for inserting the soldering iron for the repair therein is secured when the inspection result is determined to be failure. On the other hand, when the inspection result is determined to be normal, the parts on the other side are merely placed on the printed circuit board, whereby both the parts on the one side and the parts on the other side are electrically connected. Alternatively, the parts on the other side may be assembled to the lower housing 101a in advance and the printed circuit board 117 may be housed within the lower housing 101a thereby to electrically connect the contact terminals 127 and the connection lands 130a.

**[0045]** Next, detailed explanation will be made as to the SD card connector 116 and the open/close lid 125.

**[0046]** The SD card connector 116 includes the housing 132 and the terminals 133. Image or audio or voice information can be recorded into an IC contained within the SD card 123. The SD card 123 has a size of 24mm in width, 32mm in height and 2.1 in thickness.

**[0047]** The housing 132 includes the opening portion 134 in which the SD card 123 is inserted and the housing portion 135 for storing the SD card 123 which is inserted through the opening portion 134. Nine terminals 133 are provided for card detection, command, ground, power source and data I/O. The one ends of the terminals 133 abut against the contact portions (123a of Fig. 2) of the SD card 123 and the other ends thereof are soldered and connected to the printed circuit board 118 contained within the lower housing 101a. The SD card connector 116 is disposed in a manner that the longitudinal direction of the SD card 123 to be attached coincides with the longitudinal direction of the lower housing 101a.

**[0048]** The card 116 is housed within the step portion 101e which is protruded in the attachment direction of the battery 107 with respect to the bottom surface of the battery attachment portion 101c. The opening portion 134 is covered by the open/close lid 125. The open/close lid 125 includes the holder 136, the bearing shaft 137, the bearing shaft 138, the coupling plates 139, the coupling plate 140, the open/close cover 141, the torsion coil spring 142 and the torsion coil spring 143.

**[0049]** A pair of the coupling plates 139a and 139b couple the both ends of each of the bearing shafts 137 and 138. The coupling plate 140 is rotatably supported by the bearing shaft 138. The open/close cover 141 is attached to the coupling plate 140 and forms the external appearance surfaces together with the lower housing.101a. The bearing shaft 137 is passed through the torsion coil spring 142 thereby to apply a rotational torque around the shaft center of the bearing shaft 137 to the coupling plates 139 with respect to the holder 136. The one end of the torsion coil spring 143 is hooked on the coupling plate 139 and the other end thereof is provided so as to lean against the bent root of the coupling plate 140 thereby to apply a rotational torque around the shaft center of the bearing shaft 138 to the coupling plate 140 and the open/close cover 141 with respect to the coupling plates 139.

**[0050]** The holder 136 is provided at both ends thereof with the elongated holes 144 through which the bearing shaft 137 is passed and further provided at the outer side thereof with the flange 145 which is fastened to the lower housing 101a by means of screws (not shown). The engagement projections 147 engaging with the engagement nails 146 of the open/close cover 141 are provided at the both ends of the upper portion of the holder 136 in an erected manner, respectively.

**[0051]** Further, the holder 136 is provided at the center portion thereof with the projection portion 148 having a top portion which slightly bends the center portion of the bearing shaft 137 when the bearing shaft 137 is shifted in the longitudinal direction of the elongated holes 144, and further provided with the spring groove 149 which is disposed at the side of the projection portion 148 and in which the one end of the first torsion coil spring 142 is inserted to suppress the rotation of the one end. Each of the torsion coil springs 142 and 143 is attached so as to be twisted in a direction of increasing its winding number in a manner that the twisted angle thereof is 0 degree or more irrespective of the positions of the coupling plates 139a, 139b, the coupling plate 140 and the open/close cover 141.

**[0052]** Each of the coupling plates 139a and 139b is provided at the end portions thereof with the two fixing holes 150 in which the bearing shaft 137 and the bearing shaft 138 are fixed through the caulking, respectively. The coupling plate 139a is provided with the hook hole 151 in which the one end of the second torsion coil spring 143 is hooked. The other end of the torsion coil spring 142 is hooked on the outer peripheral portion of the coupling plate 139a.



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**[0053]** The coupling plate 140 is provided at the center portions thereof with two rectangular holes 152 which engage with the two projections 143 (shown in Fig. 5) of the open/close cover 141, whereby the open/close cover 141 is attached to the coupling plate 140 when inserted along the direction shown by an arrow A. In the case of disengaging the open/close cover 141, the engagement between the rectangular holes 152 and the projections 153 are released and the open/close cover 141 is pulled in a direction opposite to the direction shown by the arrow A., whereby the open/close cover is separated from the coupling plate.

**[0054]** In an assembling factory, a unit (hereinafter referred to a rotation unit) formed by assembling in advance the holder 136, the bearing shaft 137, the bearing shaft 138, the coupling plates 139, the coupling plate 140, the torsion coil spring 142 and the torsion coil spring 143 is supplied, and this unit is assembled to the lower housing 101a. Then, various characteristics such as radio characteristics, receiving characteristics and transmission characteristics are inspected as to each of the units thus assembled, and the open/close cover 141 is assembled only to each of the units having passed the inspection. In this manner, since the confirmation of the rotating operation of the rotation unit can be performed in a different procedure from the inspection of the external appearance of the open/close cover 141, the productivity of the portable telephones 100 can be improved.

**[0055]** Next, the operation of the portable telephone according to the embodiment of the invention will be explained with reference to Figs. 1 to 8.

**[0056]** Fig. 8 is sectional diagrams showing the open/close lid of the portable telephone according to the embodiment of the invention, wherein Fig 8(a) shows a state where the open/close lid is at the first position, Fig. 8(b) shows a state where the open/close lid is at the second position, Fig. 8(c) shows a state where the open/close lid is at the third position, and Fig. 8(d) shows a state where the open/close lid is at the fourth position.

**[0057]** First, the operation of the open/close lid will be explained with reference to Fig. 8.

**[0058]** Fig. 8(a) shows the state where the open/close cover 141 of the open/close lid 125 covers the opening portion 134, in which the engagement nails 146 of the open/close cover 141 engage with the engagement projections 147 of the holder 136. The bearing shaft 137 locates at the one end sides of the elongated holes 144 (the upper side in Fig. 8(a) but the lower side in Fig. 4) and so the lower housing 101a coincides with the open/close cover 141 in their external appearance surfaces. This state is referred as the first position (closed state).

**[0059]** When an external force is applied to the open/close cover 141 by a finger in a direction shown by an arrow B in the first position, the bearing shaft 137 passes the projection portion 148 accompanied with a clicking operation and moves to the other end sides of the elongated holes 144. Then, the engagement between the engagement nails 146 and the engagement projections 147 is released and so the lid etc. are placed in a state shown in Fig. 8(b). This state is referred as the second position of the open/close lid 125.

**[0060]** When the engagement between the engagement nails 146 and the engagement projections 147 is released, the holder 136 and the coupling plates 139a, 139b are applied with a force due to the torsion moment of the torsion coil spring 142, so that a torque is generated around the bearing shaft 137 thereby to start to rotate the coupling plate 139 together with the open/close cover 141 counterclockwise.

**[0061]** Further, since the coupling plates 139a, 139b and the open/close cover 141 are applied with a force due to the torsion moment of the torsion coil spring 143, a torque is generated around the bearing shaft 138 thereby to start to rotate the open/close cover 141 counterclockwise. This state is referred as the third position of the open/close lid 125 as shown in Fig. 8(c). Thereafter, the coupling plate 139a and the coupling plate 139b are rotated by about 90 degrees counterclockwise, and the open/close cover 141 is rotated by about 180 degrees counterclockwise. The state where these rotation operations are terminated is shown in Fig. 8(d) and this state is referred as the fourth position of the open/close lid 125.

**[0062]** As shown in Fig. 8(d), the open/close cover 141 is opened semi-automatically so that the external appearance surface of the open/close cover opposes to the external appearance surface of the lower housing 101a thereby to expose the opening portion 134 of the SD card connector 116, whereby the SD card 123 can attach to and detach from the SD card connector 116.

**[0063]** In Fig. 7, the UIM card 122 is attached to the UIM card connector 115 along the direction shown by an arrow C. Thereafter, when the battery 107 is assembled along the direction shown by an arrow D, the battery cover 107a of the battery 107 covers the UIM card 122. After opening the open/close cover 141, the SD card 123 is attached to the SD card connector 116 along the direction shown by an arrow E and the open/close cover 141 is closed, whereby the attachment procedure is completed.

**[0064]** As explained above, according to the embodiment, the open/close lid 125 is provided with the two rotation shafts and further provided with torsion coil springs for rotating the open/close cover in the same direction around the rotation shafts, respectively. Thus, when a user attaches or detaches the SD card 123, the user can open the opening portion 134 without damaging the open/close cover 141 by merely moving the open/close cover 141. Further, since the opening portion 134 is near the external appearance surface of the lower housing 101a, the SD card 123 having been attached also is positioned near the external appearance surface of the lower housing 101a in the state where the open/close lid 125 is opened. Thus, the attaching and detaching operations of the SD card 123 through the



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pushing and drawing operations thereof can be performed easily.

**[0065]** Further, since the open/close cover 141 is configured so as to rotate after being shifted in the direction orthogonal to the attaching/detaching direction of the SD card 123, there does not arise such a phenomenon that, if the portable telephone is dropped, for example, the housed SD card 123 collides with the open/close cover 141 to open the open/close lid 125 and so the SD card 123 is moved outside.

**[0066]** Incidentally, at the time of restoring (closing) the open/close lid 125 from the fourth position where the lid is opened to the first position, when a user applies a force to the open/close cover 141, the open/close cover 141 and the coupling plate 139 start to rotate clockwise. Then, the lid is shifted to the second position through the third position. Thereafter, when the user further applies a force continuously in the direction opposite to the direction shown by the arrow B, the lid moves to the first position through a clicking operation. In this manner, the operation for closing the open/close lid 125 is also very simple. Further, since the open/close lid 125 is closed accompanied with the clicking operation, the completion of the closing operation can be easily recognized advantageously.

**[0067]** If the portable telephone is configured in a manner that only the open/close cover 141 collides with the ground when the portable telephone 100 is dropped on the ground in a state that the open/close lid 125 is opened to a position near the hinge portion 124 (the fourth position of the open/close lid 125), the open/close cover 141 is broken. Thus, in this case, it is necessary to form the open/close lid 125 by metal material with high rigidity, for example.

**[0068]** In contrast, according to the embodiment, the portable telephone is configured in a manner that even when the portable telephone 100 is dropped in the opened state of the open/close lid 125, only the hinge portion 124 and the open/close cover 141 or only the hinge portion 124 collides with the ground. Thus, since a shock caused by the collision with the ground is distributed, it is not necessary to form the open/close cover 141 by material with high rigidity and high intensity. As a result, the cost-up of the portable telephones 100 at the time of production thereof can be avoided.

**[0069]** Incidentally, when the open/close cover 141 is required to be exchanged in such a case where the open/close cover 141 is broken or damaged due to an unexpected accident and a user wants to exchange this cover, the engagement between the open/close cover 141 and the coupling plate 140 is released and then the open/close cover 141 is drawn in the direction opposite to the direction shown by the arrow A, whereby the open/close cover and the coupling plate are separated. Then, a new open/close cover 141 is assembled along the direction shown by the arrow A, whereby the reassembling of the open/close lid 125 is completed. In this manner, since the portable telephone 100 can be promptly repaired at a repair shop etc. without returning the portable telephone to an assembling factory, the portable telephone can be maintained quite easily.

**[0070]** Further, according to the embodiment, since the coupling plates 139 rotate about 90 degrees, the torsion coil spring 142 is arranged to also twist about 90 degrees. On the other hand, since the torsion coil spring 143 is disposed in a manner that the coil center thereof does not coincide with the bearing shaft 138 (that is, disposed at the peripheral portion of the bearing shaft 138), the torsion angle thereof is smaller than the rotation angle of the open/close cover 141 (compare between Fig. 8(a) and Fig. 8(d)).

**[0071]** For example, when the coil center of the torsion coil spring 143 is made coincide (coaxially) with the bearing shaft 138, the torsion angle of the torsion spring becomes almost same as the rotation angle of the open/close cover 141, so that a stress generated at the spring may exceed an allowable stress depending on the average diameter and the number of the windings of the spring. Thus, a stress thus generated can be made small by arranging the constituent elements according to the embodiment. As a result, the cost-up of the portable telephones 100 at the time of production thereof can be avoided without selecting expensive material with a large allowable stress.

**[0072]** According to the aforesaid reason, the similar effect can be obtained when the torsion coil spring 142 is disposed in a manner that the coil center thereof does not coincide with the coil center of the bearing shaft 137 thereby to make the torsion angle of the torsion coil spring 142 small. Thus, suitable method may be employed depending on the structure.

**[0073]** Further, according to the embodiment, the housing portion 128 of the UIM card connector 115 is formed at the upper surface of the UIM card connector 115 (near the external appearance surface of the lower housing 101a). That is, the one major surface of the UIM card 122 attached to the UIM card connector 115 is exposed when the battery 107 is removed. Thus, even for a person having large hands or long nails etc., the person can easily attach and detach the UIM card 122 by touching the one major surface thereof with the fingers to insert and remove the card.

**[0074]** Further, according to the embodiment, since the direction orthogonal to the longitudinal direction of the lower housing 101a is made coincide with the longitudinal direction of the UIM card 122, it is not necessary to make the longitudinal direction of the lower housing 101a long. Further, since the longitudinal direction of the lower housing 101a is made coincide with the longitudinal direction of the SD card 123, it is not necessary to make the direction orthogonal to the longitudinal direction of the lower housing 101a long. Thus, the portable telephone 100 having the UIM card connector 115 and the SD card connector 116 and capable of easily detaching the UIM card 122 can be provided without increasing the size of the portable telephone 100.



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**[0075]** It should be understood by those skilled in the art that although the foregoing description has been made on the particular embodiment, the invention is not limited thereto and various changes and modifications may be made without departing from the spirit and the scope of the invention.

**[0076]** The present application is based on Japanese Patent Application No. 2002-113386 filed on April 16, 2002, the content of which is incorporated herein by reference.

<Industrial Applicability>

**[0077]** According to the invention, since the information recording medium storage portion is disposed in the state of exposing the one major surface of the information recording medium, the information recording medium can be drawn and inserted by touching the one surface of the information recording medium with fingers. Thus, the information recording medium can be easily attached and detached. Further, since the information recording medium storage portion is provided at the battery housing portion, the information recording medium storage portion can be disposed using the existing space. Therefore, it is not necessary to secure a new space for disposing the information recording medium storage portion, at a portion other than the battery housing portion. Accordingly, the enlargement of the portable terminal can be prevented.

**Claims**

1. A portable terminal comprising:

   a battery attachment portion to which a detachable battery is attached;
   an information recording medium storage portion for storing in a detachable manner an information recording medium in which information is recorded; and
   a battery housing portion, for storing the battery, which is constituted by the battery attachment portion and the information recording medium storage portion,

   wherein the information recording medium storage portion is disposed in a state of exposing one major surface of the information recording medium.

2. The portable terminal according to claim 1,
   wherein the battery housing portion is provided in a housing of an almost rectangular parallelepiped, and
   wherein a second information recording medium storage portion, for storing in a detachable manner an information recording medium in which information is recorded, is disposed in adjacent to the battery housing portion along a longitudinal direction of the housing within the housing.

3. The portable terminal according to claim 2, further comprising:

   the housing;
   a second housing; and
   a hinge portion for coupling the housing and the second housing in a manner of capable of being folded.

4. The portable terminal according to claim 2 or 3,
   wherein each of the information recording medium and the second information recording medium has an almost rectangular parallelepiped shape,
   wherein the information recording medium storage portion is disposed in a manner that a longitudinal direction of the information recording medium coincides with a direction orthogonal to the longitudinal direction of the housing, and
   wherein the second information recording medium storage portion is disposed in a manner that a longitudinal direction of the second information recording medium coincides with the longitudinal direction of the housing.

5. The portable terminal according to one of claims 2 to 4,
   wherein the housing has an opening portion for storing the second information recording medium within the second information recording medium storage portion, and
   wherein the opening portion is covered by an open/close lid in a manner that the lid moves in a direction orthogonal to a housing direction of the second information recording medium and rotates in a freely closing and opening manner with respect to the housing.

6. The portable terminal according to one of claims 1 to 5,
   wherein the information recording medium storage portion and an input/output portion for inputting and outputting information are disposed in an overlapped manner at a side of the information recording medium opposite to a surface of the information recording medium being exposed.



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FIG. 1 (c)

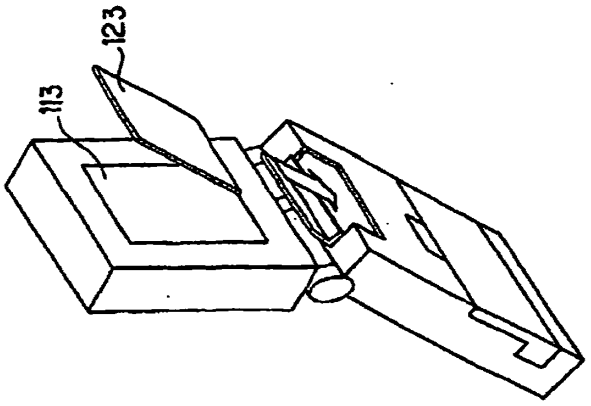



FIG. 1 (b)

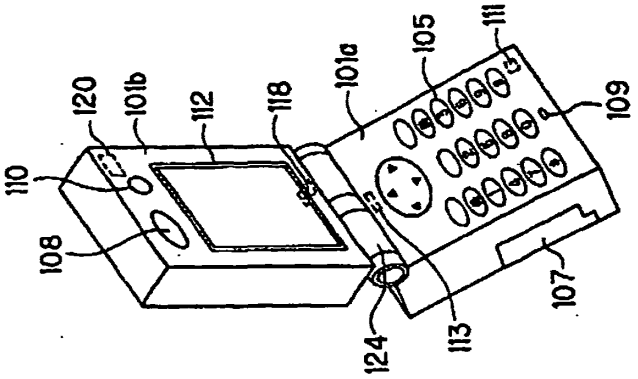
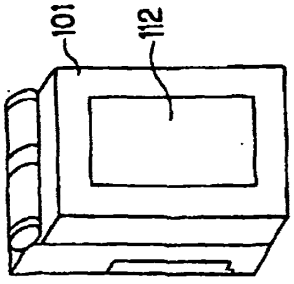


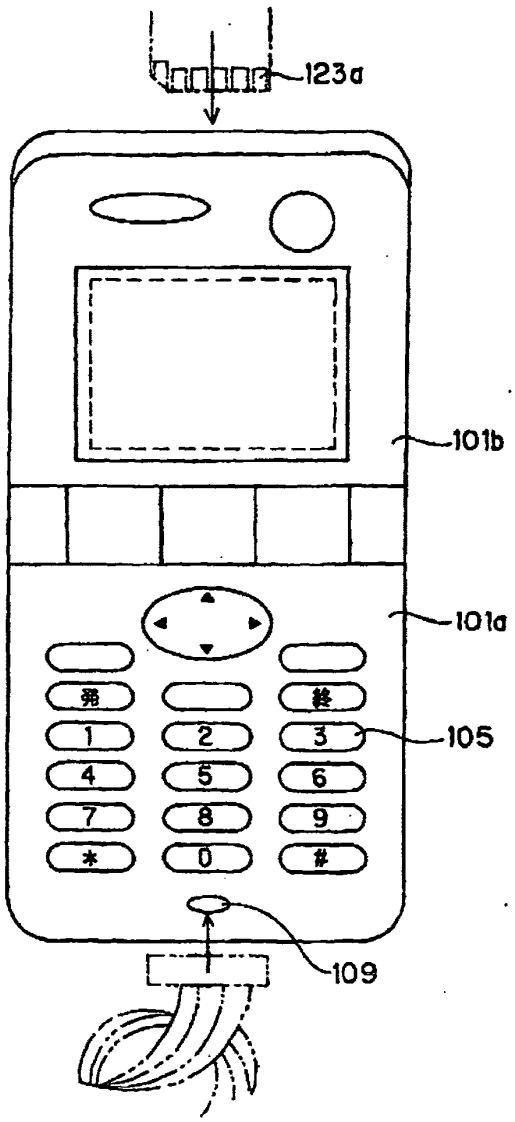

FIG. 1 (a)






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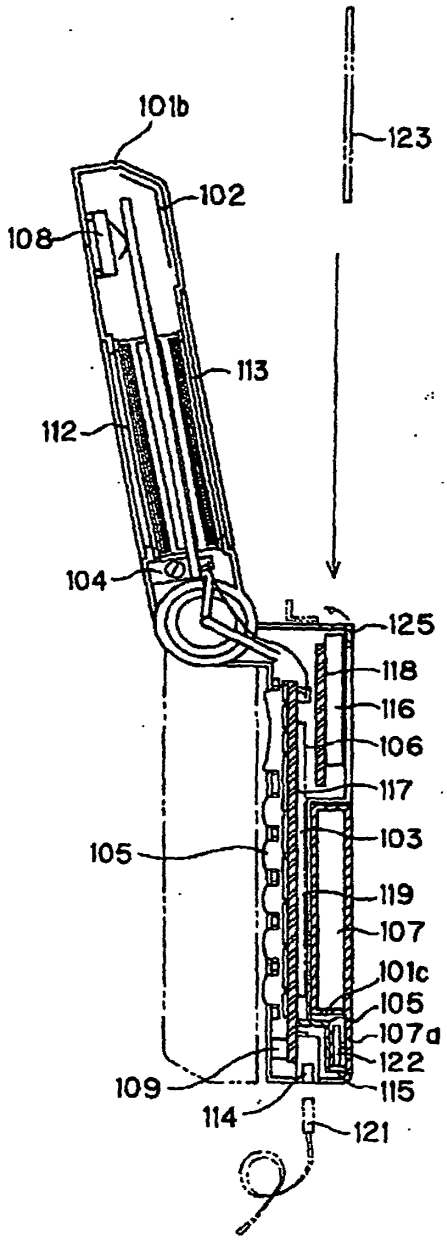
FIG. 2






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FIG. 3






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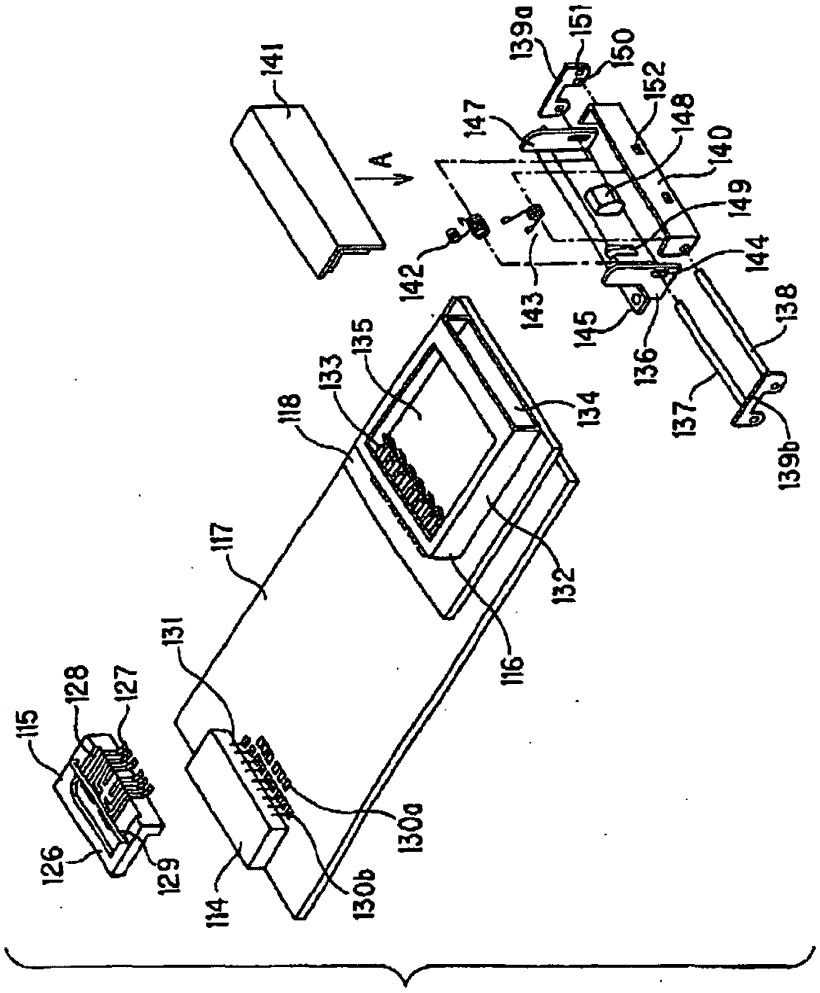



FIG. 4



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FIG. 5

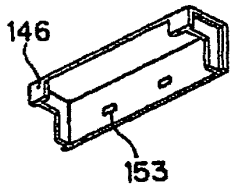
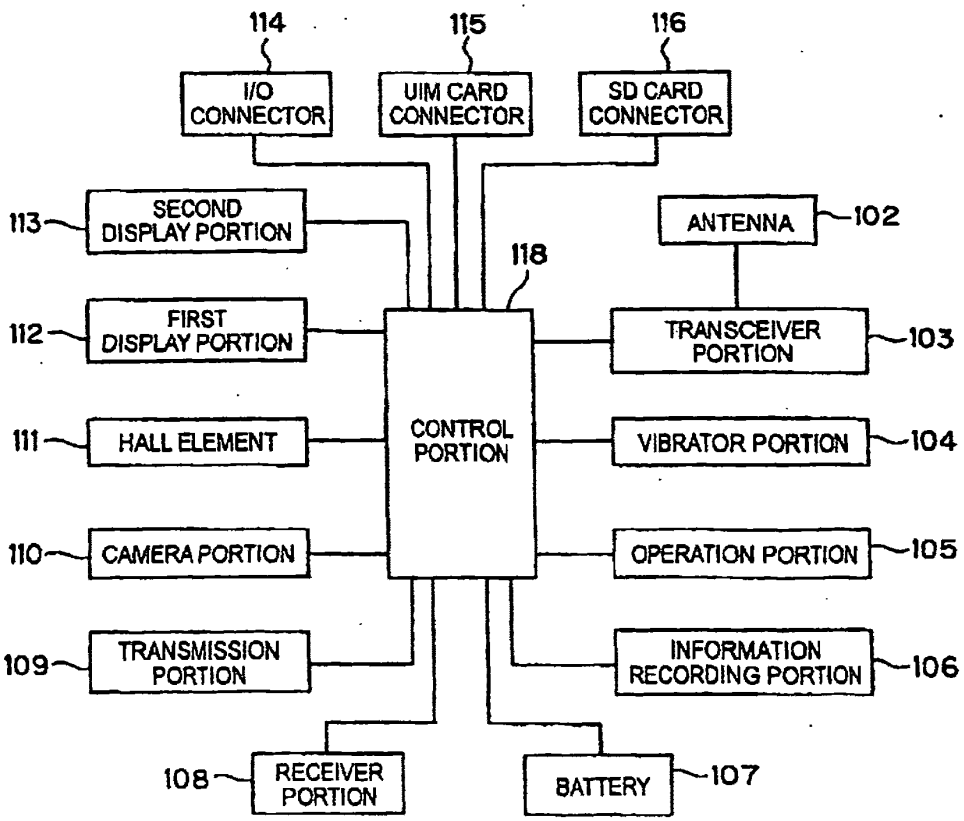


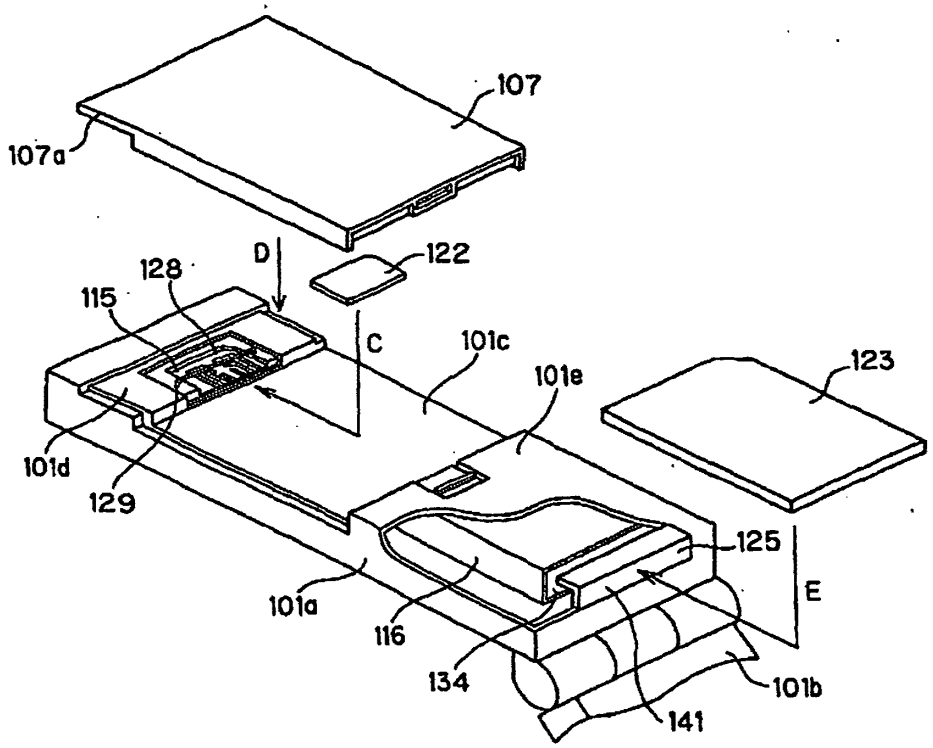

FIG. 6






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FIG. 7






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FIG. 8 (a)

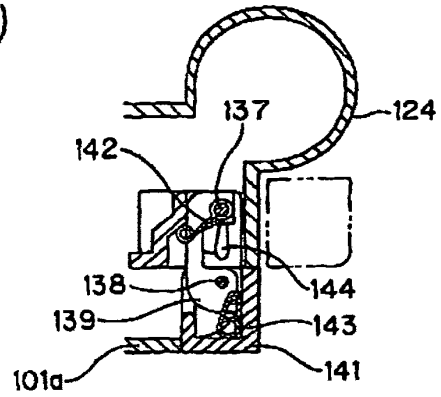



FIG. 8 (b)

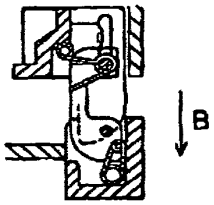



FIG. 8 (c)

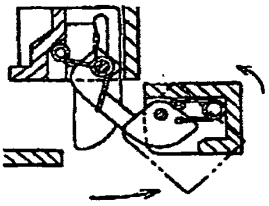
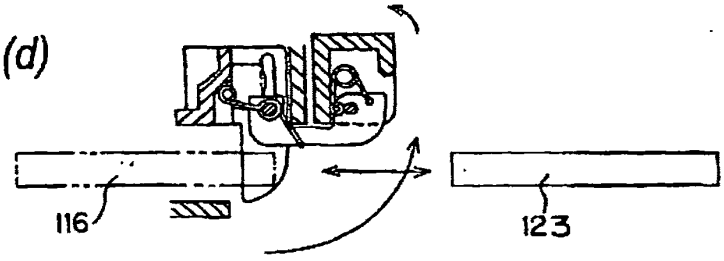


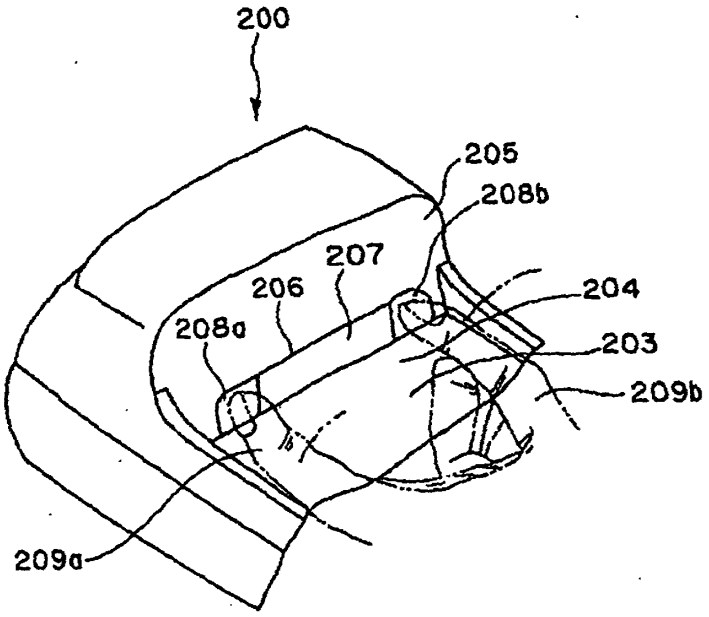
FIG. 8 (d)






Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000175

FIG. 9






Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000176

## INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP03/04781

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] H04M1/02

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)
Int.Cl[7] H04M1/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

| | | | |
|---|---|---|---|
| Jitsuyo Shinan Koho | 1922-1996 | Toroku Jitsuyo Shinan Koho | 1994-2003 |
| Kokai Jitsuyo Shinan Koho | 1971-2003 | Jitsuyo Shinan Toroku Koho | 1996-2003 |

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y<br>A | JP 10-190803 A (Kyocera Corp.),<br>21 July, 1998 (21.07.98),<br>Figs. 15, 16<br>(Family: none) | 1-4,6<br>5 |
| Y | JP 8-79344 A (Motorola, Inc.),<br>22 March, 1996 (22.03.96),<br>Fig. 1<br>& GB 9515342 A & DE 19526730 A<br>& CA 2154318 A & FR 2724086 A | 2,4 |
| Y | JP 2001-251402 A (NEC Corp.),<br>14 September, 2001 (14.09.01),<br>Fig. 2<br>& US 2001/21657 A & GB 2366060 A | 2,4 |

☒ Further documents are listed in the continuation of Box C. ☐ 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
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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 |
|---|---|
| 13 June, 2003 (13.06.03) | 01 July, 2003 (01.07.03) |
| Name and mailing address of the ISA/<br>Japanese Patent Office<br><br>Facsimile No. | Authorized officer<br><br>Telephone No. |

Form PCT/ISA/210 (second sheet) (July 1998)



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000177

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP03/04781

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 77026/1992(Laid-open No. 41247/1994) (Oki Electric Industry Co., Ltd.), 31 May, 1994 (31.05.94), Fig. 6 (Family: none) | 2,4 |
| Y | JP 2002-27079 A (Sony Corp.), 25 January, 2002 (25.01.02), Fig. 1 (Family: none) | 3 |

Form PCT/ISA/210 (continuation of second sheet) (July 1998)



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000178

PLUS Search Results for S/N 14067249, Searched Thu Jan 30 16:43:07 EST 2014

The Patent Linguistics Utility System (PLUS) is a USPTO automated search system for U.S. Patents from 1971 to the present PLUS is a query-by-example search system which produces a list of patents that are most closely related linguistically to the application searched. This search was prepared by the staff of the Scientific and Technical Information Center, SIRA.

4580054 99
5860636 99
5915895 99
6009916 99
4342139 96
4504165 96
4512177 96
4583062 96
4773395 96
4840282 96
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4362331 92
4368867 92
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4378913 92
4384168 92
4383397 92
4383458 92
4390762 92

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

# NOTICE OF ALLOWANCE AND FEE(S) DUE

10948 7590 02/05/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER |
|---|
| NGUYEN, TUAN DUC |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 02/05/2014

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 05/05/2014 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

**HOW TO REPLY TO THIS NOTICE:**

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**





Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000180

## PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail** **Mail Stop ISSUE FEE**
**Commissioner for Patents**
**P.O. Box 1450**
**Alexandria, Virginia 22313-1450**
**or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

10948 7590 02/05/2014
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

**Certificate of Mailing or Transmission**
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

| (Depositor's name) |
|---|
| (Signature) |
| (Date) |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 05/05/2014 |

| EXAMINER | ART UNIT | CLASS-SUBCLASS |
|---|---|---|
| NGUYEN, TUAN DUC | 2656 | 379-433080 |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ❑ A check is enclosed.
- ❑ Payment by credit card. Form PTO-2038 is attached.
- ❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status.
  NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____



PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000181

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

10948 7590 02/05/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER | |
|---|---|
| NGUYEN, TUAN DUC | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 02/05/2014

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.





Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000182

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

| Notice of Allowability | Application No. 14/067,249 | Applicant(s) JORGENSEN, CLAUS H. | |
|---|---|---|---|
| | Examiner TUAN D. NGUYEN | Art Unit 2656 | AIA (First Inventor to File) Status No |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *10/30/2013*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-42 and renumbered as 1-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   **Certified copies:**

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date See Continuation Sheet
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TUAN D NGUYEN/
Primary Examiner, Art Unit 2656



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000184

Continuation of Attachment(s) 2. Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date: 12/30/2013,11/18/2013,10/30/2013.



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000185

## Office Action

### Examiner's Statement of Reasons for Allowance

1. Claims 25-42 are allowed.

   The following is an examiner's statement of reasons for allowance: The prior art of record teaches various portable electronic devices thereon, for example US 2001/0034242. However, the prior art of record fails to show claim 25, a portable electronic device comprising: a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing; a camera located in said housing and extending to said cut out at said rear side and combined with all limitations of claim 25; and claim 36, a housing for a portable electronic device comprising: a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing, said cut out configured to receive at least part of a camera and combined with all the limitations of claim 36.

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays,

should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan D. Nguyen whose telephone number is (571) 272-8163. The examiner can normally be reached on M-F 6:30-3:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Curt Kuntz can be reached on (571) 272-7499. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TDN

2/4/14

/TUAN D NGUYEN/

Primary Examiner, Art Unit 2656

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| CPC | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | | | | | **Type** | **Version** |
| H04M | | 1 | / | 0264 | F | 20130101 |
| H04M | | 1 | / | 0262 | I | 20130101 |
| H04M | | 1 | / | 0214 | I | 20130101 |
| H04M | | 1 | / | 0277 | I | 20130101 |
| H04M | | 1 | / | 0216 | A | 20130101 |
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| CPC Combination Sets | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Symbol** | | | | | **Type** | **Set** | **Ranking** | **Version** |
| | | | / | | | | | |
| | | | / | | | | | |

| NONE | | **Total Claims Allowed:** | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 2/4/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000189

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| US ORIGINAL CLASSIFICATION | | INTERNATIONAL CLASSIFICATION | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CLASS | SUBCLASS | CLAIMED | | | | | NON-CLAIMED | | | | | |
| 379 | 433.08 | H | 0 | 4 | M | 1 / 00 (2006.01.01) | | | | | | |
| CROSS REFERENCE(S) | | H | 0 | 4 | M | 9 / 00 (2006.01.01) | | | | | | |

| CLASS | SUBCLASS (ONE SUBCLASS PER BLOCK) | | | | |
|---|---|---|---|---|---|
| 379 | 433.01 | 433.13 | | | |
| 455 | 575.3 | | | | |

| NONE | | Total Claims Allowed: | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 2/4/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000190

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 17 | 41 | | | | | | | | | | | | |
| 2 | 26 | 18 | 42 | | | | | | | | | | | | |
| 3 | 27 | | | | | | | | | | | | | | |
| 4 | 28 | | | | | | | | | | | | | | |
| 5 | 29 | | | | | | | | | | | | | | |
| 6 | 30 | | | | | | | | | | | | | | |
| 7 | 31 | | | | | | | | | | | | | | |
| 8 | 32 | | | | | | | | | | | | | | |
| 9 | 33 | | | | | | | | | | | | | | |
| 10 | 34 | | | | | | | | | | | | | | |
| 11 | 35 | | | | | | | | | | | | | | |
| 12 | 36 | | | | | | | | | | | | | | |
| 13 | 37 | | | | | | | | | | | | | | |
| 14 | 38 | | | | | | | | | | | | | | |
| 15 | 39 | | | | | | | | | | | | | | |
| 16 | 40 | | | | | | | | | | | | | | |

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|---|---|---|---|
| NONE<br><br>(Assistant Examiner) | (Date) | **Total Claims Allowed:**<br>18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656<br><br>(Primary Examiner) | 2/4/14<br><br>(Date) | O.G. Print Claim(s)<br>25 | O.G. Print Figure<br>7 |



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000191

| Search Notes | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

| CPC- SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
| | | |

| CPC COMBINATION SETS - SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
| | | |

| US CLASSIFICATION SEARCHED | | | |
|---|---|---|---|
| Class | Subclass | Date | Examiner |
| 379 | 433.01,433.08,433.11,433.13 | 1/30/14 | TN |
| 455 | 90.3,575.1,575.3,572,573,574 | 2/3/14 | TN |
| 361 | 679.23 | 2/4/14 | TN |
| 348 | 374,376 | 2/4/14 | TN |

| SEARCH NOTES | | |
|---|---|---|
| Search Notes | Date | Examiner |
| PLUS and inventor search | 2/3/14 | TN |

| INTERFERENCE SEARCH | | | |
|---|---|---|---|
| US Class/ CPC Symbol | US Subclass / CPC Group | Date | Examiner |
| | updated same as above | 2/4/14 | TN |

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| | /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 |

OPAP AKIMA-10
DEC 3 0 2013
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249
Applicant(s): Jorgensen
Art Unit: 2642
Title: Portable Electronic Device

Confirmation No.: 7955
Filed: October 30, 2013
Examiner: N/A

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement
(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

A search report has issued in a counterpart foreign application (EP 13187465.3-1858), mailed on December 4, 2013. Copies of the art are enclosed with a Form PTO-1449 for the Examiner's use. Also included is a copy of the search report.

☒ Each item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of this Statement, or

☐ No item of information contained in this Information Disclosure Statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the statement after making reasonable inquiry, no item of information contained in this Statement was known to any individual designated in 37 C.F.R. §1.56(c) more than three months prior to the filing of this Statement.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000193

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,

12/23/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

12/23/13
Date

Blair Ribeiro



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Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000194

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2642 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | EP-1209880-A2 | 05-29-2002 | Nokia Corp. | N/A |
| | EP-1496672-A1 | 01-12-2005 | Matushita Electric Ind. Co. | N/A |
| | GB-2383472-A | 06-25-2003 | Nokia Mobile Developments, et al. | N/A |
| | GB-2391740-A | 02-11-2004 | Matushita Electric Ind. Co. | N/A |

**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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Examiner's Signature: /Tuan Nguyen/ Date Considered: 01/30/2014

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

| Index of Claims | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

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|---|---|---|---|---|---|---|---|
| ✓ | Rejected | - | Cancelled | N | Non-Elected | A | Appeal |
| = | Allowed | ÷ | Restricted | I | Interference | O | Objected |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| CLAIM | | DATE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Final | Original | 02/04/2014 | | | | | | | | |
| 1 | 25 | = | | | | | | | | |
| 2 | 26 | = | | | | | | | | |
| 3 | 27 | = | | | | | | | | |
| 4 | 28 | = | | | | | | | | |
| 5 | 29 | = | | | | | | | | |
| 6 | 30 | = | | | | | | | | |
| 7 | 31 | = | | | | | | | | |
| 8 | 32 | = | | | | | | | | |
| 9 | 33 | = | | | | | | | | |
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| 12 | 36 | = | | | | | | | | |
| 13 | 37 | = | | | | | | | | |
| 14 | 38 | = | | | | | | | | |
| 15 | 39 | = | | | | | | | | |
| 16 | 40 | = | | | | | | | | |
| 17 | 41 | = | | | | | | | | |
| 18 | 42 | = | | | | | | | | |



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OPAP AKIMA-16
NOV 1 8 2013
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 3725
Examiner:
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

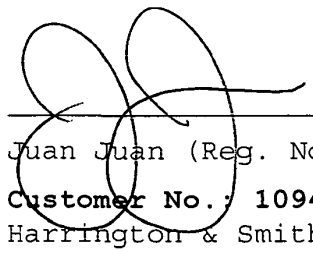
The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



11/12/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

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NOV 1 8 2013
PATENT & TRADEMARK OFFICE

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

11/13/2013
Date

Elaine F. Mian
Elaine F. Mian



ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000199

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group:3725 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
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| | US-7,627,343 B2 | 12-01-2009 | Fadell et al. | 455 | 557 |
| | US-8,140,133 B2 | 03-20-2012 | Jung et al. | 455 | 575.3 |
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| | US-7,099,709 B2 | 08-29-2006 | Hsu et al. | 455 | 575.8 |
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| | US-6,785,395 B1 | 08-31-2004 | Arneson et al. | 381 | 334 |
| | US-6,075,470 | 06-13-2000 | Little et al. | 341 | 107 |
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| | US-D506,476 S | 06-21-2005 | Andre et al. | D14 | 496 |
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| | US-D433,460 | 11-07-2000 | Griffin et al. | D21 | 329 |
| | US-2003/0095656 A1 | 05-22-2003 | Sommer | 379 | 419 |

OPAP AKIMA-16 NOV 18 2013 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | JP-2001308992-A | 11-02-2001 | Kyocera Corp. | |
| | - - | | | |
| | - - | | | |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Gabe, "Installing Palm Zire 31 Battery", www.iFixit.com, document generated 08/24/2013, Palm Zire 31 first released April 2004, 6 pages |
| | |

| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 01/30/2014 |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: Confirmation No.:
Applicant(s): Jorgensen, Claus H.
Filed: Herewith
Art Unit:
Examiner:
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

A Form PTO-1449 is enclosed for the Examiner's use which lists art cited in the parent application (Application No.: 13/741,781 [which is a continuation patent application of Application No.: 12/860,234 [now US 8,363,824], which is a continuation patent application of 11/393,510 [now US 7,787,618]). In accordance with 37 C.F.R. §1.98(d) copies of the art are not included. These can be obtained by the Examiner from the file of the parent application.

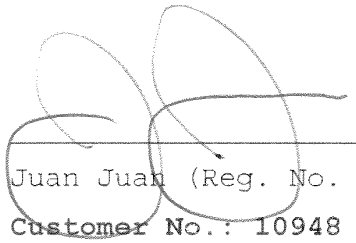
ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000201

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



10/30/2013

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000202

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No.: 891.0013.U4(US) | Serial No.: to be assigned 14/067249 /T.N./ |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: herewith | Group: n/a |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-DES. 427,171 | 06-27-2000 | Frye et al. | D14 | 138 |
| | US-2005/0282593 A1 | 12-22-2005 | Spence et al. | 455 | 575.3 |
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| | US-7,010,121 | 03-07-2006 | Wennemer et al. | 379 | 433.01 |
| | US-7,336,228 B2 | 02-26-2008 | Lu et al. | 343 | 702 |
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| | US-7,522,889 B2 | 04-21-2009 | Wulff et al. | 455 | 90.3 |
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| | US-2006/0233356 A1 | 10-19-2006 | Lu et al. | 379 | 433.01 |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | GB 2 383 472 A | 06/25/2003 | Vertu Limited | n/a |
| | EP-1209880-A3 | 02-05-2003 | Nokia Corporation | |
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| | GB-2391740-A | 02-11-2004 | Matsushita Electrical Industrial Co. Ltd. | |
| | JP-2005-318064-A | 11-10-2005 | Toshiba Corp | Abstract |
| | EP-1496672-A1 | 01-12-2006 | Matsushita Electric Industrial Co., Ltd. | |
| | EP-1 617 313-A2 | 01-18-2005 | LG Electronics, Inc. | |
| | WO-95/31048-A1 | 11-16-1995 | Daniels, John J. | |

**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

| | |
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| | |
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| | |

Examiner's Signature: /Tuan Nguyen/ Date Considered: 01/30/2014

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

# BIB DATA SHEET

**CONFIRMATION NO. 7955**

| SERIAL NUMBER | FILING or 371(c) DATE<br>RULE | CLASS | GROUP ART UNIT | ATTORNEY DOCKET NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | 379 | 2656 | 891.0013.U4(US) |

**APPLICANTS**

Nokia Corporation, Espoo, FINLAND, Assignee (with 37 CFR 1.172 Interest);

**INVENTORS**

Claus H. Jorgensen, Bronshoj, DENMARK;

**** CONTINUING DATA ***************************

This application is a CON of 13/741,781 01/15/2013 PAT 8615077
and is a CON of 12/860,234 08/20/2010 PAT 8363824
and is a CON of 11/393,510 03/29/2006 PAT 7787618

**** FOREIGN APPLICATIONS ***************************

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| Foreign Priority claimed ☐ Yes ☑ No<br>35 USC 119(a-d) conditions met ☐ Yes ☑ No<br>Verified and Acknowledged /TUAN DUC NGUYEN/ Examiner's Signature | ☐ Met after Allowance<br>Initials | STATE OR COUNTRY | SHEETS DRAWINGS | TOTAL CLAIMS | INDEPENDENT CLAIMS |
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UNITED STATES

**TITLE**

Portable Electronic Device

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| APPLICATION NUMBER | FILING OR 371(C) DATE | FIRST NAMED APPLICANT | ATTY. DOCKET NO./TITLE |
|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) |

**CONFIRMATION NO. 7955**

10948
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

**PUBLICATION NOTICE**




**Title:**PORTABLE ELECTRONIC DEVICE

**Publication No.**US-2014-0073374-A1
**Publication Date:**03/13/2014

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# Request for Continued Examination (RCE) Transmittal

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| | |
|---|---|
| Application Number | 14/067,249 |
| Filing Date | October 30, 2013 |
| First Named Inventor | Claus H. Jorgensen |
| Art Unit | 2656 |
| Examiner Name | Nguyen, Tuan Duc |
| Attorney Docket Number | 891.0013.U4(US) |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. ☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. ☐ Other _____

   b. ☑ Enclosed

      i. ☐ Amendment/Reply

      ii. ☐ Affidavit(s)/ Declaration(s)

      iii. ☑ Information Disclosure Statement (IDS)

      iv. ☐ Other _____

2. Miscellaneous

   a. ☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. ☐ Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. ☑ The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 50-1924.

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      i. ☑ RCE fee required under 37 CFR 1.17(e)

      ii. ☐ Extension of time fee (37 CFR 1.136 and 1.17)

      iii. ☐ Other _____

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| Signature | | Date | May 5, 2014 |
| Name (Print/Type) | Juan Juan | Registration No. | 60,564 |

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| Name (Print/Type) | Elaine F. Mian | Date | May 5, 2014 |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Claus H. Jorgensen
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)

Customer No.: 10,948

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Information Disclosure Statement

(37 C.F.R. §1.97(b))

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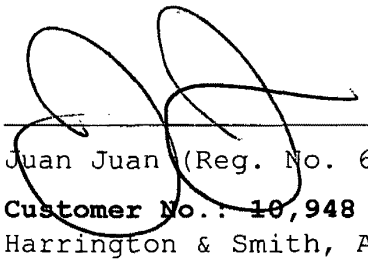
The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the documents listed on the enclosed Form PTO-1449. No fee is believed due as this IDS is being filed together with an RCE. However, if the undersigned attorney is mistaken, please charge deposit account 50-1924.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this

Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

Respectfully submitted,



5/5/2014

Juan Juan (Reg. No. 60,564) Date

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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| | JP-2000133973-A | 05-12-2000 | NEC Corp. | |
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| | WO-2007/110771-A2 | 10-04-2007 | Nokia Corporation | |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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(19) Europäisches Patentamt
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(11) EP 2 472 833 A1

# (12) EUROPEAN PATENT APPLICATION

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(71) Applicant: **Nokia Corporation**
**02150 Espoo (FI)**

(72) Inventor: **Jorgensen, Claus**
**DK-4000 Frederiksberg (DK)**

(74) Representative: **Väänänen, Janne Kalervo**
**Berggren OY AB**
**P.O. Box 16**
**00101 Helsinki (FI)**

Remarks:
This application was filed on 13-03-2012 as a divisional application to the application mentioned under INID code 62.

## (54) Portable electronic device

(57) A portable electronic device includes a first section, a second section, and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.

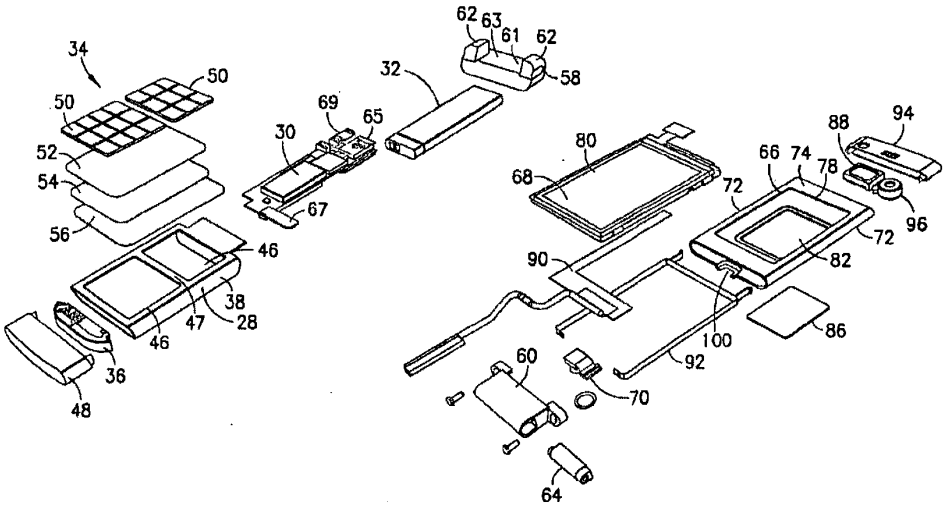



FIG.7

EP 2 472 833 A1

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## Description

### Field of the Invention

[0001] The invention relates to a portable electronic device and, more particularly, to form factor configuration of a portable electronic device.

### Brief Description of Prior Developments

[0002] Ultra thin telephone products have emerged in the market, pioneering a new approach in mechanical architecture for flip-phone designs (also known a clam-shell handset). Priority for these products is mechanical thinness, allowing the feature set and industrial design to be adjusted to suit this goal. New flip-phones include the Motorola RAZR, the Motorola V3, the Motorola V3x, the Samsung SCH-V740, the NEC L1. For example, the Motorola RAZR has a thickness of about 0.54 inch. Candy-bar shaped mobile phones can have smaller thicknesses, such as the Motorola SLIVR with a thickness of about 0.45 inch and the Motorola SCALPEL with a thickness of about 0.25 inch.

[0003] There is a desire for an architecture for an ultrathin fold product, such as a flip-phone style of mobile telephone, which can maintain aesthetic balance in proportions, and allow added thickness to avoid a "squeezed" appearance as seen with the RAZR™ mobile telephone.

### Summary

[0004] In accordance with one aspect of the invention, there is provided a new portable electronic device comprising: an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a battery located adjacent the engine section; and a user input section located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

[0005] In accordance with another aspect of the invention, a portable electronic apparatus is provided comprising a first section comprising electronics; a second section movably connected to the first section by a hinge section, wherein the second section comprises a display; and an access entry provided in the hinge section adapted to allow insertion of an electrical device through the hinge section and into electrical connection with an electrical connector inside the first section.

[0006] In accordance with another aspect of the invention, a portable electronic device is provided including a first section, a second section and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.

[0007] In accordance with another aspect of the invention, a mobile telephone is provided comprising an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a battery located adjacent the engine section; and a user input section comprising a keypad located directly above the engine section and the battery. The user input section is located directly opposite the battery without a portion of the engine section therebetween.

[0008] In accordance with another aspect of the invention, a portable electronic device is provided comprising a first section; a second section movably connected to the first section by a hinge; and a camera. The hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section. The camera is connected to the second section. The camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of an exterior housing of the second section.

### Brief description of the drawings

[0009] The foregoing aspects and other features of exemplifying embodiments of the invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

[0010] Fig. 1 is a perspective view of a mobile telephone comprising features of an exemplifying embodiment of the invention;

[0011] Fig. 2 is a perspective view of the telephone shown in Fig. 1 is a closed configuration;

[0012] Fig. 3 is a side view of the telephone shown in Fig. 1;

[0013] Fig. 4 is a front view of the telephone shown in Fig. 2;

[0014] Fig. 5 is a side view of the telephone shown in Fig. 2;

[0015] Fig. 6 is a rear view of the telephone shown in Fig. 2;

[0016] Fig. 7 is an exploded perspective view of the telephone shown in Figs. 1-6;

[0017] Fig. 8 is a schematic view showing the layout of the engine and the battery of the telephone shown in Figs. 1-7;

[0018] Fig. 9 is a schematic view similar to Fig. 8 showing an alternate embodiment of the layout of the engine and the battery;

[0019] Fig. 10 is a schematic view similar to Fig. 8 showing another alternate embodiment of the layout of the engine and the battery;

[0020] Fig. 11 is a schematic view showing an alternate



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embodiment of the layout of the engine and the battery;

**[0021]** Fig. 12 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery; and

**[0022]** Fig. 13 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery.

**Description of exemplifying embodiments**

**[0023]** Referring to Fig. 1, there is shown a perspective view of a portable electronic device 10 incorporating features of the invention. Although the invention will be described with reference to the exemplary embodiments shown in the drawings, it should be understood that the invention can be embodied in many alternate forms of embodiments. In addition, any suitable size, shape or type of elements or materials could be used.

**[0024]** In the embodiment shown, the device 10 comprises a hand-held mobile telephone. However, in alternate embodiments, features of the invention could be used in other types of portable electronic devices, such as a PDA or a hand-held gaming device for example. The telephone 10 is a flip-phone type of telephone comprising a first section 12 connected to a second section 14 by a movably connecting section 16. In this embodiment the connecting section 16 is a hinge. However, in alternate embodiments, any suitable type of movable connecting section could be provided. Fig. 1 shows the telephone 10 in an open configuration. Fig. 2 shows the telephone 10 in a closed configuration.

**[0025]** Referring also to Figs. 3-6, in the closed configuration, the second section 14 lies directly opposite the first section 12. The hinge 16 allows the second section 14 to pivot open to the open configuration at an angle 18 of about 165°. However, in alternate embodiments, the angle 18 could have any suitable angle. In the closed configuration, the telephone has a height 20 of about 88.7 mm, a width 22 of about 45 mm, and a thickness 24 of about 15 mm. In the open configuration, the telephone has a length 26 of about 166 mm. However, in alternate embodiments, any suitable dimensions could be provided. As seen with reference to Fig. 3, the design shown has a substantially uniform thickness lower section 12 and a substantially uniform thickness upper section 14 along their entire lengths except for at the hinge 16. As seen best in Figs. 5 and 14, when the two sections 12, 14 are closed, the telephone 10 has a block shape with grooves along the joints at the lateral sides, but with the ends of the sections 12, 14 being at the same bottom end of the closed shape.

**[0026]** Referring also to Fig. 7, there is shown an exploded perspective view of the telephone 10 for details of how the small thickness 24 of about only 15 mm in a flip-phone design can be accomplished. The first section 12 generally comprises a first housing member 28, an engine 30, a battery 32, a user input section 34, and an antenna module 36. Additional components could be provided. The first housing member 28 generally comprises a one-piece tubular member. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after it is extruded. The first housing member 28 forms a majority of opposite exterior lateral sides 38 and a rear side 40 of the first section 12 (except at top and bottom ends 42, 44 of the first section). The front side of the first housing member 28 has holes 46 therethrough for portions of the user input section 34 to be located in the holes. Because of the tubular shape of the first housing member 28, the first housing member 28 has substantially open top and bottom apertures, which are slanted in the embodiment shown.

**[0027]** The antenna module 36 is located at the bottom aperture into the first housing member 28 and enclosed by the antenna cover 48. The antenna cover 48, such as made of plastic, is attached to the first housing member 28 at the bottom aperture to keep the antenna module 36 attached to the rest of the telephone. In one type of embodiment, the antenna module could be a STINGRAY antenna from RaySat, Inc. However, any suitable antenna module could be provided.

**[0028]** The user input section generally comprises keymats 50, an EL backlight foil 52, a keymat dome sheet 54 and a keymat stiffener 56. However, in alternate embodiments, any suitable user input section could be provided. The keymats 50 are located in the holes 46 of the first housing member 28. The other components of the user input section are located inside the first housing member 28. A cross bar portion 47 of the first housing member 28 is located between the two keymats 50.

**[0029]** The engine 30 generally comprises a printed circuit board, a transceiver, a processor, and a memory, among other components. Referring also to Fig. 8, the width of the engine 30 is only about less than half the width 22 of the telephone. The battery 32 is located adjacent the lateral side of the engine 30 and is also about less than half the width 22 of the telephone. Unlike conventional telephones which have the engine located above the battery, the configuration of the side-by-side engine/battery allows the battery and the engine to have a practical design thickness and still provide a reduced thickness 24 as compared to conventional flip-phones. The keypads are located above the engine section 30 and the battery 32, wherein the user input section 34 is located directly opposite the battery 32 without a significant portion of the engine section 30 therebetween.

**[0030]** The connecting section 16 has a first hinge member 58 and a second hinge member 60. The first hinge member 58 is connected to the top end of the first frame member 28 to substantially close the open top end of the first frame member 28. The first hinge member 58 also comprises a door 61 for access to the battery 32 such that the battery can be removed, and a door 63 for access to the engine 30 for inserting and removing an



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electronic module 65, such as a SIM card or flash memory or other memory card. The doors 61, 63 are located below the shoulders 62 such that there is a path at the connecting section 16 past the second hinge member 60. In an alternate embodiment, the connecting section 16 could have only one door; for the battery or for the electronic module or both. The door(s) is preferably connected to the rest of the first hinge member 58 by a living hinge. However, in alternate embodiments any suitable type of doorway system could be provided. In other alternate embodiments any suitable access entry could be provided. In a preferred embodiment the door(s) support the electronic device (such as the battery 32 and/or electronic module 65). The engine 30 comprises electrical connectors 67 and 69 for the electronic devices 32 and 65 to connect to inside the first section 12.

**[0031]** The first hinge member 58 has shoulders 62 with interior facing apertures to receive ends of the hinge module 64. The hinge module 64 is mounted in the second hinge member 60. The second hinge member 60 is sized and shaped to pivotably fit between the shoulders 62. In an alternate embodiment any suitable type of hinge assembly could be provided, such as disclosed in U.S. Patent No. 6,900,981, and U.S. Patent Application Nos. 10/610,978, 11/055,914, 11/077,674, and 11/253,017, for example, which are hereby incorporated by reference in their entireties. In an alternate embodiment, the electronic device insertion and removal feature through a movable connection section of the invention could be used in other types of telephones having movable sections including, for example, a slide phone such as shown in U.S. Patent No. Des. 427,171 which is hereby incorporated by reference in its entirety, or could be used in other apparatus, such as a gaming device or PDA having two movable sections connected by a hinge or connecting section.

**[0032]** The second section 14 generally comprises a second housing member 66, a display module 68 and a camera 70. The second housing member 66 preferably comprises a one-piece member having a general tubular shape. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after extrusion. The second housing member 66 forms portions of opposite exterior lateral sides 72, a front side 74 and a rear side 76 of the second section 14. The front side of the second housing member 66 has a hole 78. A front portion 80 of the display module 68 can be located for viewing through the hole 78. The rear side of the second housing member 66 has a hole 82 therethrough. A rear portion 84 (see Fig. 4) of the display module 68 is located for viewing through the hole 82. Front portion 80 forms a main display, and rear portion 84 forms a sub-display. A window 86 can be glued onto the sub-display 84. Because of the tubular shape of the second housing member 66, the second housing member 66 has substantially open top and bottom apertures, which are slanted in the embodiment shown.

**[0033]** The display module 68, camera 70 and a speaker or sound transducer 88 are coupled to the engine 30 by a flex cable assembly 90 which extends through the hinge 16. A mounting bracket 92 is provided for mounting the display module 68 inside the second housing member 66 between the second hinge member 60 and a speaker cover 94 at opposite ends of the second housing member 66. An optional second camera 96 could also be provided.

**[0034]** The camera 70 extends to the rear side 76 of the second section 14. The camera 70 is housed at an exterior side of the portable electronic device by a junction 98 of a cutout portion 99 of the second hinge member 60 and a cutout portion 100 of the second tubular housing member 66. The cutout portions 99, 100 project slightly from the rear side of the telephone to form a protrusion 142 (see Fig. 14). By providing a projecting portion of the housing for the camera, rather than making the housing flush with the camera, this allows the rest of the telephone to have the reduced thickness 24, but still use a standard size camera.

**[0035]** Referring also to Figs. 9-10, alternate embodiments of configuration of the battery relative to the engine of Fig. 8 is shown. Fig. 10 shows an embodiment where the battery 102 and engine 104 are located in the first section 12 in a side-by-side configuration. This side-by-side configuration comprises the battery 102 being located at a top side of the engine 104 proximate the hinge end of the first section. Fig. 11 shows an embodiment where the battery 102 is located between two portions 106, 108 of the engine 110. Thus a split side-by-side configuration is provided. In both of these alternate embodiments the keypad is located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a substantial portion of the engine section therebetween.

**[0036]** Figs. 11-13 show other alternate embodiments of positioning the battery relative to the engine. In Fig. 11 the battery 112 is located below the engine 114. The keypad 116 is located above the engine 114. The components 112, 114, 116 are housed in a one-piece metal tubular housing member 118. The keypad is located at a hole through the front side 120 of the housing member 118. Otherwise, the housing member 118 forms enclosed lateral exterior sides 122 and rear side 124.

**[0037]** Fig. 12 shows an embodiment similar to Fig. 11. However, in this embodiment the battery 126 is thinner and wider than the battery 112. The tubular housing member 128 is thinner and wider than the tubular housing member 118. Fig. 13 shows another alternate embodiment. In this embodiment the battery 130 is about half the width of the tubular housing member 132. The engine 134 comprises a portion 136 located at the lateral side of the battery 130 and another portion 138 located between the battery and the keypad 140. The configurations shown in Figs. 11-13 could be used in candy-bar style telephone handsets as well as flip-phone style handsets.



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**[0038]** One of the features of the invention is the use of tubular members to form the major housing components of the first and second sections of the flip-phones. The tubular housing members provide an increased strength than conventional housing designs. This allows the reduction in side of the housing components versus conventional housing components and, thus, a reduction in the thickness 24 of the telephone. In addition, the side-by-side positioning of the battery/engine can further allow a reduction in thickness of the handset versus conventional stacked battery/engine handsets.

**[0039]** With the present invention a user exchangeable battery and/or cards (SIM, flash and other memory cards) can be inserted and removed through the hinge end in a portable terminal. The housing of a fold phone can be extruded in one material. Extruding a housing in one material and having a user exchangeable battery (and cards) through a hinge end can be provided. With the invention a battery can be located next to the PWB on a lateral side of the phone.

**[0040]** It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.

## Claims

1. A portable electronic device comprising:

   an engine section comprising a printed circuit board, a transceiver, a processor and a memory;
   a battery located adjacent the engine section; and
   a user input section located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

2. A portable electronic device as in claim 1 wherein the portable electronic device comprises a first section and a second section movably connected to the first section and said engine section is located in the first section.

3. A portable electronic device as in claim 2 wherein the second section has a display and/or camera.

4. A portable electronic device as in claim 1 wherein the battery is located at a lateral side of the engine section.

5. A portable electronic device as in claim 1 wherein the engine section is located at opposite sides of the battery.

6. A portable electronic device as in claim 5 wherein the battery is located between two portions of the engine section.

7. A portable electronic device as in claim 5 wherein the battery is located in a side by side arrangement between two portions of the engine section.

8. A portable electronic device as in claim 1 wherein the portable electronic device comprises a first section comprising a first one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the first section, wherein the engine section, battery and user input section are housed in the first section.

9. A portable electronic device as in claim 8 wherein the portable electronic device comprises a second section pivotably connected to the first section, wherein the second section comprises a second one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the second section.

10. A portable electronic device as in claim 1 wherein the portable electronic device comprises a first section pivotably connected to a second section by a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and the portable electronic device further comprises a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of a one-piece second tubular housing member of the second section, wherein the second tubular housing member forms opposite exterior lateral sides of the second section.

11. A portable electronic device according to any preceding claim wherein the user input section comprises a keypad.

12. A portable electronic device according to any preceding claim wherein the portable electronic device is any of a PDA, gaming machine or mobile telephone.



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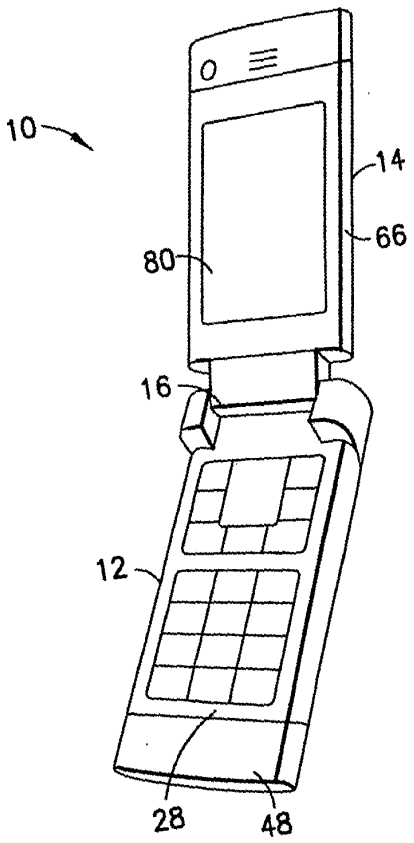



FIG.1

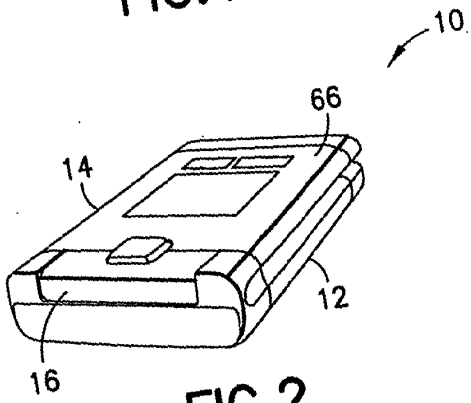



FIG.2



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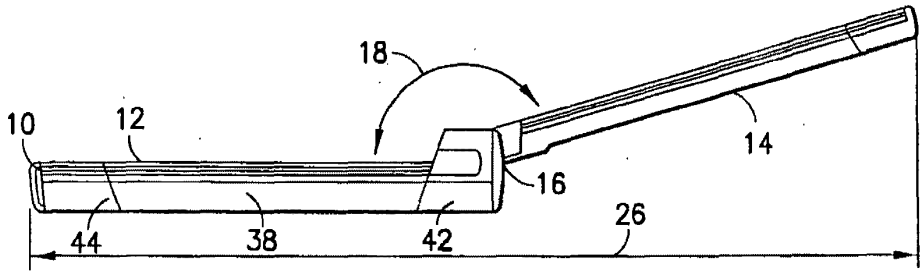



FIG.3

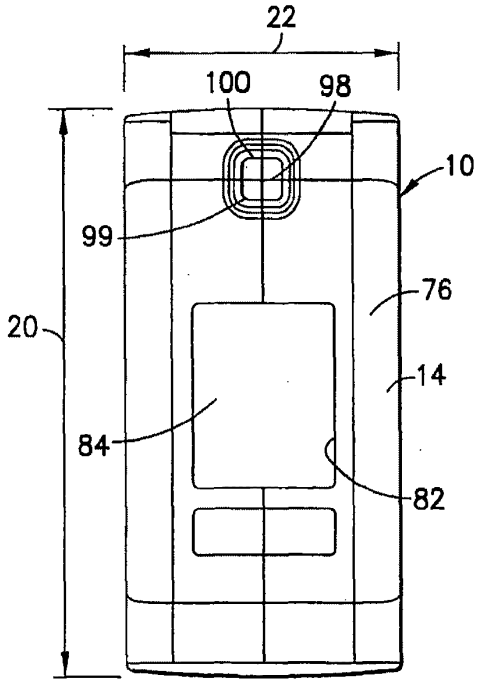



FIG.4



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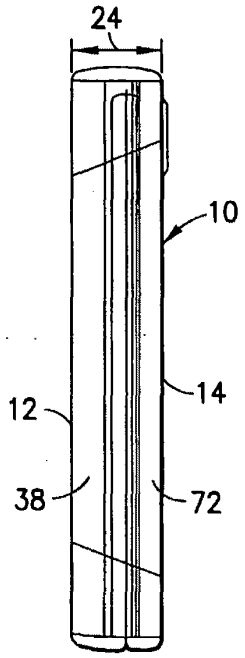



FIG.5

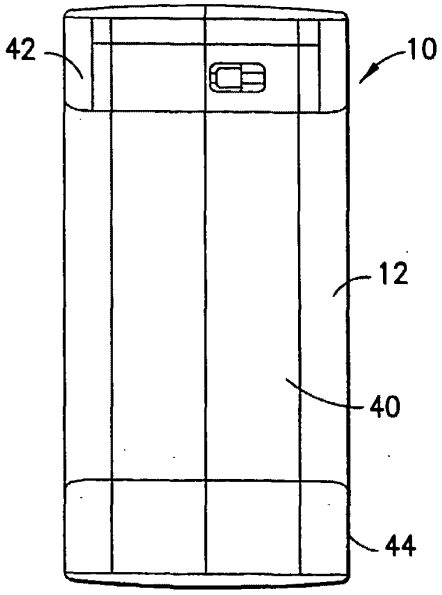



FIG.6



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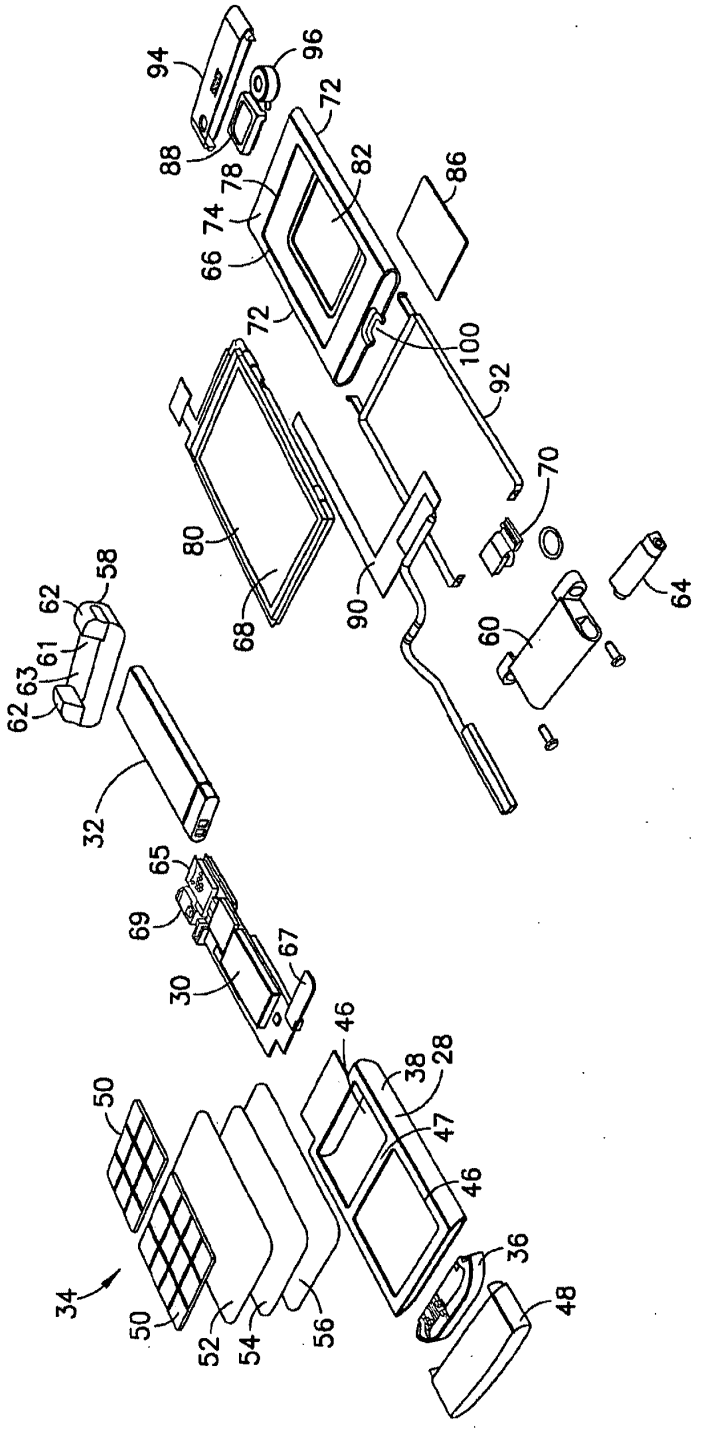



FIG.7



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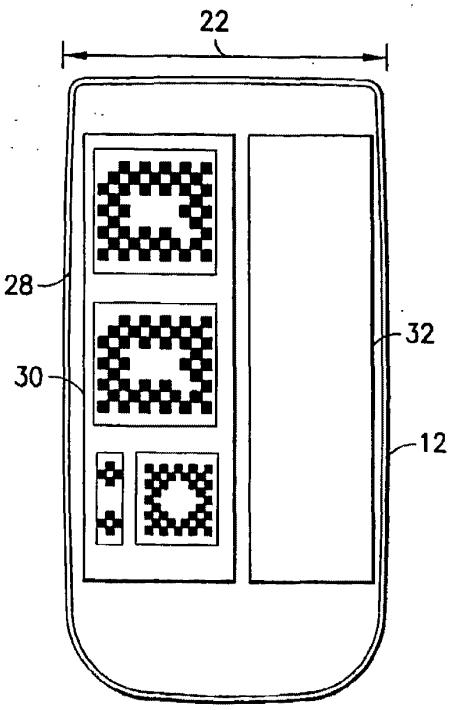



FIG.8

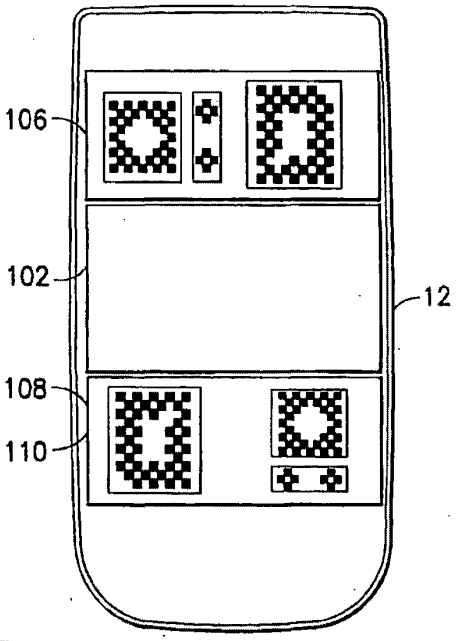



FIG.10

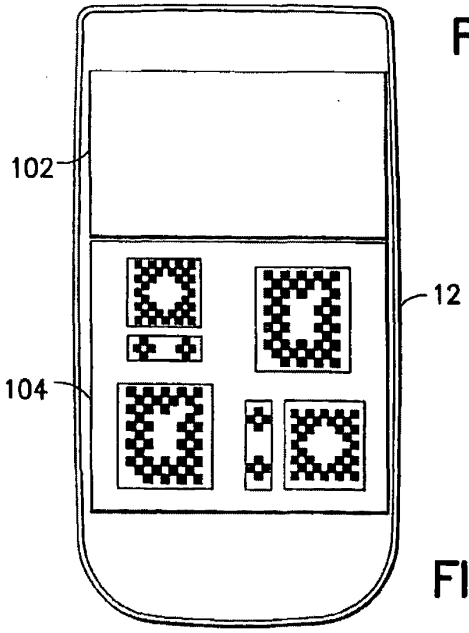



FIG.9



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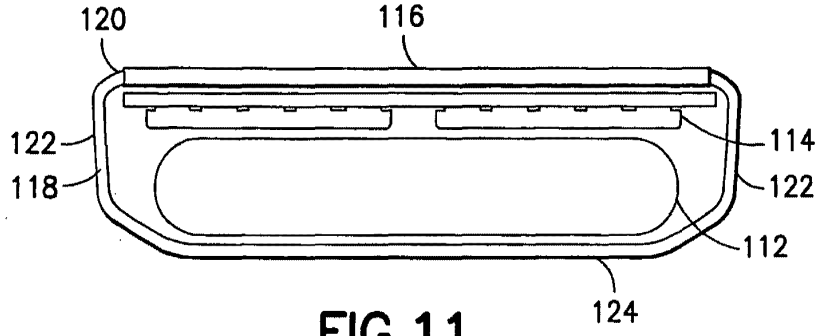



FIG.11

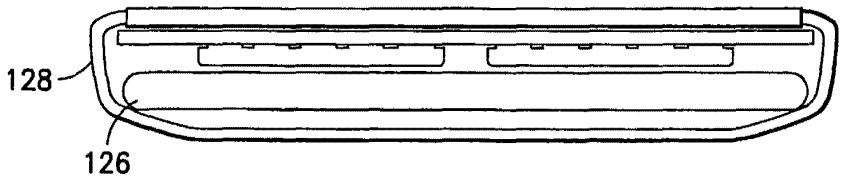



FIG.12

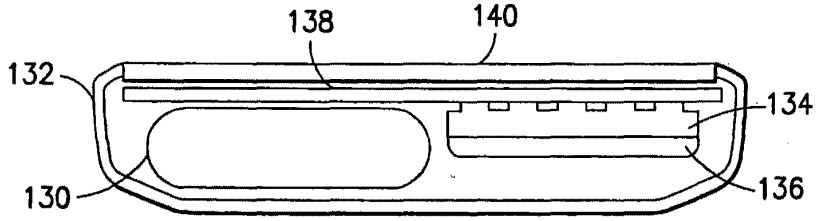



FIG.13



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# EUROPEAN SEARCH REPORT

Application Number
EP 12 15 9141

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
| Munich | 23 May 2012 | Bianchi, Damiano |

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X : particularly relevant if taken alone
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O : non-written disclosure
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EPO FORM 1503 03.82 (P04C01)



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23-05-2012

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



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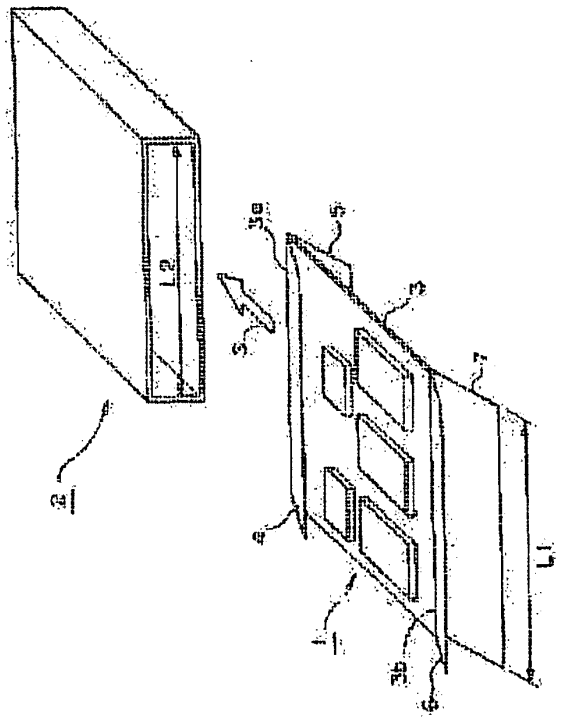
# Bibliographic data: JP2000133973 (A) — 2000-05-12

## ELECTRONIC COMPONENT

No documents available for this priority number.

| | |
|---|---|
| **Inventor(s):** | HASEGAWA TAKUMI ± (HASEGAWA TAKUMI) |
| **Applicant(s):** | NEC CORP ± (NEC CORP) |
| **Classification:** | **- international:** ***H05K7/12; H05K7/14;*** (IPC1-7): H05K7/12<br>**- cooperative:** **H05K7/142** |
| **Application number:** | JP19980301424 19981022 |
| **Priority number(s):** | JP19980301424 19981022 |
| **Also published as:** | JP3389119 (B2) US6381142 (B1) |

**Abstract of JP2000133973 (A)**






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PROBLEM TO BE SOLVED: To save the labor for making a holding mechanism on a case and to facilitate assembling/disassembling an electronic component on/from the case, by providing the main body of a tabular component capable of inserting into the case and elastic members which are fixed on the front and rear surfaces of the main body of the component and which are pressed on the inner surface of the case with the board inserted into the case to keep the entire component in an engaged state.
SOLUTION: A printed wiring board 1 is provided with the main body of a board 3 capable of inserting into a case 2 of a thin computer; and metal plates i.e., four plate springs 4 to 7 (elastic members) which are fixed on the front and rear surfaces of the main body of the board 3, and which are pressed to the inner surface of the case 2 with the main body inserted into the case 2 to keep the entire component in a engaged state. To install the printed wiring board 1 into the case 2, the board 1 is inserted into the case 2 from the plate spring sides 4 and 5. Consequently, every plate springs 4 to 7 are deformed elastically and are pressed to the inner surface of the case 2 respectively by elastic force. As a result, the board 1 is kept in an engaged state and is semifixed in the case 2.

Last updated: 11.12.2013 Worldwide Database 5.8.15.10; 92p



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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報**（Ａ）　(11)特許出願公開番号
特開2000－133973
（P2000－133973A）
(43)公開日　平成12年５月12日(2000.5.12)

| (51)Int.Cl.' | 識別記号 | ＦＩ | | テーマコード'（参考） |
|---|---|---|---|---|
| Ｈ０５Ｋ　7/12 | | Ｈ０５Ｋ　7/12 | Ａ | ４Ｅ３５３ |

審査請求　有　　請求項の数３　ＯＬ　（全　４　頁）

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(22)出願日　平成10年10月22日(1998.10.22)

(71)出願人　000004237
日本電気株式会社
東京都港区芝五丁目７番１号

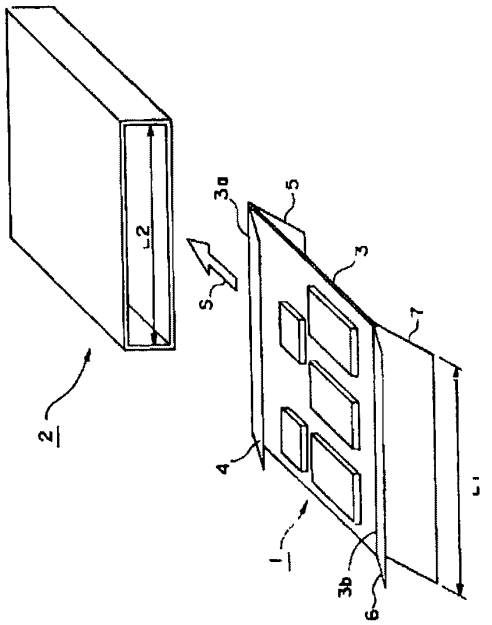
(72)発明者　長谷川　拓己
東京都港区芝五丁目７番１号・日本電気株式会社内

(74)代理人　100108578
弁理士　高橋　昭男　（外３名）

Ｆターム(参考)　4E353 AA16 AA17 AA20 BB02 CC02
CC13 CC16 CC33 CC36 DD05
DR02 DR36 DR42 GG13 GG19
GG20 GG21 GG31

(54)【発明の名称】　電子部品

(57)【要約】
【課題】　電子部品において、保持用機構を筐体に作製する手間がいらず、筐体への取り付けや取り外しを容易にすること。
【解決手段】　電子回路を備え筐体２内に設置される電子部品１であって、前記筐体内に挿入可能な板状の部品本体３と、該部品本体の表裏面に取り付けられ前記筐体内に挿入した状態で筐体内面に圧接して部品本体を係止状態にする弾性部材４，５，６，７とを備えている。




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【特許請求の範囲】
【請求項１】　電子回路を備え筐体内に設置される電子部品であって、
前記筐体内に挿入可能な板状の部品本体と、
該部品本体の表裏面に取り付けられ前記筐体内に挿入した状態で筐体内面に圧接して部品本体を係止状態にする弾性部材とを備えていることを特徴とする電子部品。
【請求項２】　請求項１記載の電子部品において、
前記弾性部材は、前記部品本体に基端部が固定されているとともに該基端部から前記筐体内への挿入方向に対して斜め後方に延びた板バネであることを特徴とする電子部品。
【請求項３】　請求項１または２記載の電子部品において、
前記弾性部材は、少なくとも前記挿入方向に対する前記部品本体の後端縁部に固定され前記筐体内に挿入された状態で筐体の開口部側を塞ぐように設定されていることを特徴とする電子部品。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、本発明は薄型コンピュータ等の筐体に実装されるプリント基板等の電子部品に関する。
【０００２】
【従来の技術】従来、例えば、薄型コンピュータ等の筐体内部にプリント基板を設置する場合、筐体とプリント基板とをネジ止めするか、ガイドレール等のプリント基板保持用の機構を用意する必要があった。
【０００３】
【発明が解決しようとする課題】筐体とプリント基板をネジ止めする場合、筐体へのプリント基板の取り付けや取り外しの手間が多くなるという不都合があり、また、ガイドレール等のプリント基板保持用の機構を用意する場合、筐体に保持用機構を作製する手間が多くなるという欠点があった。
【０００４】本発明は、前述の課題に鑑みてなされたもので、保持用機構を筐体に作製する手間がいらず、筐体への取り付けや取り外しが容易な電子部品を提供することを目的とする。
【０００５】
【課題を解決するための手段】本発明は、前記課題を解決するため、以下の構成を採用した。すなわち、請求項１記載の電子部品では、電子回路を備え筐体内に設置される電子部品であって、前記筐体内に挿入可能な板状の部品本体と、該部品本体の表裏面に取り付けられ前記筐体内に挿入した状態で筐体内面に圧接して部品本体を係止状態にする弾性部材とを備えている技術が採用される。
【０００６】請求項２記載の電子部品では、請求項１記載の電子部品において、前記弾性部材は、前記部品本体に基端部が固定されているとともに該基端部から前記筐体内への挿入方向に対して斜め後方に延びた板バネである技術が採用される。
【０００７】請求項３記載の電子部品では、請求項１または２記載の電子部品において、前記弾性部材は、少なくとも前記挿入方向に対する前記部品本体の後端縁部に固定され前記筐体内に挿入された状態で筐体の開口部側を塞ぐように設定されている技術が採用される。
【０００８】
【発明の実施の形態】以下、本発明に係る電子部品の一実施形態を、図１および図２を参照しながら説明する。これらの図において、符号１はプリント基板、２は筐体、３は基板本体、４～７は板バネである。
【０００９】本実施形態は、図１および図２に示すように、本発明に係る電子部品としてプリント基板１に適用したものであって、該プリント基板１は、薄型コンピュータの筐体２内に挿入可能な基板本体（板状の部品本体）３と、該基板本体３の表裏面に取り付けられ筐体２内に挿入した状態で筐体２内面に圧接して基板本体３を係止状態にする板金である４つの板バネ（弾性部材）４～７とを備えている。
【００１０】前記基板本体３は、その表裏面の少なくとも一方にプリント配線が形成されているとともに、電子回路が形成されたＬＳＩやＩＣ等が表面に実装されたものであり、外部と電気的に接続するためのコネクタ（図示略）が後端縁部３ｂに設けられている。なお、基板本体３の任意の場所からコネクタ等を通じて接続ケーブルを出して外部との電気的接続を行っても構わない。
【００１１】前記板バネ４～７は、基板本体３に基端部が固定されているとともに該基端部から筐体２内への挿入方向Ｓに対して斜め後方に延びるように取り付けられている。すなわち、板バネ４、５は、基板本体３の表裏面にそれぞれ配され基板本体３の先端縁部３ａに基端部が固定されて一対で断面くの字形状に取り付けられている。同様に、板バネ６、７は、基板本体３の表裏面にそれぞれ配され基板本体３の後端縁部３ｂに基端部が固定されて一対で断面くの字形状に取り付けられている。なお、板バネ４～７は、横幅Ｌ１が基板本体３に沿った筐体２の開口幅Ｌ２と同じに設定されている。
【００１２】このプリント基板１を筐体２内に設置するには、図１に示すように、プリント基板１を板バネ４、５側から筐体２内に挿入することにより、図２に示すように、各板バネ４～７が弾性変形しその弾性力によって筐体２内面をそれぞれ圧接するので、プリント基板１が係止状態となって筐体２内に半固定される。また、板バネ４～７によって、基板本体３が筐体２内面から離間状態に保持されるので、プリント配線やＬＳＩ等が筐体２に直接接触することを防ぐことができる。
【００１３】なお、通常、コンピュータの筐体には、プリント基板の挿入方向後方の筐体面に蓋等が取り付けら

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れ、内部が外部から見えないようになっているが、本実施形態では、板バネ６、７の横幅Ｌ１が、基板本体３に沿った筐体２の開口幅Ｌ２と同じに設定され、プリント基板１が筐体２内に挿入された状態で、板バネ６、７が筐体２の開口部側を塞ぐように設定されているので、筐体２内部が見えないようになっている。すなわち、本実施形態では、筐体２に蓋等を設ける必要がない。

【００１４】なお、本発明は、次のような実施形態をも含むものである。

（１）本実施形態では、板状の電子部品としてプリント基板１に適用したが、電子回路を備えたものならば、他の電子部品でも構わない。例えば、ＩＣカード等に適用してもよい。

【００１５】（２）設置する筐体として薄型コンピュータのものに適用したが、他の筐体に適用しても構わない。例えば、電話器、ビデオ、ＣＤ・ＭＤプレーヤー等の別の電気製品の筐体でもよい。また、一番外側の筐体に設置するものでなく、内部の筐体に設置しても構わない。

【００１６】（３）板バネ４～７によってプリント基板１を筐体２内に設置したが、挿入時に筐体内面に圧接するものなら他の弾性部材を用いて設置しても構わない。例えば、板バネの代わりに、スプリング、スポンジ、ゴム等の弾性部材を取り付けても構わない。また、複数種類の弾性部材を取り付けても構わない。例えば、本実施形態における板バネ４、５は板バネのままとし、板バネ６、７をスポンジに変えた組み合わせにしてもよい。

【００１７】（４）板バネ４～７をプリント基板１の先端縁部３ａおよび後端縁部３ｂに取り付けたが、他の任意の位置に取り付けても構わない。なお、上述したように、筐体の開口部を塞ぐ機能をプリント基板に付加したい場合は、板バネの一部をプリント基板の後端縁部３ｂに取り付けることが好適である。

【００１８】

【発明の効果】本発明によれば、以下の効果を奏する。

（１）請求項１記載の電子部品によれば、部品本体の表裏面に取り付けられ筐体内に挿入した状態で筐体内面に圧接して部品本体を係止状態にする弾性部材を備えているので、筐体内に挿入するだけで弾性部材の弾性力で電子部品を設置することができ、容易に取り付け及び取り外しを行うことができる。したがって、従来のネジ止め等の取り付け作業が不要になって、作業工数を削減できるとともに、筐体にガイドレール等の保持用機構を作製する必要が無く、設計の高い自由度が得られるとともに全体として小型化を図ることができる。また、振動等に対しても、弾性部材が緩衝材として機能するため、電子部品の耐衝撃性を向上させることもできる。

【００１９】（２）請求項２記載の電子部品によれば、弾性部材が、部品本体に基端部が固定されているとともに該基端部から筐体内への挿入方向に対して斜め後方に延びた板バネであるので、容易に挿入することができるとともに外れ難くすることができる。

【００２０】（３）請求項３記載の電子部品によれば、弾性部材が、少なくとも挿入方向に対する部品本体の後端縁部に固定され筐体内に挿入された状態で筐体の開口部側を塞ぐように設定されているので、筐体の外部から内部が見えないようにすることができ、筐体の開口部に蓋等を取り付ける必要が無くなり、部材点数の削減を図ることができる。

【図面の簡単な説明】

【図１】　本発明に係る電子部品としてプリント基板に適用した一実施形態を示す斜視図である。

【図２】　本発明に係る電子部品としてプリント基板に適用した一実施形態において、筐体内に挿入した状態を示す概略断面図である。

【符号の説明】

１　プリント基板（電子部品）

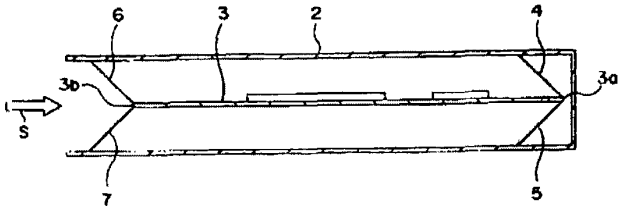
２　筐体

３　基板本体（部品本体）

３ｂ　基板本体の後端縁部

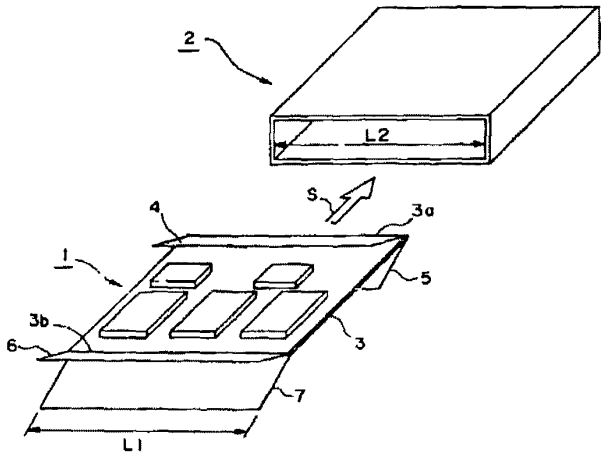
４、５、６、７　板バネ（弾性部材）

【図２】




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【図1】



Espacenet

## Bibliographic data: JP2001007550 (A) — 2001-01-12

### PORTABLE INFORMATION RADIO TERMINAL DEVICE AND ITS MANUFACTURE

No documents available for this priority number.

| | |
|---|---|
| **Inventor(s):** | IIDA HIROKO ± (IIDA HIROKO) |
| **Applicant(s):** | NEC CORP ± (NEC CORP) |
| **Classification:** | **- international:** ***G06F1/16; H04M1/02; H05K5/02;*** (IPC1-7): H04M1/02; H05K5/02<br>**- cooperative:** G06F1/1626; G06F1/1656; G06F1/1684 |
| **Application number:** | JP19990177730 19990624 |
| **Priority number (s):** | JP19990177730 19990624 |
| **Also published as:** | US6917517 (B1) |

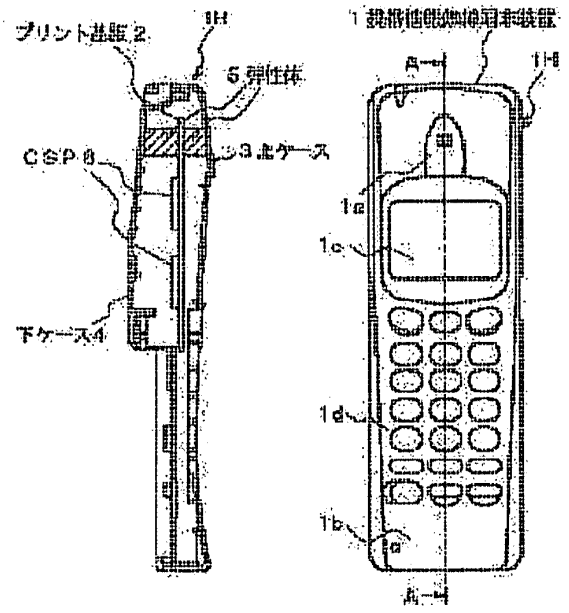
**Abstract of JP2001007550 (A)**

PROBLEM TO BE SOLVED: To hold electric connection of electronic components mounted on a board in a device body, when a portable radio information terminal device receives a shock (external force) due to fall or the like. SOLUTION: This terminal device is provided with a device body 1H constituted of a first case 3 and a second case 4 which are mutually combined, a printed wiring board 2 which is installed in the device body 1H and mounts electronic components 6, and elastic members 5 retaining the printed wiring board 2 in the device body. The elastic members 5 are arranged between the printed wiring board 2 and the first case 3, and between the printed wiring board 2 and the second case 4.

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（P2001－7550A）
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| (51)Int.Cl.[7] | 識別記号 | ＦＩ | | テーマコード(参考) |
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審査請求　有　　請求項の数８　ＯＬ　（全６頁）

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(71)出願人　000004237
日本電気株式会社
東京都港区芝五丁目７番１号

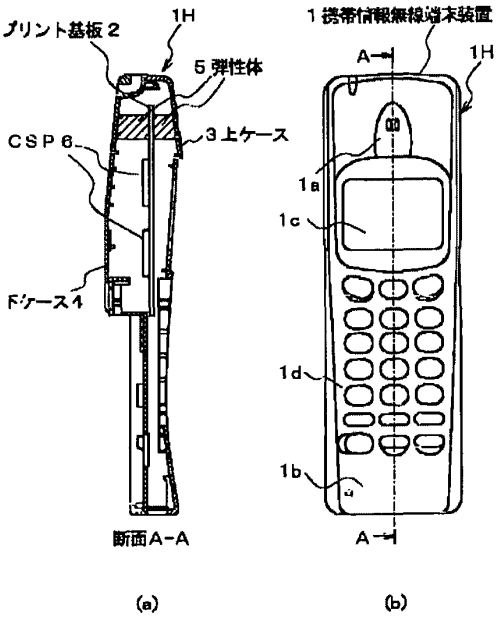
(72)発明者　飯田　裕子
東京都港区芝五丁目７番１号　日本電気株式会社内

(74)代理人　100102864
弁理士　工藤　実　（外１名）

Ｆターム(参考)　4E360 AA02 AB02 AB13 AB42 AB51
BA02 CA03 CA04 EA12 EA18
ED07 ED23 FA02 FA08 GA12
GA13 GA14 GB26 GC08
5K023 AA07 BB27 LL01 LL06 QQ04
RR08

(54)【発明の名称】　携帯情報無線端末装置およびその製造方法

(57)【要約】　（修正有）
【課題】　携帯無線情報端末装置が落下等による衝撃（外力）を受けたとき、その装置本体内の基板に搭載された電子部品の電気的接続を保持する。
【解決手段】　互いに組み合わされる第１および第２のケース３、４からなる装置本体１Ｈと、装置本体に設けられ電子部品６が搭載されるプリント基板２と、プリント基板を装置本体に支持する弾性体５とを備え、弾性体は、プリント基板と第１ケースの間およびプリント基板と第２ケースの間に設けられている携帯無線情報端末装置。




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【特許請求の範囲】
【請求項１】 装置本体と、
前記装置本体に設けられた電子部品と、
前記電子部品を前記装置本体に支持する弾性体とを備えた携帯情報無線端末装置。
【請求項２】 装置本体と、
前記装置本体に設けられたプリント基板と、
前記プリント基板に設けられた電子部品と、
前記プリント基板を前記装置本体に支持する弾性体とを備えた携帯情報無線端末装置。
【請求項３】 請求項２記載の携帯情報無線端末装置において、
前記装置本体は、互いに組み合わされる第１および第２のケースを備え、
前記弾性体は、前記プリント基板と前記第１ケースの間、および前記プリント基板と前記第２ケースの間に設けられている携帯情報無線端末装置。
【請求項４】 請求項３記載の携帯情報無線端末装置において、
前記第１ケースとの間に設けられた前記弾性体から前記プリント基板に作用する弾性力の方向、および前記第２ケースとの間に設けられた前記弾性体から前記プリント基板に作用する弾性力の方向は、前記第１および第２のケースの組み合わせ方向と実質的に一致している携帯情報無線端末装置。
【請求項５】 請求項２から４のいずれかに記載の携帯情報無線端末装置において、
前記弾性体は、前記プリント基板の長手方向の一端部側のみに設けられ、
前記プリント基板の前記長手方向の他端部側は、自由端である携帯情報無線端末装置。
【請求項６】 請求項１から５のいずれかに記載の携帯情報無線端末装置において、
前記装置本体を前記装置本体の長手方向に２分割して第１および第２部分としたときに、前記第１および第２部分のうちの前記携帯無線情報端末装置の重心が位置する方のみに前記弾性体が設けられている携帯情報無線端末装置。
【請求項７】 請求項２から６のいずれかに記載の携帯情報無線端末装置において、
前記弾性体は、前記プリント基板の片面につき複数設けられている携帯情報無線端末装置。
【請求項８】 第１ケースを提供するステップと、
前記第１ケースと組み合わされる第２ケースを提供するステップと、
電子部品が搭載されたプリント基板を提供するステップと、
前記第１および第２のケースのいずれか一方に、弾性体を介して前記プリント基板を配置するステップと、
前記第１および第２のケースのいずれか他方を、前記配置されたプリント基板との間に弾性体を介して、前記第１および第２のケースの前記一方と組み合わせるステップとを備えた携帯情報無線端末装置の製造方法。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】本発明は、携帯情報無線端末装置およびその製造方法に関し、特に、装置本体内のプリント基板に搭載された電子部品の電気的接続部の剥離・破断等を有効に防止できる携帯情報無線端末装置およびその製造方法に関する。
【０００２】
【従来の技術】従来、図３に示すように、携帯情報無線端末装置１１に組み込まれているプリント基板１２は、ねじ１５とボス１７によって装置本体に固定されている。したがって、携帯情報無線端末装置１１が衝撃を受けた際、ねじ止めした部分が、衝撃を受けたために起こるプリント基板１２の振動や撓みに順応することができず、ねじ止めされた部分を支点とした応力の集中が起こり、プリント基板１２の振動や撓みなどの現象がより大きく生じていた。その結果、プリント基板１２に搭載されたＣＳＰ（Ｃｈｉｐ Ｓｉｚｅ Ｐａｃｋａｇｅ：チップサイズパッケージ）１６のような半田ボール（電気的接続部）が剥がれるという問題があった。
【０００３】なお、実開昭５８－１６２６８９号公報に開示された次の技術が知られている。プリント配線およびリレー等の各種部品を搭載したプリント基板をケースに一体に固定する電子機器のプリント基板支持構造であって、前記ケースのプリント基板装着面側に弾性の係止突起を突設するとともに、これと対向してプリント基板を挟む間隔位置に補助突起を突設し、前記プリント基板には前記係止突起を嵌合係止すべき係止孔を形成した電子機器のプリント基板支持構造である。また、ケースおよびプリント基板の各支持部間の寸法許容量のための空隙部にゴム材等を介在させる旨が記載されている。
【０００４】また、特開平８－２３１８１号公報には、次の技術が知られている。回路基板は弾性を有する第１及び第２のローラで密着挟持される構成とされ、かつ、第１及び第２のローラ間に回路基板を挿入すると第１及び第２のローラは回路基板との摩擦力により基板挿入方向へ回転する。機器筐体に生ずる振動を吸収して回路基板を振動から保護することができ、しかも回路基板を筐体内に円滑に挿入できる保持構造として提供される。
【０００５】
【発明が解決しようとする課題】携帯無線情報端末装置が落下等による衝撃（外力）を受けたとき、その装置本体内の基板に搭載された電子部品の電気的接続が保持されることが望まれる。また、携帯無線情報端末装置が外力を受けたとき、その装置本体内の電子部品に大きな振動・衝撃が伝わることがなく、該電子部品の電気的接続が保持されると共に、該電子部品の故障の要因となるこ

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とがないことが望まれる。さらに、上記のような衝撃に強い携帯無線情報端末装置を容易に製造できることが望まれる。

【０００６】

【課題を解決するための手段】その課題を解決するための手段が請求項に対応して表現される次の記載中に現れる（）つきの数字は、請求項の記載事項が詳しく後述される実施の複数の形態のうちの少なくとも１つの形態の部材、工程、動作に対応することを示すが、本発明の解決手段がそれらの数字が示す実施の形態の部材に限定して解釈されるためのものではなく、その対応関係を明白にするためのものである。

【０００７】本発明の携帯情報無線端末装置（１）は、装置本体（１Ｈ）と、前記装置本体（１Ｈ）に設けられた電子部品（６）と、前記電子部品（６）を前記装置本体（１Ｈ）に支持する弾性体（５）とを備えている。

【０００８】本発明の携帯情報無線端末装置（１）は、装置本体（１Ｈ）と、前記装置本体（１Ｈ）に設けられたプリント基板（２）と、前記プリント基板（２）に設けられた電子部品（６）と、前記プリント基板（２）を前記装置本体（１Ｈ）に支持する弾性体（５）とを備えている。

【０００９】本発明の携帯情報無線端末装置（１）において、前記装置本体（１Ｈ）は、互いに組み合わされる第１および第２のケース（３、４）を備え、前記弾性体（５）は、前記プリント基板（２）と前記第１ケース（３）の間、および前記プリント基板（２）と前記第２ケース（４）の間に設けられている。

【００１０】本発明の携帯情報無線端末装置（１）において、前記第１ケース（３）との間に設けられた前記弾性体（５）から前記プリント基板（２）に作用する弾性力の方向、および前記第２ケース（４）との間に設けられた前記弾性体（５）から前記プリント基板（２）に作用する弾性力の方向は、前記第１および第２のケース（３、４）の組み合わせ方向と実質的に一致している。

【００１１】本発明の携帯情報無線端末装置（１）において、前記弾性体（５）は、前記プリント基板（２）の長手方向の一端部側のみに設けられ、前記プリント基板（２）の前記長手方向の他端部側は、自由端である。

【００１２】本発明の携帯情報無線端末装置（１）において、前記装置本体（１Ｈ）を前記装置本体（１Ｈ）の長手方向に２分割して第１および第２部分としたときに、前記第１および第２部分のうちの前記携帯無線情報端末装置（１）の重心が位置する方のみに前記弾性体（５）が設けられている。

【００１３】本発明の携帯情報無線端末装置（１）において、前記弾性体（５）は、前記プリント基板（２）の片面につき複数設けられている。

【００１４】本発明の携帯無線情報端末装置の製造方法は、第１ケース（３）を提供するステップと、前記第１ケース（３）と組み合わされる第２ケース（４）を提供するステップと、電子部品が搭載されたプリント基板（２）を提供するステップと、前記第１および第２のケース（３、４）のいずれか一方（４）に、弾性体（５）を介して前記プリント基板（２）を配置するステップと、前記第１および第２のケース（３、４）のいずれか他方（３）を、前記配置されたプリント基板（２）との間に弾性体（５）を介して、前記第１および第２のケース（３、４）の前記一方（４）と組み合わせるステップとを備えている。

【００１５】本発明による携帯情報無線端末装置は、装置本体に組み込まれたプリント基板を弾性力に富んだ材料から成る衝撃吸収材などの弾性体によって保持することで、落下などの衝撃を受けて起こる応力の集中を軽減し、プリント基板に搭載されたＣＳＰ等のチップの剥がれを防ぐものである。

【００１６】

【発明の実施の形態】以下、添付図面を参照して、本発明の携帯無線情報端末装置の一実施の形態を詳細に説明する。

【００１７】図１は、第１の実施形態の携帯無線情報端末装置を示しており、図１（ａ）は、正面図である図１（ｂ）のＡ－Ａ線断面図である。図１に示すように、受話部１ａ、送話部１ｂ、表示部１ｃ、および操作部１ｄを有する携帯情報無線端末装置１は、装置本体１Ｈ内に組み込まれたプリント基板２が、弾性体５によって装置本体１Ｈに保持されている。

【００１８】図１（ａ）に示すように、弾性体５は、上ケース３とプリント基板２の間、および下ケース４とプリント基板２との間にそれぞれ隙間がないように若干加圧して密着させる。隙間があると、衝撃吸収性ないし応力分散機能が低下するからである。

【００１９】携帯無線情報端末装置１が落下などの衝撃を受けると、上ケース３、下ケース４、装置本体１Ｈに組み込まれたプリント基板２等が大きく振動したり、撓むなどの現象が起きる。その際、上ケース３とプリント基板２の間、および下ケース４とプリント基板２の間に設置された弾性体５がその振動や撓みの現象を吸収する。また、接着点が一カ所ではない事と、振動や撓みに対し固定しようとする作用が働かない為、応力の集中をさけることができる。従って、プリント基板２自身の大きな振動を減少させることができる。これにより、プリント基板に搭載されたＣＳＰ６もプリント基板２から剥がれる現象が少なくなる。

【００２０】図１（ａ）に示すように、プリント基板２は、装置本体１Ｈの長手方向の約１／２の長さを有し、装置本体１Ｈの長手方向の約上半分に配置されている。プリント基板２における下ケース４の内面と対向する面には、ＣＳＰ（Ｃｈｉｐ　Ｓｉｚｅ　Ｐａｃｋａｇｅ：チップサイズパッケージ）６のような電子部品が搭載さ

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れている。

【0021】携帯無線情報端末装置1の各構成要素の中では、液晶表示部1cの重量が比較的大きく、携帯無線情報端末装置1の全重量に占める割合が大きくなっている。その液晶表示部1cは、図1（b）に示すように、装置本体1Hの長手方向の半分より上に位置していることから、携帯無線情報端末装置1は、その長手方向における中心部よりも上側に重心がある。したがって、携帯無線情報端末装置1が落下したとき、その長手方向の上側から落下して衝撃を受け易い。このことから、効率的な耐衝撃性を得るべく、弾性体5でプリント基板2を装置本体1Hに保持する部位は、携帯無線情報端末装置1の長手方向の上側で、プリント基板2の最上位部近傍とされている。

【0022】プリント基板2は、該プリント基板2の最上位部近傍側（長手方向一端部）のみで支持され、該プリント基板2の長手方向の他端部は、自由端となっている。これにより、プリント基板2の支持部（弾性体5）が弾性を有していることと相俟って、携帯無線情報端末装置1に外力が与えられたとき、プリント基板2は局部的な応力集中を伴うことなく適度にそれ自身が弾性変形して、プリント基板2に作用した外力エネルギーを失わせる。よって、プリント基板2上のCSP6の電気的接続部やCSP6自身に応力が集中することはない。

【0023】弾性体5のプリント基板2に対する接触面積、および弾性体5の上ケース3または下ケース4に対する接触面積は、互いに略同じ大きさであり、それらの接触面積はなるべく大きいことが望ましい。弾性体5によりプリント基板2を支持する面積を大きくすることにより、携帯無線情報端末装置1が衝撃を受けた際の応力が集中せず、プリント基板2の振動や撓み等を防ぐことができるためである。

【0024】前述したように、プリント基板2を支持する弾性体5は、装置本体1Hのうち上ケース3および下ケース4に対して接触している。携帯無線情報端末装置1が落下等したときには、携帯無線情報端末装置1のうち比較的広い面積が確保された、操作面および表示面となる上ケース3の上面か、その裏側に位置する下ケース4の裏面のいずれかの方向から落下等をして、その方向からの衝撃を受け易い。このことに関連して、弾性体5は、その衝撃吸収性を高めるため、装置本体1Hのうち、前記上面および裏面の面方向に延在する面で面接触している。

【0025】弾性体5と、プリント基板2および上下ケース3、4との間の接着は、各種接着剤が用いられる。この場合、接着剤自身による接着力に加えて、弾性体5が各上下ケース3、4からプリント基板2に向けて押圧される分の圧着力が働く。

【0026】弾性体5の材質および弾性係数は、携帯無線情報端末装置1の通常使用時に想定される高さから落下したときに携帯無線情報端末装置1が受ける衝撃を吸収し易く、電子部品の故障や接続部の剥離の防止にとって有効な値が選択される。弾性体5は、例えば、ゴム、スポンジ、ばね、合成樹脂のような緩衝材が考えられる。

【0027】図1（a）に示すように、プリント基板2と上ケース3との間、およびプリント基板2と下ケース4の間の双方に、弾性体5が配設されている。この場合、弾性体5は、互いに別体である2つの弾性体構成部からなり、これらの弾性体構成部がプリント基板2と上ケース3の間、およびプリント基板2と下ケース4の間にそれぞれ設けられている。または、弾性体5を2つの別体である弾性体構成部によって構成する代わりに、1つの弾性体5に切り込み部を形成し、その切り込み部にプリント基板2を挟み込む構成にすることができる。

【0028】弾性体5の弾性力によりプリント基板2を支持するに際して、その弾性力をプリント基板2に対して作用させる方向は、携帯無線情報端末装置1の製造時に上ケース3と下ケース4とを合わせて組み立てる方向（図1（a）中における水平方向）と一致している。したがって、携帯無線情報端末装置1の製造時には、上ケース3および下ケース4のいずれか一方の内面の所定位置に、弾性体5を介してプリント基板2を置いた状態で、そのまま上ケース3および下ケース4のいずれか他方を、その内面に配した弾性体5を介して被せればよい。これにより、弾性体5は、上ケース3、下ケース4およびプリント基板2に対して適度に相対的に加圧される。この場合、予め所定形状に成形された上ケース3および下ケース4の間に、弾性体5が挟まれることで、プリント基板2に作用させる弾性体5の弾性力の調整が自動的に好適に図られる。このことは、弾性体5が2つの弾性構成部から成っている場合と、弾性体5に切り込み部が形成されている場合のいずれであるかを問わない。

【0029】また、図示はしないが、弾性体5は、プリント基板2と上ケース3の間およびプリント基板2と下ケース4の間のいずれか一方側のみに設けることができる。また、プリント基板2は、該プリント基板2における長手方向一端部側のみで支持されているという意味で片持ち梁の状態とされている（但し、広い接触面積をもって支持されている）が、弾性体5によりその長手方向両端部で支持することが可能である。

【0030】次に、図2を参照して、本発明の第2の実施形態について説明する。

【0031】図2に示すように、弾性体5は、プリント基板2に搭載されたCSP6の近くに配置され、かつプリント基板2における複数箇所に貼り付けられている。複数の弾性体5のうちの一部は、プリント基板2の長手方向の両端部に配設され、他の一部は、略矩形状のCSP6の外縁部（辺）に沿って延在するように配設される。

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【００３２】図２に示した例では、プリント基板２のＣＳＰ６が搭載されている側の面２ａの面積に占める、該面２ａに複数（図２では５つ）設けられた弾性体５のそれぞれと該面２ａとの接触面積の合計の比率は、約７．５％である。弾性体５は、プリント基板２の面２ａの裏面にも複数貼着されていることが望ましく、また、応力分散作用ないし衝撃緩衝作用の点から、プリント基板２の表裏面のそれぞれの面積の５％以上に弾性体５が貼着されていることが望ましい。さらに、プリント基板２の表裏面のそれぞれに複数設けられる弾性体５は、該表裏面のそれぞれの互いに対応する箇所に設けることができ、あるいは、互いにずらした箇所に設けることができる。

【００３３】本実施形態の携帯情報無線端末装置１は、装置本体１Ｈに組み込まれたプリント基板２を衝撃吸収材のような弾性体５によって保持することにより、落下などの衝撃を受けて生じたプリント基板２の振動や撓みによって、プリント基板２に搭載されたＣＳＰ６などの半田ボールの剥がれ、破断を防止するものである。

【００３４】具体的には、図１において、携帯情報無線端末装置１内に組み込まれたプリント基板２は、上ケース３と下ケース４との間に装着された衝撃吸収材のような弾性体５によって保持されている。それにより、落下などにより衝撃を受けた際に生ずる応力が、一カ所の固定点に集中せず分散される作用が働くため、プリント基板２の大きな振動や撓みを防ぐことができ、またプリント基板２に搭載されたＣＳＰ６の破壊・故障を防ぐことができる。さらに、図２のように、弾性体５を複数箇所接着することによってその効果は大きくなる。

【００３５】なお、本実施形態では、上ケース３とプリント基板２の間、および下ケース４とプリント基板２の間に、弾性体５を介在させて弾性体５によりプリント基板２を支持するようにしたが、本発明では、支持体が弾性体５に限定されることは無い。携帯無線情報端末装置１に対して落下等による衝撃のような外力が作用した場合に、応力の一カ所への集中を防止すべく、応力が複数箇所ないし広い領域に分散されるように複数箇所ないし比較的大きな面積で支持するか、固定点での支持ではなく変位可能点での支持にして、応力を分散させることができる。

【００３６】以上説明した実施形態によれば、その効果の一つとして、基板に搭載されたＣＳＰの破断や剥がれの問題が解決される。そのため、携帯電話機の落下衝撃に対する影響が軽減される。その理由は、基板の固定にねじを使わず弾性体によって保持することにより、プリント基板を支える部分が広くなり、落下等の衝撃を受けた際の応力が集中せず、プリント基板の振動や撓み等を防ぐことができるためである。

【００３７】なお、弾性体５により支持するものは、プリント基板に限定されず、電子部品が搭載される各種基板の他、電子部品そのものであってもよい。

【００３８】

【発明の効果】本発明の携帯情報無線端末装置によれば、携帯情報無線端末装置が落下等による衝撃（外力）を受けたとき、その装置本体内の基板に搭載された電子部品の電気的接続が保持され、また電子部品の故障の要因となることを最小限に抑えることができる。

【図面の簡単な説明】

【図１】図１は、本発明の第１実施形態に係る携帯情報無線端末装置を示し、（ａ）は、正面図である（ｂ）のＡ－Ａ線断面図である。

【図２】図２は、本発明の第２実施形態に係る携帯情報無線端末装置のプリント基板および弾性体を示す正面図である。

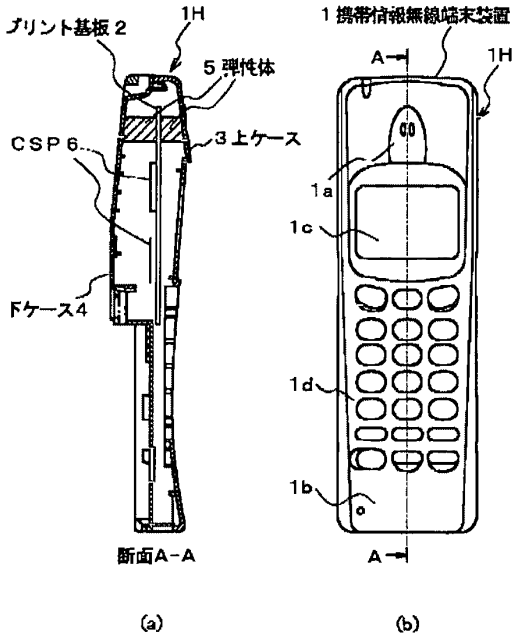
【図３】図３は、従来の携帯情報無線端末装置を示し、（ａ）は、正面図である（ｂ）のＡ－Ａ線断面図である。

【符号の説明】

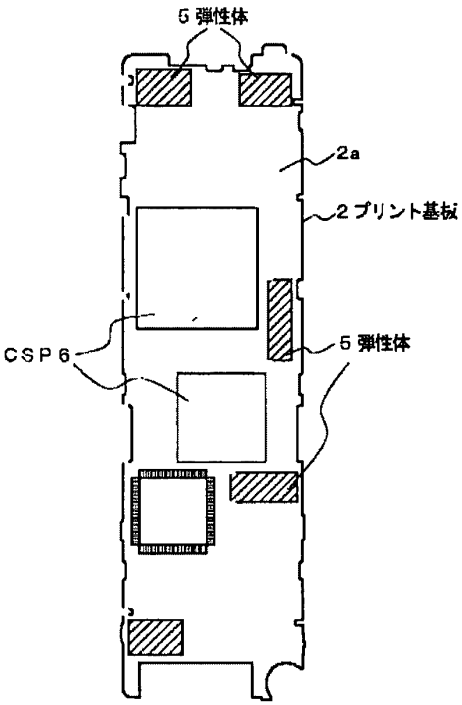
１　携帯無線情報端末装置
１ａ　受話部
１ｂ　送話部
１ｃ　表示部
１ｄ　操作部
１Ｈ　装置本体
２　プリント基板
２ａ　プリント基板のＣＳＰが搭載されている面
３　上ケース
４　下ケース
５　弾性体
６　ＣＳＰ

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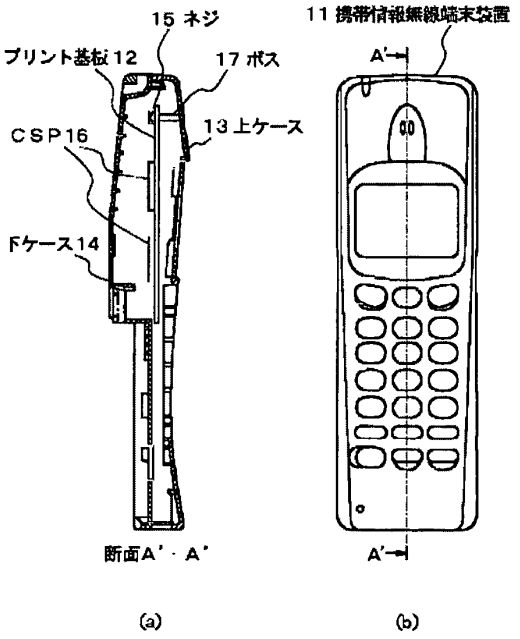
【図1】




【図2】




【図3】




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(71) Applicant *(for all designated States except LC, US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 ESPOO (FI).

(71) Applicant *(for LC only)*: **NOKIA, INC.** [US/US]; 6000 Connection Drive, Irving, TX 75039 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: **JORGENSEN, Claus, H.** [DK/DK]; Kong Georgsvej 58, 1.tv, DK-4000 Frederiksberg (DK).

(74) Agent: **HARRINGTON, Mark, F.**; Harrington & Smith, PC, 4 Research Drive, Shelton, CT 06484-6212 (US).

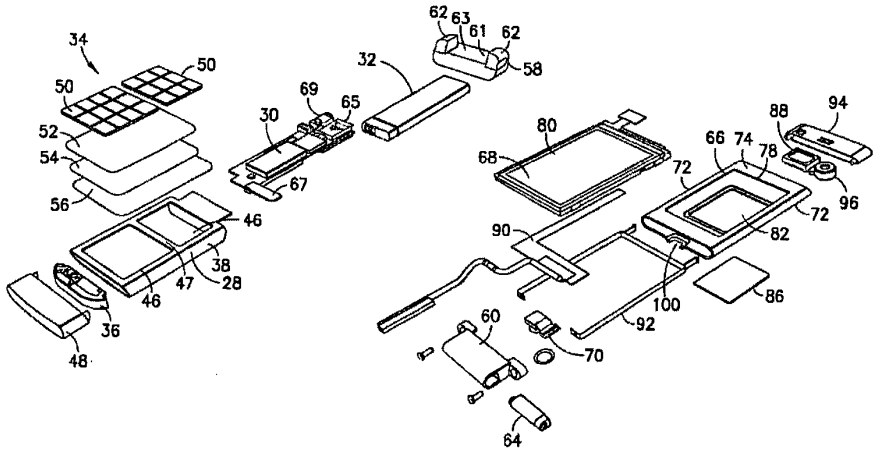
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(54) Title: PORTABLE ELECTRONIC DEVICE




(57) Abstract: A portable electronic device including a first section, a second section and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.

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# Portable Electronic Device

## BACKGROUND OF THE INVENTION

### Field of the Invention

**[0001]** The invention relates to a portable electronic device and, more particularly, to form factor configuration of a portable electronic device.

### Brief Description of Prior Developments

**[0002]** Ultra thin telephone products have emerged in the market, pioneering a new approach in mechanical architecture for flip-phone designs (also known a clam-shell handset). Priority for these products is mechanical thinness, allowing the feature set and industrial design to be adjusted to suit this goal. New flip-phones include the Motorola RAZR, the Motorola V3, the Motorola V3x, the Samsung SCH-V740, the NEC L1. For example, the Motorola RAZR has a thickness of about 0.54 inch. Candy-bar shaped mobile phones can have smaller thicknesses, such as the Motorola SLIVR with a thickness of about 0.45 inch and the Motorola SCALPEL with a thickness of about 0.25 inch.

**[0003]** There is a desire for an architecture for an ultrathin fold product, such as a flip-phone style of mobile telephone, which can maintain aesthetic balance in proportions, and allow added thickness to avoid a "squeezed" appearance as seen with the RAZR™ mobile telephone.



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## SUMMARY OF THE INVENTION

**[0004]** In accordance with one aspect of the invention, a portable electronic apparatus is provided comprising a first section comprising electronics; a second section movably connected to the first section by a hinge section, wherein the second section comprises a display; and an access entry provided in the hinge section adapted to allow insertion of an electrical device through the hinge section and into electrical connection with an electrical connector inside the first section.

**[0005]** In accordance with another aspect of the invention, a portable electronic device is provided including a first section, a second section and a connecting section. The first section has a user input section and a first tubular housing member. The first tubular housing member forms a majority of opposite exterior lateral sides of the first section. The second section has a display and a second tubular housing member. The second tubular housing member forms a majority of opposite exterior lateral sides of the second section. The connecting section movably connects the second section with the first section. The first tubular housing member at least partially houses the user input section. The second tubular housing member at least partially houses the display.

**[0006]** In accordance with another aspect of the invention, a mobile telephone is provided comprising an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a battery located adjacent the engine section; and a user input section comprising a keypad located directly above the engine



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section and the battery. The user input section is located directly opposite the battery without a portion of the engine section therebetween.

**[0007]** In accordance with another aspect of the invention, a portable electronic device is provided comprising a first section; a second section movably connected to the first section by a hinge; and a camera. The hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section. The camera is connected to the second section. The camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of an exterior housing of the second section.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0008]** The foregoing aspects and other features of the invention are explained in the following description, taken in connection with the accompanying drawings, wherein:

**[0009]** Fig. 1 is a perspective view of a mobile telephone comprising features of the invention;

**[0010]** Fig. 2 is a perspective view of the telephone shown in Fig. 1 is a closed configuration;

**[0011]** Fig. 3 is a side view of the telephone shown in Fig. 1;

**[0012]** Fig. 4 is a front view of the telephone shown in Fig. 2;



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**[0013]** Fig. 5 is a side view of the telephone shown in Fig. 2;

**[0014]** Fig. 6 is a rear view of the telephone shown in Fig. 2;

**[0015]** Fig. 7 is an exploded perspective view of the telephone shown in Figs. 1-6;

**[0016]** Fig. 8 is a schematic view showing the layout of the engine and the battery of the telephone shown in Figs. 1-7;

**[0017]** Fig. 9 is a schematic view similar to Fig. 8 showing an alternate embodiment of the layout of the engine and the battery;

**[0018]** Fig. 10 is a schematic view similar to Fig. 8 showing another alternate embodiment of the layout of the engine and the battery;

**[0019]** Fig. 11 is a schematic view showing an alternate embodiment of the layout of the engine and the battery;

**[0020]** Fig. 12 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery; and

**[0021]** Fig. 13 is a schematic view similar to Fig. 11 showing an alternate embodiment of the layout of the engine and the battery.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0022]** Referring to Fig. 1, there is shown a perspective view of a portable electronic device 10



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incorporating features of the invention. Although the invention will be described with reference to the exemplary embodiments shown in the drawings, it should be understood that the invention can be embodied in many alternate forms of embodiments. In addition, any suitable size, shape or type of elements or materials could be used.

**[0023]** In the embodiment shown, the device 10 comprises a hand-held mobile telephone. However, in alternate embodiments, features of the invention could be used in other types of portable electronic devices, such as a PDA or a hand-held gaming device for example. The telephone 10 is a flip-phone type of telephone comprising a first section 12 connected to a second section 14 by a movably connecting section 16. In this embodiment the connecting section 16 is a hinge. However, in alternate embodiments, any suitable type of movable connecting section could be provided. Fig. 1 shows the telephone 10 in an open configuration. Fig. 2 shows the telephone 10 in a closed configuration.

**[0024]** Referring also to Figs. 3-6, in the closed configuration, the second section 14 lies directly opposite the first section 12. The hinge 16 allows the second section 14 to pivot open to the open configuration at an angle 18 of about $165^{o}$. However, in alternate embodiments, the angle 18 could have any suitable angle. In the closed configuration, the telephone has a height 20 of about 88.7 mm, a width 22 of about 45 mm, and a thickness 24 of about 15 mm. In the open configuration, the telephone has a length 26 of about 166 mm. However, in alternate embodiments, any suitable dimensions could be provided. As seen with reference to Fig. 3, the



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design shown has a substantially uniform thickness lower section 12 and a substantially uniform thickness upper section 14 along their entire lengths except for at the hinge 16. As seen best in Figs. 5 and 14, when the two sections 12, 14 are closed, the telephone 10 has a block shape with grooves along the joints at the lateral sides, but with the ends of the sections 12, 14 being at the same bottom end of the closed shape.

**[0025]** Referring also to Fig. 7, there is shown an exploded perspective view of the telephone 10 for details of how the small thickness 24 of about only 15 mm in a flip-phone design can be accomplished. The first section 12 generally comprises a first housing member 28, an engine 30, a battery 32, a user input section 34, and an antenna module 36. Additional components could be provided. The first housing member 28 generally comprises a one-piece tubular member. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after it is extruded. The first housing member 28 forms a majority of opposite exterior lateral sides 38 and a rear side 40 of the first section 12 (except at top and bottom ends 42, 44 of the first section). The front side of the first housing member 28 has holes 46 therethrough for portions of the user input section 34 to be located in the holes. Because of the tubular shape of the first housing member 28, the first housing member 28 has substantially open top and bottom apertures, which are slanted in the embodiment shown.



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**[0026]** The antenna module 36 is located at the bottom aperture into the first housing member 28 and enclosed by the antenna cover 48. The antenna cover 48, such as made of plastic, is attached to the first housing member 28 at the bottom aperture to keep the antenna module 36 attached to the rest of the telephone. In one type of embodiment, the antenna module could be a STINGRAY antenna from RaySat, Inc. However, any suitable antenna module could be provided.

**[0027]** The user input section generally comprises keymats 50, an EL backlight foil 52, a keymat dome sheet 54 and a keymat stiffener 56. However, in alternate embodiments, any suitable user input section could be provided. The keymats 50 are located in the holes 46 of the first housing member 28. The other components of the user input section are located inside the first housing member 28. A cross bar portion 47 of the first housing member 28 is located between the two keymats 50.

**[0028]** The engine 30 generally comprises a printed circuit board, a transceiver, a processor, and a memory, among other components. Referring also to Fig. 8, the width of the engine 30 is only about less than half the width 22 of the telephone. The battery 32 is located adjacent the lateral side of the engine 30 and is also about less than half the width 22 of the telephone. Unlike conventional telephones which have the engine located above the battery, the configuration of the side-by-side engine/battery allows the battery and the engine to have a practical design thickness and still provide a reduced thickness 24 as compared to conventional flip-phones. The keypads are located above the engine section 30 and the battery 32, wherein the user input section 34



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is located directly opposite the battery 32 without a significant portion of the engine section 30 therebetween.

**[0029]** The connecting section 16 has a first hinge member 58 and a second hinge member 60. The first hinge member 58 is connected to the top end of the first frame member 28 to substantially close the open top end of the first frame member 28. The first hinge member 58 also comprises a door 61 for access to the battery 32 such that the battery can be removed, and a door 63 for access to the engine 30 for inserting and removing an electronic module 65, such as a SIM card or flash memory or other memory card. The doors 61, 63 are located below the shoulders 62 such that there is a path at the connecting section 16 past the second hinge member 60. In an alternate embodiment, the connecting section 16 could have only one door; for the battery or for the electronic module or both. The door(s) is preferably connected to the rest of the first hinge member 58 by a living hinge. However, in alternate embodiments any suitable type of doorway system could be provided. In other alternate embodiments any suitable access entry could be provided. In a preferred embodiment the door(s) support the electronic device (such as the battery 32 and/or electronic module 65). The engine 30 comprises electrical connectors 67 and 69 for the electronic devices 32 and 65 to connect to inside the first section 12.

**[0030]** The first hinge member 58 has shoulders 62 with interior facing apertures to receive ends of the hinge module 64. The hinge module 64 is mounted in the second hinge member 60. The second hinge member 60 is sized and



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shaped to pivotably fit between the shoulders 62. In an alternate embodiment any suitable type of hinge assembly could be provided, such as disclosed in U.S. Patent No. 6,900,981, and U.S. Patent Application Nos. 10/610,978, 11/055,914, 11/077,674, and 11/253,017, for example, which are hereby incorporated by reference in their entireties. In an alternate embodiment, the electronic device insertion and removal feature through a movable connection section of the invention could be used in other types of telephones having movable sections including, for example, a slide phone such as shown in U.S. Patent No. Des. 427,171 which is hereby incorporated by reference in its entirety, or could be used in other apparatus, such as a gaming device or PDA having two movable sections connected by a hinge or connecting section.

**[0031]** The second section 14 generally comprises a second housing member 66, a display module 68 and a camera 70. The second housing member 66 preferably comprises a one-piece member having a general tubular shape. In a preferred embodiment, the tubular member is comprises of metal, such as aluminum for example. In one type of embodiment, the tubular metal member could be formed from an extruded member with holes punched into it after extrusion. The second housing member 66 forms portions of opposite exterior lateral sides 72, a front side 74 and a rear side 76 of the second section 14. The front side of the second housing member 66 has a hole 78. A front portion 80 of the display module 68 can be located for viewing through the hole 78. The rear side of the second housing member 66 has a hole 82 therethrough. A rear portion 84 (see Fig. 4) of the



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display module 68 is located for viewing through the hole 82. Front portion 80 forms a main display, and rear portion 84 forms a sub-display. A window 86 can be glued onto the sub-display 84. Because of the tubular shape of the second housing member 66, the second housing member 66 has substantially open top and bottom apertures, which are slanted in the embodiment shown.

**[0032]** The display module 68, camera 70 and a speaker or sound transducer 88 are coupled to the engine 30 by a flex cable assembly 90 which extends through the hinge 16. A mounting bracket 92 is provided for mounting the display module 68 inside the second housing member 66 between the second hinge member 60 and a speaker cover 94 at opposite ends of the second housing member 66. An optional second camera 96 could also be provided.

**[0033]** The camera 70 extends to the rear side 76 of the second section 14. The camera 70 is housed at an exterior side of the portable electronic device by a junction 98 of a cutout portion 99 of the second hinge member 60 and a cutout portion 100 of the second tubular housing member 66. The cutout portions 99, 100 project slightly from the rear side of the telephone to form a protrusion 142 (see Fig. 14). By providing a projecting portion of the housing for the camera, rather than making the housing flush with the camera, this allows the rest of the telephone to have the reduced thickness 24, but still use a standard size camera.

**[0034]** Referring also to Figs. 9-10, alternate embodiments of configuration of the battery relative to the engine of Fig. 8 is shown. Fig. 10 shows an embodiment where the battery 102 and engine 104 are



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located in the first section 12 in a side-by-side configuration. This side-by-side configuration comprises the battery 102 being located at a top side of the engine 104 proximate the hinge end of the first section. Fig. 11 shows an embodiment where the battery 102 is located between two portions 106, 108 of the engine 110. Thus a split side-by-side configuration is provided. In both of these alternate embodiments the keypad is located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a substantial portion of the engine section therebetween.

**[0035]** Figs. 11-13 show other alternate embodiments of positioning the battery relative to the engine. In Fig. 11 the battery 112 is located below the engine 114. The keypad 116 is located above the engine 114. The components 112, 114, 116 are housed in a one-piece metal tubular housing member 118. The keypad is located at a hole through the front side 120 of the housing member 118. Otherwise, the housing member 118 forms enclosed lateral exterior sides 122 and rear side 124.

**[0036]** Fig. 12 shows an embodiment similar to Fig. 11. However, in this embodiment the battery 126 is thinner and wider than the battery 112. The tubular housing member 128 is thinner and wider than the tubular housing member 118. Fig. 13 shows another alternate embodiment. In this embodiment the battery 130 is about half the width of the tubular housing member 132. The engine 134 comprises a portion 136 located at the lateral side of the battery 130 and another portion 138 located between the battery and the keypad 140. The configurations shown



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in Figs. 11-13 could be used in candy-bar style telephone handsets as well as flip-phone style handsets.

**[0037]** One of the features of the invention is the use of tubular members to form the major housing components of the first and second sections of the flip-phones. The tubular housing members provide an increased strength than conventional housing designs. This allows the reduction in side of the housing components versus conventional housing components and, thus, a reduction in the thickness 24 of the telephone. In addition, the side-by-side positioning of the battery/engine can further allow a reduction in thickness of the handset versus conventional stacked battery/engine handsets.

**[0038]** With the present invention a user exchangeable battery and/or cards (SIM, flash and other memory cards) can be inserted and removed through the hinge end in a portable terminal. The housing of a fold phone can be extruded in one material. Extruding a housing in one material and having a user exchangeable battery (and cards) through a hinge end can be provided. With the invention a battery can be located next to the PWB on a lateral side of the phone.

**[0039]** It should be understood that the foregoing description is only illustrative of the invention. Various alternatives and modifications can be devised by those skilled in the art without departing from the invention. Accordingly, the invention is intended to embrace all such alternatives, modifications and variances which fall within the scope of the appended claims.



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CLAIMS

What is claimed is:

1. A portable electronic apparatus comprising:

a first section comprising electronics;

a second section movably connected to the first section by a hinge section, wherein the second section comprises a display; and

an access entry provided in the hinge section adapted to allow insertion of an electrical device through the hinge section and into electrical connection with an electrical connector inside the first section.

2. A portable electronic apparatus as in claim 1 wherein the access entry comprises a movable door on the hinge section.

3. A portable electronic apparatus as in claim 2 wherein the access entry comprises a living hinge connecting the door to the rest of the hinge section.

4. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to allow insertion of a battery through the access entry, and the electrical connector is adapted to electrically connect to the battery.

5. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to allow insertion of an electronic module through the access entry, and the electrical connector is adapted to electrically connect to the electronic module.



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6. A portable electronic apparatus as in claim 1 wherein the access entry is sized and shaped to at least partially support the electronic device when the electronic device is fully inserted into the portable electronic device.

7. A portable electronic device comprising:

a first section having a user input section and a first one-piece tubular housing member, wherein the first tubular housing member forms a majority of opposite exterior lateral sides of the first section;

a second section having a display and a second tubular housing member, wherein the second tubular housing member forms a majority of opposite exterior lateral sides of the second section; and

a connecting section movably connecting the second section with the first section,

wherein the first tubular housing member at least partially houses the user input section, and wherein the second tubular housing member at least partially houses the display.

8. A portable electronic device as in claim 7 wherein at least one of the first and second tubular housing members comprises a metal member.

9. A portable electronic device as in claim 8 wherein the first tubular housing members comprises an extruded member.



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10. A portable electronic device as in claim 7 wherein the connecting section comprises a hinge with a first hinge member forming a cap to an open end of the first tubular housing member and a second hinge member forming a cap to an open end of the second tubular housing member.

11. A portable electronic device as in claim 7 wherein the first section comprises:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

the user input section comprises a keypad located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

12. A portable electronic device as in claim 7 wherein the connecting section comprises a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and the portable electronic device further comprises a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of the second tubular housing member.

13. A portable electronic device as in claim 7 wherein the portable electronic device comprises a mobile telephone having a transceiver.



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14. A portable electronic device as in claim 7 wherein the connecting section comprises an access entry provided in the connecting section adapted to allow insertion of an electrical device through the connecting section and into electrical connection with an electrical connector inside the first section.

15. A mobile telephone comprising:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

a user input section comprising a keypad located above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

16. A mobile telephone as in claim 15 wherein the battery is located at a lateral side of the engine section.

17. A mobile telephone as in claim 15 wherein the engine section is located at opposite sides of the battery.

18. A mobile telephone as in claim 15 wherein the mobile telephone comprises a first section comprising a first one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the first section, wherein the engine section, battery and user input section are housed in the first section.

19. A mobile telephone as in claim 18 wherein the mobile telephone comprises a second section pivotably connected to the first section, wherein the second section



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comprises a second one-piece housing member having a general tubular shape and forming opposite exterior lateral sides of the second section.

20. A mobile telephone as in claim 15 wherein the mobile telephone comprises a first section pivotably connected to a second section by a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and the mobile telephone further comprises a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of a one-piece second tubular housing member of the second section, wherein the second tubular housing member forms opposite exterior lateral sides of the second section.

21. A portable electronic device comprising:

a first section;

a second section movably connected to the first section by a hinge, wherein the hinge comprises a first hinge member connected to the first section and a second hinge member connected to the second section; and

a camera connected to the second section, wherein the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of an exterior housing of the second section.



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22. A portable electronic device as in claim 21 wherein the first section comprises:

a first tubular housing member, wherein the first tubular housing member forms a majority of opposite exterior lateral sides of the first section, and located at the first tubular section:

an engine section comprising a printed circuit board, a transceiver, a processor and a memory;

a battery located adjacent the engine section; and

a user input section comprising a keypad located directly above the engine section and the battery, wherein the user input section is located directly opposite the battery without a portion of the engine section therebetween.

23. A portable electronic device as in claim 21 wherein the first section comprises a tubular metal housing member forming a majority of opposite exterior lateral sides of the first section, and wherein the second section comprises a tubular metal housing member forming a majority of opposite exterior lateral sides of the second section.

24. A portable electronic device as in claim 21 wherein the first and second sections each comprises tubular metal exterior housing members comprising extruded metal members.



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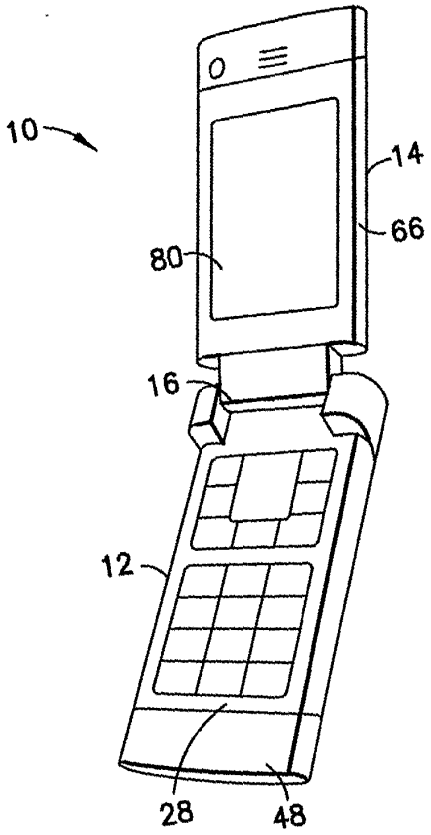



FIG.1

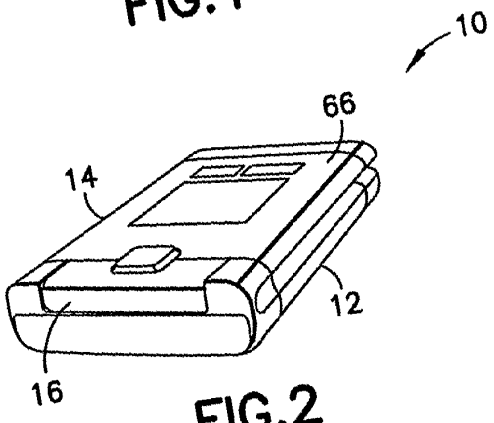



FIG.2

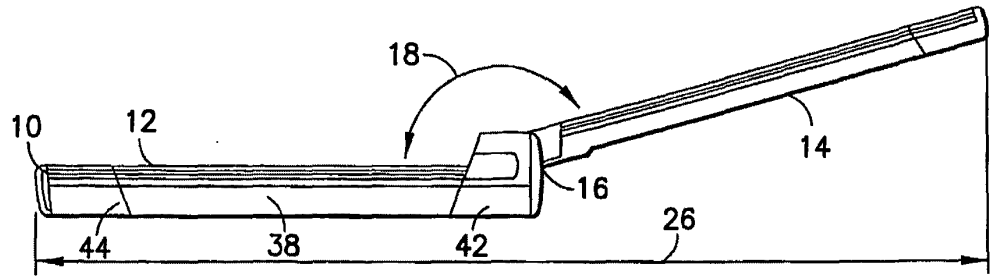



FIG.3

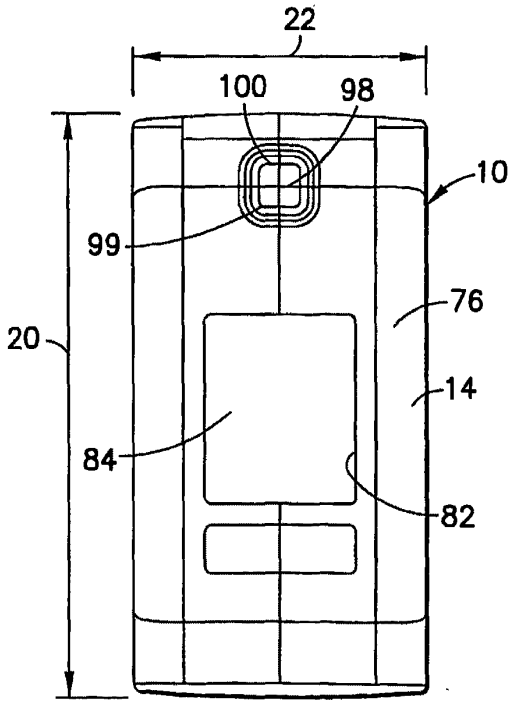



FIG.4

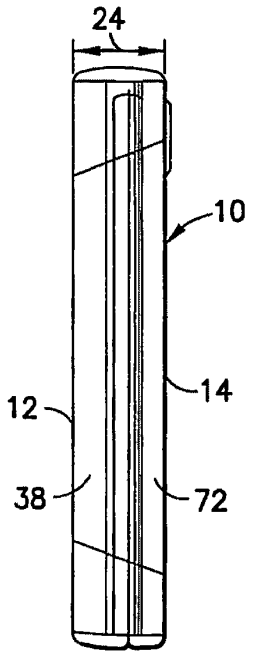



FIG.5

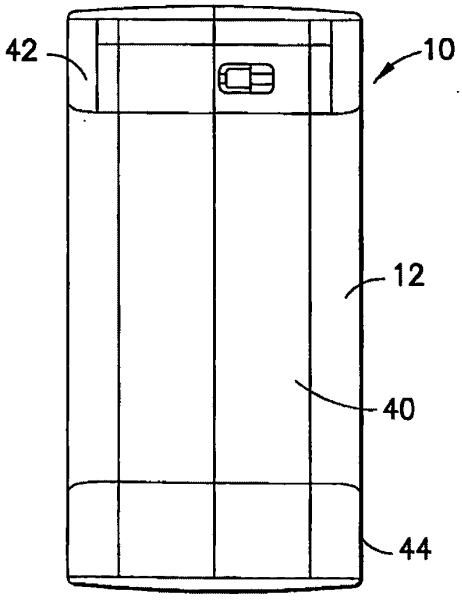



FIG.6

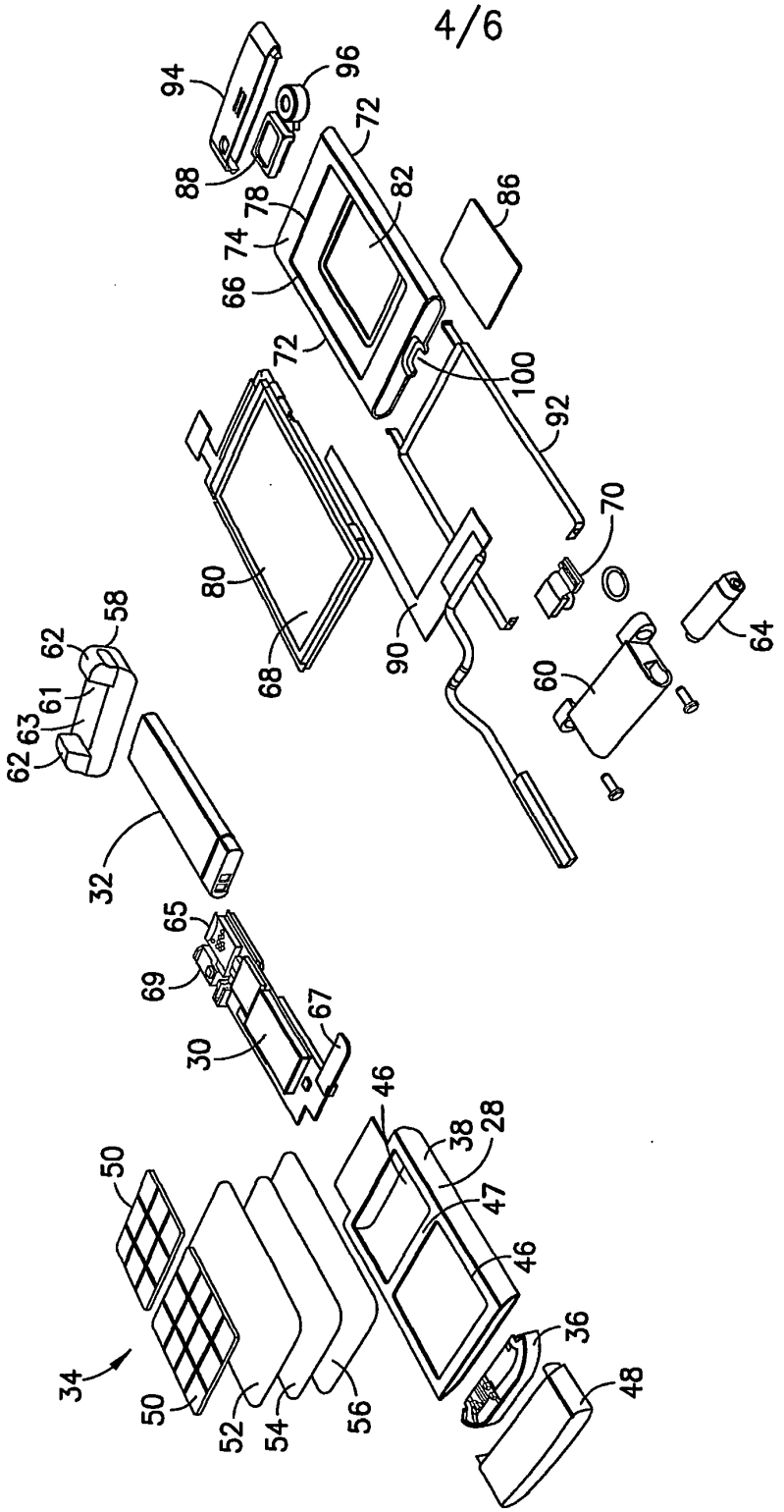

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FIG.7

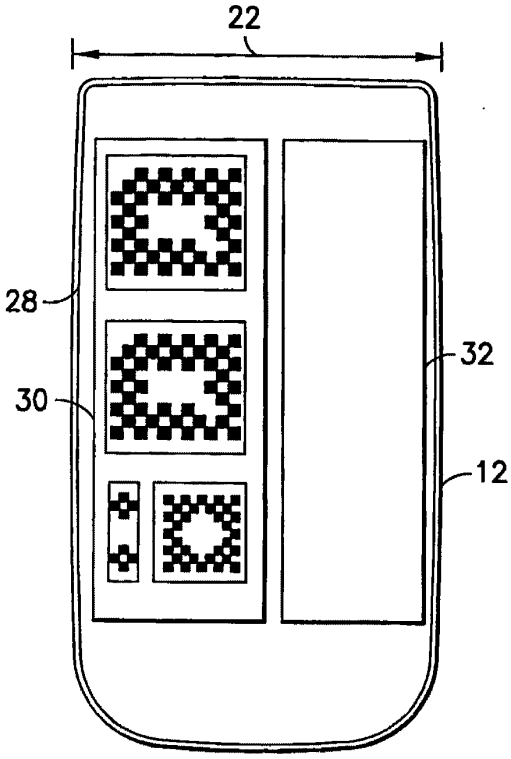



FIG.8

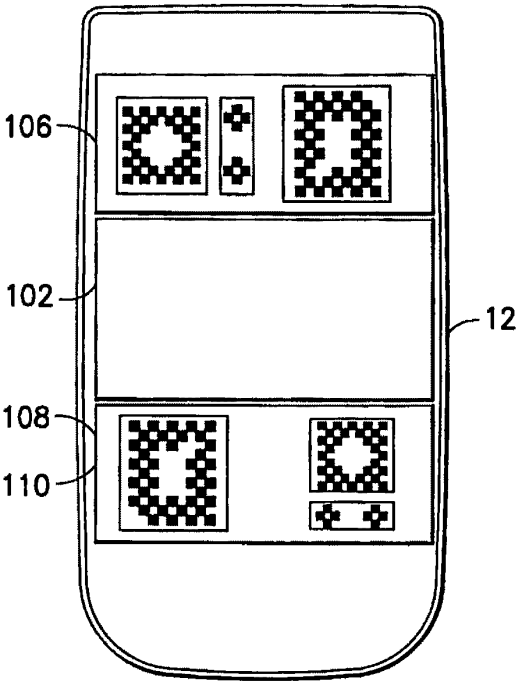



FIG.10

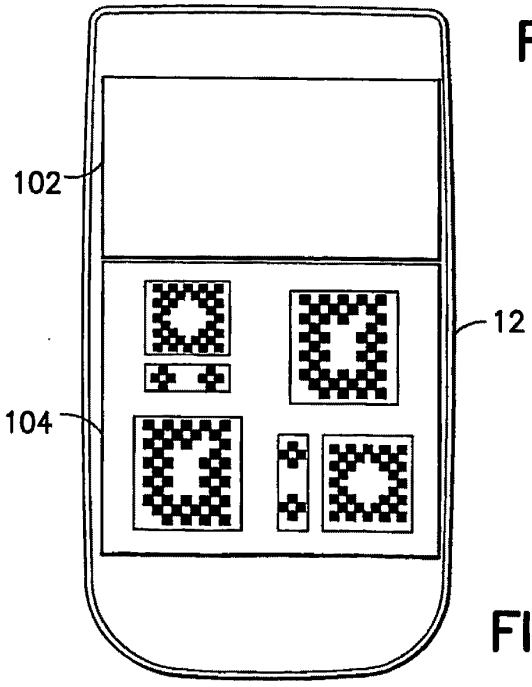



FIG.9

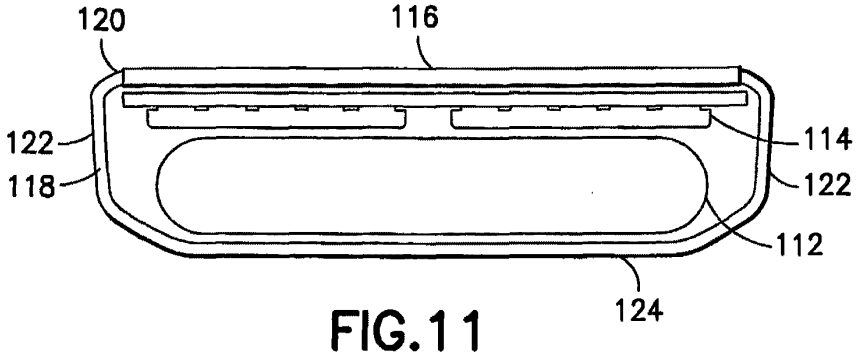



FIG.11

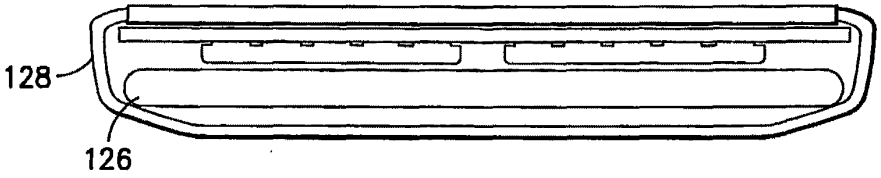



FIG.12

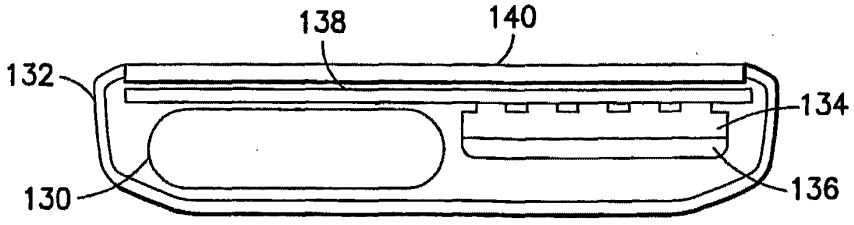



FIG.13

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

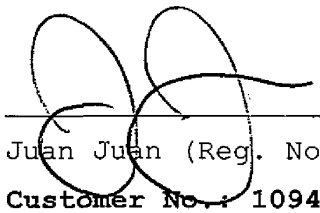


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that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



5/30/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
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# Electronic Acknowledgement Receipt

| | |
|---|---|
| **EFS ID:** | 19170228 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Robert J. Mauri/Gail Conway |
| **Filer Authorized By:** | Robert J. Mauri |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 30-MAY-2014 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 13:55:22 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

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| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
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| 3 | Non Patent Literature | Zire_72.pdf | 622892<br>7cf80d099264503f5be4969a58676086082742db | no | 3 |
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| 4 | Non Patent Literature | Motorola_Razr.pdf | 2411680<br>abcfbf8e14fc55de34a9edceb28ec7587842afbf | no | 12 |
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| 5 | Non Patent Literature | iPod_mini.pdf | 95145<br>eecd44bf3137e08285ab5aea132b59fd8ec3ce8c | no | 1 |
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| 6 | Non Patent Literature | Palm_One_Zire_31.pdf | 86627<br>ada81aeb74b9d45d9db34f70f107a807cfbc2045 | no | 1 |
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| 7 | Non Patent Literature | ipod_nano.pdf | 107864<br>4cfc7499e45e511a329ff1f549bfbe2a9c5a066a | no | 1 |
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| 8 | Non Patent Literature | Nokia_9300.pdf | 99878<br>d475583a59124e022099755e7c741f4254df8f29 | no | 1 |
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| 9 | Non Patent Literature | BlackBerry_857_Specs_CNET.pdf | 76804<br>e6ed8ec5f6a4138b5ee539818b37d4e0d967084d | no | 3 |
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| 10 | Non Patent Literature | BlackBerry_957_Specs_CNET.pdf | 92259<br>9cb5027a24b24db9bc23897333387c4a48744ce0 | no | 2 |

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| 11 | Non Patent Literature | Jonylve.pdf | 34171<br>ad5e0a32b00373401ec6adad6d39aa3e0dc80d94 | no | 2 |
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**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

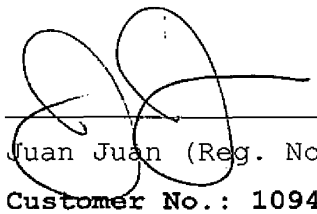


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that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



5/30/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US- | | | | |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | - -<br>- -<br>- - | | | |

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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

# Electronic Acknowledgement Receipt

| | |
|---|---|
| **EFS ID:** | 19174292 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Robert J. Mauri/Erin Lofink |
| **Filer Authorized By:** | Robert J. Mauri |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 30-MAY-2014 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 16:31:31 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

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| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
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| 1 | Information Disclosure Statement (IDS) Form (SB08) | IDS_05-30-2014.pdf | 77740<br>5a0228d3b76732ca8733d7479b2d6bc25dd8add0 | no | 3 |
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| 2 | Non Patent Literature | TonyFadellAppleseriouslyconsideredbuildinganiPhonewithhardwarekeyboard.pdf | 1095972<br>454feb89768856f909fd487261e9cbd34379e95b | no | 13 |
| **Warnings:** | | | | | |
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| 3 | Non Patent Literature | PalmOneZire31GettingStarted_pg1-38.pdf | 1366237<br>647c57d812686b1576c44549f9b918e1a902b732 | no | 38 |
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| 4 | Non Patent Literature | PalmOneZire31GettingStarted_pg39-69.pdf | 1026396<br>f6ac480f4c43d8822649e4000a483692afa99b32 | no | 30 |
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| **Information:** | | | | | |
| 5 | Non Patent Literature | PalmOneZire31GettingStarted_pg69-105.pdf | 1187812<br>4b704a967fac6225c6ccaa285ba0fd20448ed129 | no | 36 |
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| 6 | Non Patent Literature | SendoM550Manual.pdf | 4750450<br>5e29a9a662ef41ee720ae96dca05bb884377a3b8 | no | 50 |
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| 7 | Non Patent Literature | SoHoUserGuide.pdf | 1753543<br>b252c228890762c920fa3a36611b5564f2003d83 | no | 60 |
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| 8 | Non Patent Literature | RepairingTomTomONEBackCover.pdf | 152142<br>53de073c4feeeb25a52040edb50fdbef36eedeae | no | 8 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 9 | Non Patent Literature | palmOneZire31Review.pdf | 167814<br>ac166afc8b00f5b4c2364f12a0e0611744254c3d | no | 8 |
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| 10 | Non Patent Literature | TheBirthoftheiPhone.pdf | 2285182<br>d554836c0feadc31baa7527eb21035681c166f1f | no | 30 |

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| 11 | Non Patent Literature | V176GSMMotomanual_pg1-46.pdf | 5442821<br>c13f460e310a2b56d83858829ff7a746f0e217a6 | no | 46 |
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| 12 | Non Patent Literature | V176GSMMotomanual_pg47-79.pdf | 4419360<br>a41d6d82b858e4699fb1217a4dca8e2f683108c2 | no | 32 |
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| 13 | Non Patent Literature | SprintPCSVisionV1-3155iUserGuide_pg1-68.pdf | 1250211<br>32f4e84e287ab9b05f42bd10c8d2d479c1ce16d1 | no | 68 |
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| 21 | Non Patent Literature | NokiaAnnouncesConvergenceDevicesforMobileTVandtheDigitalHomeatNokiaMobilityConference2005.pdf | 154759<br>585201f2861b49fcdeedd1193ea6554e2ecd8502 | no | 3 |
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| **Information:** | | | | | |
| 27 | Non Patent Literature | OperatingInstructionsPanasonic1_49.pdf | 6042107<br>08ce8321d8ae4cdb6641efab43953d9c9faffffb | no | 52 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 28 | Non Patent Literature | OperatingInstructionsPanasonic50_97.pdf | 6315427<br>20f36525ae7435cd7bade79673cc8832505304a3 | no | 48 |

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| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 29 | Non Patent Literature | OperatingInstructionsPanasonic98_145.pdf | 6500912<br>8988f255f85f64afa023e017ba29aeaa84f25317 | no | 48 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| 30 | Information Disclosure Statement (IDS) Form (SB08) | OperatingInstructionsPanasonic146_191.pdf | 6047317<br>47de443b413d6955faaf7dd882b492868282f650 | no | 46 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| This is not an USPTO supplied IDS fillable form | | | | | |
| | | | **Total Files Size (in bytes):** | 53507050 | |

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**New Applications Under 35 U.S.C. 111**
**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

**National Stage of an International Application under 35 U.S.C. 371**
**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**
**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

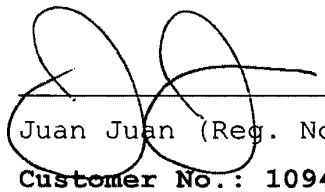


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that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



5/30/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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IN THE U.S. PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of:

Applicant: Jorgensen, Claus H.

Serial No.: 14/067,249

Filed: October 30, 2013

Title: Portable electronic Device

Attorney Docket No.: 891.0013.U4(US)

Express Mail Certificate

I hereby certify that the following correspondence:

Information Disclosure Statement

PTO 1449

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 , **Express Mail No. EM 519 542 695 US** on the date shown below, first class mail, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, Mail Stop Amendment .

May 30, 2014

Date

Blair Ribeiro

Blair Ribeiro

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U1(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

OPAP AKIMA-10 MAY 3 0 2014 PAT & TRADEMARK OFFICE

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| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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| Examiner's Signature: | Date Considered: |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U1(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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| Examiner's Signature: | Date Considered: |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

# PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-331333

(43)Date of publication of application : 30.11.1999

(51)Int.Cl. H04M 1/02
H05K 7/14

(21)Application number : 10-132237

(22)Date of filing : 14.05.1998

(71)Applicant : NEC SAITAMA LTD

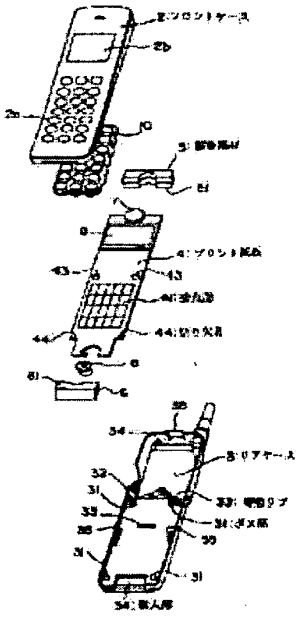
(72)Inventor : AKIYAMA TAKASHI

## (54) MOUNT STRUCTURE FOR PRINTED BOARD OF PORTABLE TELEPHONE SET

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a mount structure of a printed board which makes it difficult to spread deformation to the printed board even if a case is deformed by load and impact applied to the case and prevents the omission and contact failure of a mounted part.

SOLUTION: In the mount structure of a printed board 4 of a portable telephone which has a case and the board 4 mounted inside the case, cushion members 5 and 6 are provided between the inner wall of the case and the board 4. In further details, the case is provided with an interfitting part 34 of the members 5 and 6 and it is fixed to a prescribed position in the case by such a manner that the members 5 and 6 provided in the board 4 are inserted into the part 34 and also the board 4 is supported.



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(19)日本国特許庁（ＪＰ）　(12) **公開特許公報（Ａ）**　(11)特許出願公開番号

**特開平11－331333**

(43)公開日　平成11年(1999)11月30日

| (51)Int.Cl.[6] | 識別記号 | ＦＩ | | |
|---|---|---|---|---|
| Ｈ０４Ｍ　1/02 | | Ｈ０４Ｍ　1/02 | | Ｃ |
| Ｈ０５Ｋ　7/14 | | Ｈ０５Ｋ　7/14 | | Ｇ |

審査請求　有　　請求項の数２　ＯＬ　（全　８　頁）

(21)出願番号　特願平10－132237

(22)出願日　平成10年(1998)５月14日

(71)出願人　390010179
埼玉日本電気株式会社
埼玉県児玉郡神川町大字元原字豊原300番18

(72)発明者　秋山　崇
埼玉県児玉郡神川町大字元原字豊原300番18　埼玉日本電気株式会社内

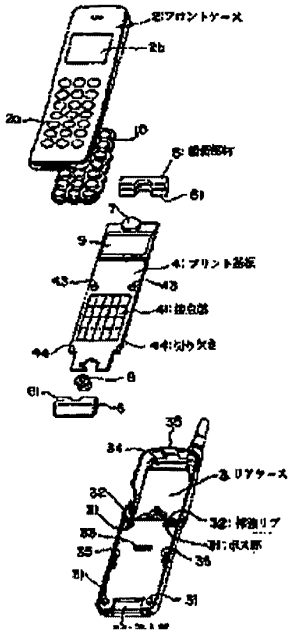
(74)代理人　弁理士　渡辺　喜平

(54)【発明の名称】　携帯電話機のプリント基板の実装構造

(57)【要約】

【課題】　ケースに加えられた荷重や衝撃によってケースが変形しても，その変形をプリント基板に伝えにくくして実装部品の脱落や接点不良を防止することのできるプリント基板の実装構造を提供する。

【解決手段】　ケース１と，このケース１の内部に装着されたプリント基板４とを有する携帯電話機のプリント基板４の実装構造において，ケース１の内壁とプリント基板４との間に緩衝部材５，６を介在させて構成した。詳しくは，ケース１には緩衝部材５，６の嵌入部３４が設けられ，プリント基板４に設けられた緩衝部材５，６が嵌入部３４に嵌め込まれることによりケース１内の所定位置に固定され，かつ，プリント基板４を支持するように構成した。



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【特許請求の範囲】

【請求項１】　ケースと，このケースの内部に固定されたプリント基板とを有する携帯電話機のプリント基板の実装構造において，

前記ケースの内壁と前記プリント基板との間に緩衝部材を介在させたこと，

を特徴とする携帯電話機のプリント基板の実装構造。

【請求項２】　前記ケースはフロントケースとリアケースとからなる二分割構造で，前記プリント基板は前記フロントケースと前記リアケースの間に緩衝部材を介在させて前記ケース内で固定されること，

を特徴とする請求項１に記載の携帯電話機のプリント基板の実装構造。

【請求項３】　前記ケースには前記緩衝部材の嵌入部が設けられ，前記プリント基板に取り付けられた緩衝部材が前記嵌入部に嵌め込まれることにより，前記プリント基板を所定位置に位置決めして固定すること，

を特徴とする請求項１または請求項２に記載の携帯電話機のプリント基板の実装構造。

【請求項４】　前記ケースの内部には一つまたは複数の補強リブまたはボス部が形成され，前記プリント基板は前記補強リブまたは前記ボス部との間に間隙を有して固定されること，

を特徴とする請求項１ないし請求項３のいずれかに記載の携帯電話機のプリント基板の実装構造。

【請求項５】　請求項４に記載の携帯電話機のプリント基板の実装構造において，前記補強リブまたは前記ボス部と前記プリント基板との間に緩衝部材を介在させたこと，

を特徴とする携帯電話機のプリント基板の実装構造。

【請求項６】　前記緩衝部材は前記プリント基板の周縁部に着脱自在であること，

を特徴とする請求項１ないし請求項５のいずれかに記載の携帯電話機のプリント基板の実装構造。

【請求項７】　前記緩衝部材は前記携帯電話機の操作キーの近傍で前記プリント基板を支持すること，

を特徴とする請求項１ないし請求項６のいずれかに記載の携帯電話機のプリント基板の実装構造。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】この発明は，携帯電話機のプリント基板の実装構造に関し，特に，携帯電話機のケースが荷重や衝撃等によってある程度変形しても，この変形をケース内部のプリント基板に伝えにくくして，プリント基板に実装された各種部品の脱落や接触不良を防止できる携帯電話機のプリント基板の実装構造に関する。

【０００２】

【従来の技術】従来，携帯電話機においては，プリント基板の実装構造に関し，フロントケースとリアケースの間にプリント基板を挟込んで，前記プリント基板を前

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記ケース内の所定位置に位置決めして固定していた。図３及び図４は従来の携帯電話機におけるプリント基板の実装構造の説明図で図３は携帯電話機の分解斜視図，図４はケース内におけるボス部近傍の拡大断面図である。

【０００３】図示するように，携帯電話機のケースはフロントース２とリアケース３とからなり，前記ケース内に各種実装部品が装着されたプリント基板４′が取り付けられる。フロントース２は，リアケース３の裏側からリアケース３内の複数箇所に設けられたボス部３１，３１・・の穴を通して，フロントケース２内のボス部２１に形成されたねじ穴にねじ１１を螺入することによって，リアケース３に取り付けられる。

【０００４】また，プリント基板４′にも穴３１，３１・・に応じて穴４３′，４３′・・が形成されていて，ねじ１１がこの穴４３′，４３′・・を挿通して前記ねじ穴に螺入される。プリント基板４′は，フロントース２とリアケース３との間に挟み付けられた状態で前記ケース内の所定位置に固定される。なお，図３において符号１０は，数字キーや機能キーなどの各種のキーが配列されたキーシートである。

【０００５】

【発明が解決しようとする課題】しかしながら，上記したような従来の携帯電話機においては，フロントケース２とリアケース３の間にプリント基板４′が挟み付けられた構造であるため，フロントケース２又はリアケース３に荷重が加えられたり，携帯電話機を落下させたような場合に前記ケースが変形すると，その変形は殆どそのままプリント基板４′に伝達されることになる。このようなプリント基板４′の変形は，プリント基板４′に実装された部品の接触不良や，ときには，部品の脱落を生じさせる原因となる。

【０００６】この発明は上記の課題にかんがみてなされたもので，その目的とするところは，ケースに加えられた荷重や衝撃によってケースが変形しても，その変形をプリント基板に伝えにくくして実装部品の脱落や接点不良を防止することのできるプリント基板の実装構造を提供することにある。

【０００７】

【課題を解決するための手段】上記課題を解決するために，この発明の携帯電話機のプリント基板の実装構造は，以下のように構成した。

【０００８】請求項１に記載の発明は，ケースと，このケースの内部に固定されたプリント基板とを有する携帯電話機のプリント基板の実装構造において，前記ケースの内壁と前記プリント基板との間に緩衝部材を介在させたことを特徴とする携帯電話機のプリント基板の実装構造として構成した。このように構成することにより，携帯電話機のケースに荷重や衝撃が加わってケースが変形しても，その変形の大部分は緩衝部材に吸収されてプリ

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良等を防止することができる。緩衝部材としては、ウレタン樹脂や発泡スチロール等の樹脂やゴム等、ある程度の弾性と硬度を有する部材を使用することができる。

【０００９】請求項２に記載の発明は、前記ケースはフロントケースとリアケースとからなる二分割構造で、前記プリント基板は前記フロントケースと前記リアケースの間に緩衝部材を介在させて前記ケース内で固定されることを特徴とする請求項１に記載の携帯電話機のプリント基板の実装構造として構成した。この構成により、ケースがフロントケースとリアケースとからなる二分割構造の携帯電話機に対してもこの発明を適用することができる。この場合、フロントケースまたはリアケースのいずれかが変形しても、前記プリント基板は前記フロントケースと前記リアケースの間に緩衝部材を介在させて前記ケース内で固定されているので、フロントケース又はリアケースのいずれかが変形しても、これらの変形を緩衝部材が吸収し、変形がプリント基板に伝わりにくく、実装部品の脱落や接触不良を防止できる。

【００１０】請求項３に記載の発明は、前記ケースには前記緩衝部材の嵌入部が設けられ、前記プリント基板に取り付けられた緩衝部材が前記嵌入部に嵌め込まれることにより、前記プリント基板を所定位置に位置決めして固定することを特徴とする請求項１または請求項２に記載の携帯電話機のプリント基板の実装構造として構成した。この構成により、プリント基板に緩衝部材を取り付け、この緩衝部材を嵌入部に嵌め込むように装着するだけでプリント基板がケース内で位置決めされるので、携帯電話機の組み立てを容易にすることができる。また、プリント基板はケース内で緩衝部材のみによって支持されるので、緩衝部材によって吸収されるケースの変形もより大きくなり、ある程度大きな荷重や衝撃がケースに付与されてもプリント基板が大きく変形するということが防止でき、実装部品の脱落や接触不良を防止できる。

【００１１】請求項４に記載の発明は、前記ケースの内部には一つまたは複数の補強リブまたはボス部が形成され、前記プリント基板は前記補強リブまたは前記ボス部との間に間隙を有して固定されること特徴とする請求項１ないし請求項３のいずれかに記載の携帯電話機のプリント基板の実装構造として構成した。この構成により、ケース内部に一つ又は複数の補強リブ又はボス部が形成されている場合でも、プリント基板と補強リブまたはボス部との間には間隙が設けられているので、ケースの変形により補強リブ又はボス部がプリント基板に接触することがなく、これによるプリント基板の変形を防止でき、実装部品の脱落や接触不良を防止できる。

【００１２】請求項５に記載の発明は、請求項４に記載の携帯電話機のプリント基板の実装構造において、前記補強リブまたは前記ボス部と前記プリント基板との間に緩衝部材を介在させたことを特徴とする携帯電話機のプリント基板の実装構造として構成した。この構成によ



ても、ケースの変形が変形しても補強リブ又はボス部がプリント基板に直接接触することがなく、これによるプリント基板の変形を防止でき、実装部品の脱落や接触不良を防止できる。

【００１３】請求項６に記載の発明は、前記緩衝部材は前記プリント基板の周縁部に着脱自在であることを特徴とする請求項１ないし請求項５のいずれかに記載の携帯電話機のプリント基板の実装構造として構成した。この構成により、前記緩衝部材を簡単に前記プリント基板に着脱することができるので、携帯電話機の組立コストも殆ど増加させることがない。

【００１４】請求項７に記載の発明は、前記緩衝部材は前記携帯電話機の操作キーの近傍で前記プリント基板を支持することを特徴とする請求項１ないし請求項６のいずれかに記載の携帯電話機のプリント基板の実装構造として構成した。この構成により、携帯電話機の使用時において最も頻繁に荷重が加えられる操作キーの近傍で緩衝部材がプリント基板を支持するので、繰り返し荷重に対するプリント基板の抵抗が増し、長期間使用しても実装部品の脱落や接触不良が生じにくい。

【００１５】

【発明の実施の形態】以下、この発明の携帯電話機のプリント基板の実装構造を、図面にしたがって詳細に説明する。図１及び図２はこの発明の一実施形態にかかり、図１は携帯電話機の分解斜視図、図２はボス部近傍におけるケースの拡大断面図である。

【００１６】携帯電話機は、フロントース２及びリアケース３から構成されるケースと、このケース内に内蔵されるプリント基板４とから概略構成される。フロントース２の上方には、ディスプレイ９が装着されるための開口２ｂが形成され、フロントース２の下方には数字キーや各種機能キーを配列したキー操作部２ａが形成されている。キー操作部２ａには、フロントース２の裏側から樹脂性のキーシート１０が装着される。

【００１７】プリント基板４の上方部分にはフロントース２の開口２ｂに嵌まり込むディスプレイ９が設けられている。また、プリント基板４の下方部分には、ケースのキー操作部２ａに設けられた数字キーや機能キーなどの各種のキーの押下動作によって開閉される接点部４ａが形成されている。さらに、プリント基板４の上端には、通話相手方の音声を出力する音声出力部（スピーカ）７が取り付けられ、下端には、音声を入力する音声入力部（マイクロフォン）８が取り付けられている。

【００１８】リアケース３の中には、補強のための複数のリブ３２，３３の他、フロントケース２と連結するための爪３５およびねじ穴が形成された複数のボス部３１，３１・・が形成されている。また、リアケース３の上端側と下端側には、後述する緩衝部材５１，６１が嵌め込まれる嵌入部３４，３４が形成されている。

【００１９】緩衝部材５，６は各々、ウレタン樹脂や発

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のゴム，発泡スチロール等の弾性及びある程度の硬度を有する材質のもので形成され，かつ，嵌入部３４，３４の形状に一致する形状に形成される。また，緩衝部材５，６の各々には，厚み方向のほぼ中央位置に切り込み５１，６１が入れられている。このように形成された緩衝部材５，６は，プリント基板４の上端および下端に切り込み５１，６１を差し込むことにより取り付けられて，プリント基板４とともにリアケース３内に挿入される。

【００２０】リアケース３内に挿入された緩衝部材５，６は，嵌入部３４，３４に嵌め込まれてプリント基板４をケース内の所定位置にしっかりと位置決めして固定する。切り込み５１，６１はプリント基板４を、リブ３２，３３と干渉しない高さ位置に位置決めする。また，プリント基板４には、ボス部２１，３１と干渉しないようにボス部２１，３１よりも大きい穴４３および切り欠き４４が形成されている。このように，プリント基板４がリブ３２，３３やボス部２１，３１と干渉しないように保持するのは，ケースが変形したときにリブ３２，３３及びボス部２１，３１がプリント基板４に接触しないようにして、これらによってプリント基板４が変形させられないようにするためである。

【００２１】リブ３２，３３やボス部２１，３１とプリント基板４との間の隙間は，ケースの大きさやリブ３２，３３の高さ及びボス部２１，３１の大きさに応じて異なり，少なくとも、通常加えられる荷重や衝撃によってケースが変形したときに，リブ３２，３３やボス部２１，３１がプリント基板４に接触することのない寸法のものでなければならない。なお、リブ３２，３３やボス部２１，３１とプリント基板４との間の前記隙間に緩衝部材を介在させてもよい。

【００２２】次に、上記構成のこの発明の作用を説明する。プリント基板には、切り込み５１，６１を上下の端縁に差し込むことにより緩衝部材５，６が取り付けられる。そして，緩衝部材５，６を嵌入部３４，３４に嵌め込むことにより，ケース内の所定位置に位置決めして固定される。ケースに荷重や衝撃が加えられてケースが変形すると、その変形はまずケースの内壁とプリント基板４の間に介在する緩衝部材５，６に伝達される。この緩衝部材５，６は，ウレタン樹脂やゴムなどの弾性を有する部材で形成されているので、ケースの変形によりこの緩衝部材５，６が変形させられる。従って，ケースの変形の大部分が緩衝部材５，６によって吸収されるので，プリント基板４はほとんど変形せず，プリント基板４に実装された各種実装部品の脱落や接触不良を防止できる。

【００２３】また，この実施形態では，キー操作部２ａの近傍で緩衝部材５，６がプリント基板４を支持するので，キー操作部２ａのキーを比較的強く押してもプリント基板４の撓みを比較的小さくすることができ，この点



においても、実装部品の脱落や接触不良を防止することができる。

【００２４】この発明の好適な実施形態について説明してきたが，この発明は上記の実施形態に限定されるものではない。例えば，ケースはフロントとリアの二分割構造として説明したが，三分割以上の多分割構造であってもよいし，フロント部分とリア部分が予め一体に形成されたものであってもよい。また，緩衝部材を設ける部位はプリント基板４の上下に限らず左右，あるいは中央のいずれの位置であってもよい。また，緩衝部材５，６を嵌入部３４，３４に嵌め込んでプリント基板４を固定する形態に限らず，接着剤等によって緩衝部材をケース内に固定するようにしてもよい。

【００２５】

【発明の効果】この発明の携帯電話機のプリント基板の実装構造によれば，ケースの内壁と前記プリント基板との間に緩衝部材を介在させているので，荷重や衝撃によりケースがある程度変形しても，この変形がプリント基板に伝わりにくくなり，実装部品の脱落や接点不良を防止することができる。従って，長期にわたって確実に動作する信頼性の高い携帯電話機を提供することが可能になる。また，極めて簡単な改良を施すだけで実施が可能であるので，携帯電話機の製造コストも高くすることもない。

【００２６】さらに，一般の使用において最もよく荷重が加えられる操作キーの近傍に緩衝部材を設け，この緩衝部材でプリント基板を支持するように構成することにより，キー操作時のプリント基板の撓み（変形）を極めて小さくすることができ，長期にわたって高い信頼性を保証でき，かつ，寿命も長い携帯電話機を得ることができる。

【図面の簡単な説明】

【図１】この発明の一実施形態にかかり、携帯電話機の分解斜視図である。

【図２】この発明の一実施形態にかかり、ボス部近傍のケースの拡大断面図である。

【図３】この発明の従来例にかかり，携帯電話機の分解斜視図である。

【図４】この発明の従来例にかかり，ボス部近傍のケースの拡大断面図である。

【符号の説明】

２　フロントケース
２１　ボス部
３　リアケース
３１　ボス部
３２　補強リブ
３３　補強リブ
３４　嵌入部
４　プリント基板
４１　接点部

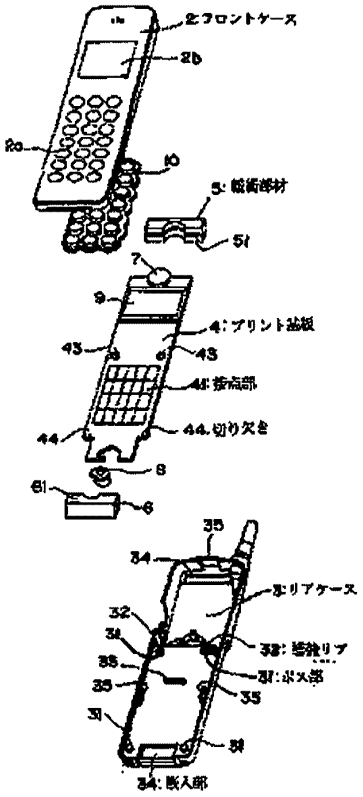
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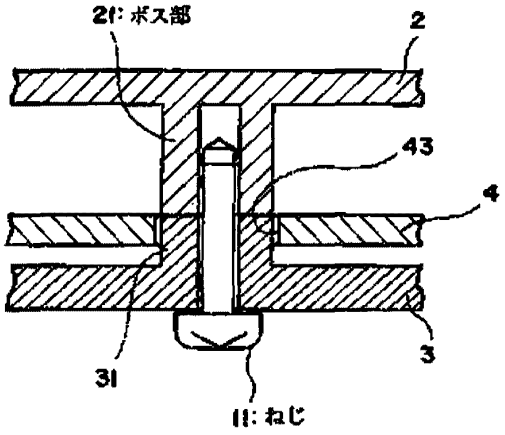
４３　穴
４４　切り欠き
５，６　緩衝部材

＊１０　キーシート
１１　ねじ
＊

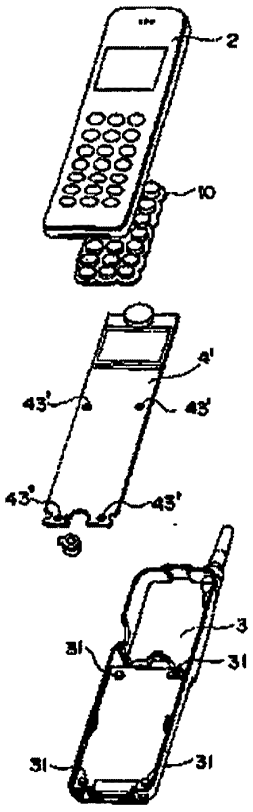
【図１】




【図２】



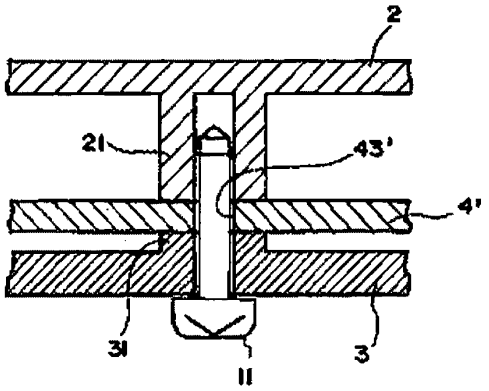

【図３】






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【図４】




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【手続補正書】
【提出日】平成１１年４月３０日
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】全文
【補正方法】変更
【補正内容】
【書類名】　　明細書
【発明の名称】　携帯電話機のプリント基板の実装構造
【特許請求の範囲】
【請求項１】　ケースと、このケースの内部に固定されたプリント基板とを有する携帯電話機のプリント基板の実装構造において、
前記ケースに緩衝部材の嵌入部を形成し、
この嵌入部の形状に一致する形状に形成した前記緩衝部材を前記嵌入部に嵌め込み、
前記嵌入部に嵌め込まれた前記緩衝部材に前記プリント基板の両端を支持させることによって前記プリント基板を前記ケース内で位置決め固定し、
前記ケースの内部に形成された一つまたは複数の補強リブまたはボス部と前記プリント基板との間に間隙を設けたこと、
を特徴とする携帯電話機のプリント基板の実装構造。
【請求項２】　請求項１に記載の携帯電話機のプリント基板の実装構造において、前記補強リブまたは前記ボス部と前記プリント基板との間に緩衝部材を介在させたこと、
を特徴とする携帯電話機のプリント基板の実装構造。
【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、携帯電話機のプリント基板の実装構造に関し、特に、携帯電話機のケースが荷重や衝撃等によってある程度変形しても、この変形をケース内部のプリント基板に伝えにくくして、プリント基板に実装された各種部品の脱落や接触不良を防止できる携帯電話機のプリント基板の実装構造に関する。
【０００２】
【従来の技術】従来、携帯電話機においては、プリント基板の実装構造に関し、フロントケースとリアケースの間にプリント基板を挟み込んで、前記プリント基板を前記ケース内の所定位置に位置決めして固定していた。図３及び図４は従来の携帯電話機におけるプリント基板の実装構造の説明図で図３は携帯電話機の分解斜視図、図４はケース内におけるボス部近傍の拡大断面図である。
【０００３】図示するように、携帯電話機のケースはフロントース２とリアケース３とからなり、前記ケース内に各種実装部品が装着されたプリント基板４′が取り付けられる。フロントース２は、リアケース３の裏側からリアケース３内の複数箇所に設けられたボス部３１，３１・・の穴を通して、フロントケース２内のボス部２１に形成されたねじ穴にねじ１１を螺入することによって、リアケース３に取り付けられる。
【０００４】また、プリント基板４′にも穴３１，３１・・に応じて穴４３′，４３′・・が形成されていて、ねじ１１がこの穴４３′，４３′・・を挿通して前記ねじ穴に螺入される。プリント基板４′は、フロントース２とリアケース３との間に挟み付けられた状態で前記ケース内の所定位置に固定される。なお、図３において符号１０は、数字キーや機能キーなどの各種のキーが配列されたキーシートである。
【０００５】
【発明が解決しようとする課題】しかしながら、上記した

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２とリアケース３の間にプリント基板４′が挟み付けられた構造であるため、フロントケース２又はリアケース３に荷重が加えられたり、携帯電話機を落下させたような場合に前記ケースが変形すると、その変形は殆どそのままプリント基板４′に伝達されることになる。このようなプリント基板４′の変形は、プリント基板４′に実装された部品の接触不良や、ときには、部品の脱落を生じさせる原因となる。

【０００６】この発明は上記の課題にかんがみてなされたもので、その目的とするところは、ケースに加えられた荷重や衝撃によってケースが変形しても、その変形をプリント基板に伝えにくくして実装部品の脱落や接点不良を防止することのできるプリント基板の実装構造を提供することにある。

【０００７】

【課題を解決するための手段】上記課題を解決するために、この発明の携帯電話機のプリント基板の実装構造は、以下のように構成した。

【０００８】請求項１に記載の発明は、ケースと、このケースの内部に固定されたプリント基板とを有する携帯電話機のプリント基板の実装構造において、前記ケースに緩衝部材の嵌入部を形成し、この嵌入部の形状に一致する形状に形成した前記緩衝部材を前記嵌入部に嵌め込み、前記嵌入部に嵌め込まれた前記緩衝部材に前記プリント基板の両端を支持させることによって前記プリント基板を前記ケース内で位置決め固定し、前記ケースの内部に形成された一つまたは複数の補強リブまたはボス部と前記プリント基板との間に間隙を設けた構成としてある。この構成によれば、プリント基板をケース内で緩衝部材のみによって支持させることができるので、ケースの変形をプリント基板に伝わりにくくすることができる。また、補強リブ又はボス部とプリント基板との間に間隙を設けているので、ケースが変形しても補強リブ又はボス部がプリント基板に接触せず、これによるプリント基板の変形を防止でき、実装部品の脱落や接触不良を防止できる。さらに、プリント基板に緩衝部材を取り付け、この緩衝部材を嵌入部に嵌め込むように装着するだけでプリント基板がケース内で位置決めされるので、携帯電話機の組み立てを容易にすることができる。緩衝部材としては、ウレタン樹脂や発泡スチロール等の樹脂やゴム等、ある程度の弾性と硬度を有する部材を使用することができる。

【０００９】請求項２に記載の発明は、前記補強リブまたは前記ボス部と前記プリント基板との間に緩衝部材を介在させた構成としてある。この構成により、ケースが変形しても補強リブ又はボス部がプリント基板に直接接触することがなく、これによるプリント基板の変形を防止でき、実装部品の脱落や接触不良を防止できる。

【００１０】

【発明の実施の形態】以下、この発明の携帯電話機のプリント基板の実装構造を、図面にしたがって詳細に説明する。図１及び図２はこの発明の一実施形態にかかり、図１は携帯電話機の分解斜視図、図２はボス部近傍におけるケースの拡大断面図である。

【００１１】携帯電話機は、フロントース２及びリアケース３から構成されるケースと、このケース内に内蔵されるプリント基板４とから概略構成される。フロントース２の上方には、ディスプレイ９が装着されるための開口２ｂが形成され、フロントース２の下方には数字キーや各種機能キーを配列したキー操作部２ａが形成されている。キー操作部２ａには、フロントース２の裏側から樹脂性のキーシート１０が装着される。

【００１２】プリント基板４の上方部分にはフロントース２の開口２ｂに嵌まり込むディスプレイ９が設けられている。また、プリント基板４の下方部分には、ケースのキー操作部２ａに設けられた数字キーや機能キーなどの各種のキーの押下動作によって開閉される接点部４ａが形成されている。さらに、プリント基板４の上端には、通話相手方の音声を出力する音声出力部（スピーカ）７が取り付けられ、下端には、音声を入力する音声入力部（マイクロフォン）８が取り付けられている。

【００１３】リアケース３の中には、補強のための複数のリブ３２，３３の他、フロントケース２と連結するための爪３５およびねじ穴が形成された複数のボス部３１、３１・・が形成されている。また、リアケース３の上端側と下端側には、後述する緩衝部材５１，６１が嵌め込まれる嵌入部３４，３４が形成されている。

【００１４】緩衝部材５、６は各々、ウレタン樹脂や他のゴム，発泡スチロール等の弾性及びある程度の硬度を有する材質のもので形成され、かつ、嵌入部３４、３４の形状に一致する形状に形成される。また、緩衝部材５、６の各々には、厚み方向のほぼ中央位置に切り込み５１、６１が入れられている。このように形成された緩衝部材５，６は、プリント基板４の上端および下端に切り込み５１，６１を差し込むことにより取り付けられて、プリント基板４とともにリアケース３内に挿入される。

【００１５】リアケース３内に挿入された緩衝部材５，６は、嵌入部３４，３４に嵌め込まれてプリント基板４をケース内の所定位置にしっかりと位置決めして固定する。切り込み５１，６１はプリント基板４を、リブ３２、３３と干渉しない高さ位置に位置決めする。また、プリント基板４には、ボス部２１，３１と干渉しないようにボス部２１、３１よりも大きい穴４３および切り欠き４４が形成されている。このように、プリント基板４がリブ３２，３３やボス部２１，３１と干渉しないように保持するのは、ケースが変形したときにリブ３２，３３及びボス部２１，３１がプリント基板４に接触しないようにして、これらによってプリント基板４が変形させられないようにするためである。

http://www4.ipdl.inpit.go.jp/Tokujitu/tjcontentpaj.ipdl?N0000=21&N0005=XclUPrgHo0czj2UGTWln&N0400=...

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【0016】リブ32，33やボス部21，31とプリント基板4との間の隙間は、ケースの大きさやリブ32，33の高さ及びボス部21，31の大きさに応じて異なり、少なくとも、通常加えられる荷重や衝撃によってケースが変形したときに、リブ32，33やボス部21，31がプリント基板4に接触することのない寸法のものでなければならない。なお、リブ32，33やボス部21，31とプリント基板4との間の前記隙間に緩衝部材を介在させてもよい。

【0017】次に、上記構成のこの発明の作用を説明する。プリント基板には、切り込み51，61を上下の端縁に差し込むことにより緩衝部材5，6が取り付けられる。そして、緩衝部材5，6を嵌入部34，34に嵌め込むことにより、ケース内の所定位置に位置決めして固定される。ケースに荷重や衝撃が加えられてケースが変形すると、その変形はまずケースの内壁とプリント基板4の間に介在する緩衝部材5，6に伝達される。この緩衝部材5，6は、ウレタン樹脂やゴムなどの弾性を有する部材で形成されているので、ケースの変形によりこの緩衝部材5，6が変形させられる。従って、ケースの変形の大部分が緩衝部材5，6によって吸収されるので、プリント基板4はほとんど変形せず、プリント基板4に実装された各種実装部品の脱落や接触不良を防止できる。

【0018】また、この実施形態では、キー操作部2aの近傍で緩衝部材5，6がプリント基板4を支持するので、キー操作部2aのキーを比較的強く押してもプリント基板4の撓みを比較的小さくすることができ、この点においても、実装部品の脱落や接触不良を防止することができる。

【0019】この発明の好適な実施形態について説明してきたが、この発明は上記の実施形態に限定されるものではない。例えば、ケースはフロントとリアの二分割構造として説明したが、三分割以上の多分割構造であってもよいし、フロント部分とリア部分が予め一体に形成されたものであってもよい。また、緩衝部材を設ける部位はプリント基板4の上下に限らず左右、あるいは中央のいずれの位置であってもよい。また、緩衝部材5，6を嵌入部34，34に嵌め込んでプリント基板4を固定する形態に限らず、接着剤等によって緩衝部材をケース内に固定するようにしてもよい。

【0020】

【発明の効果】この発明の携帯電話機のプリント基板の実装構造によれば、ケースの内壁と前記プリント基板との間に緩衝部材を介在させているので、荷重や衝撃によりケースがある程度変形しても、この変形がプリント基板に伝わりにくくなり、実装部品の脱落や接点不良を防止することができる。従って、長期にわたって確実に動作する信頼性の高い携帯電話機を提供することが可能になる。また、極めて簡単な改良を施すだけで実施が可能であるので、携帯電話機の製造コストも高くすることもない。

【0021】さらに、プリント基板に緩衝部材を取り付け、この緩衝部材を嵌入部に嵌め込むように装着するだけでプリント基板がケース内で位置決めされるので、携帯電話機の組み立てを容易にすることができる。

【図面の簡単な説明】

【図1】この発明の一実施形態にかかり、携帯電話機の分解斜視図である。

【図2】この発明の一実施形態にかかり、ボス部近傍のケースの拡大断面図である。

【図3】この発明の従来例にかかり、携帯電話機の分解斜視図である。

【図4】この発明の従来例にかかり、ボス部近傍のケースの拡大断面図である。

【符号の説明】

2　フロントケース
21　ボス部
3　リアケース
31　ボス部
32　補強リブ
33　補強リブ
34　嵌入部
4　プリント基板
41　接点部
43　穴
44　切り欠き
5，6　緩衝部材
10　キーシート
11　ねじ



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# NOTICE OF ALLOWANCE AND FEE(S) DUE

10948 7590 06/04/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER |
|---|
| NGUYEN, TUAN DUC |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 06/04/2014

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 09/04/2014 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

**HOW TO REPLY TO THIS NOTICE:**

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

**IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.**





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## PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail** **Mail Stop ISSUE FEE**
**Commissioner for Patents**
**P.O. Box 1450**
**Alexandria, Virginia 22313-1450**
**or Fax (571)-273-2885**

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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4 Research Drive, Suite 202
Shelton, CT 06484

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**Certificate of Mailing or Transmission**
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

| (Depositor's name) |
|---|
| (Signature) |
| (Date) |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 09/04/2014 |

| EXAMINER | ART UNIT | CLASS-SUBCLASS |
|---|---|---|
| NGUYEN, TUAN DUC | 2656 | 379-433080 |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.
1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
- ❑ Issue Fee
- ❑ Publication Fee (No small entity discount permitted)
- ❑ Advance Order - # of Copies _____

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5. **Change in Entity Status** (from status indicated above)
- ❑ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ❑ Applicant changing to regular undiscounted fee status.
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NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____



PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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10948 7590 06/04/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
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| EXAMINER | |
|---|---|
| NGUYEN, TUAN DUC | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 06/04/2014

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.



PTOL-85 (Rev. 02/11)

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## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

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**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

| Notice of Allowability | Application No. 14/067,249 | Applicant(s) JORGENSEN, CLAUS H. | |
|---|---|---|---|
| | Examiner TUAN D. NGUYEN | Art Unit 2656 | AIA (First Inventor to File) Status No |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *05/09/2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-42 and renumbered as 1-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   **Certified copies:**

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE**.

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 05/09/2014
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TUAN D NGUYEN/
Primary Examiner, Art Unit 2656



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The present application is being examined under the pre-AIA first to invent provisions.

## Office Action

### Examiner's Statement of Reasons for Allowance

1. Claims 25-42 are allowed.

The following is an examiner's statement of reasons for allowance: The prior art of record teaches various portable electronic devices thereon, for example US 2001/0034242. However, the prior art of record fails to show claim 25, a portable electronic device comprising: a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing; a camera located in said housing and extending to said cut out at said rear side; an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a user input section located above the engine section and a battery, wherein the user input section is located adjacent the battery and the engine section; wherein the battery and engine section are housed in the housing and the user input is located in a hole through a front side of the housing; and claim 36, a housing for a portable electronic device comprising; a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing, said cut out configured to receive at least part of a camera; wherein the housing is configured to receive a

battery and an engine section, wherein the battery and engine section are housed in the housing, and wherein a user input is located in a hole through a front side of the housing.

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan D. Nguyen whose telephone number is (571) 272-8163. The examiner can normally be reached on M-F 6:30-3:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Curt Kuntz can be reached on (571) 272-7499. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TDN

5/27/14

/TUAN D NGUYEN/

Primary Examiner, Art Unit 2656

| Search Notes | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

| CPC- SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
| H04M1/0262, H04M1/0214, H04M1/0216, H04M1/0264, H04M1/0277 | 5/27/14 | TN |

| CPC COMBINATION SETS - SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
| | | |

| US CLASSIFICATION SEARCHED | | | |
|---|---|---|---|
| Class | Subclass | Date | Examiner |
| 379 | 433.01,433.08,433.11,433.13 | 1/30/14 | TN |
| 455 | 90.3,575.1,575.3,572,573,574 | 2/3/14 | TN |
| 361 | 679.23 | 2/4/14 | TN |
| 348 | 374,376 | 2/4/14 | TN |
| | updated same as above | 5/27/14 | TN |

| SEARCH NOTES | | |
|---|---|---|
| Search Notes | Date | Examiner |
| PLUS and inventor search | 2/3/14 | TN |

| INTERFERENCE SEARCH | | | |
|---|---|---|---|
| US Class/ CPC Symbol | US Subclass / CPC Group | Date | Examiner |
| | updated same as above | 2/4/14 | TN |
| | updated same as above | 5/27/14 | TN |

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| | /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 |

OPAP AKINA-18
MAY 09 2014
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Claus H. Jorgensen
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)

Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

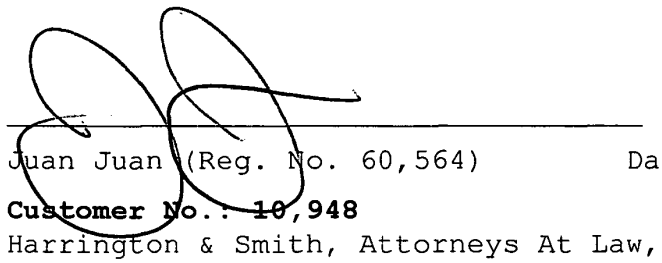
Applicant's Attorney is aware of the documents listed on the enclosed Form PTO-1449. No fee is believed due as this IDS is being filed together with an RCE. However, if the undersigned attorney is mistaken, please charge deposit account 50-1924.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

Respectfully submitted,



5/5/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: ~~10~~ 948**
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000302

OPAP AKIMA-18
MAY 0 9 2014
PATENT & TRADEMARK OFFICE

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

5/5/2014
Date

Elaine F. Mian
Elaine F. Mian



ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000303

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-5,537,294 | 07-16-1996 | Siwinski | 361 | 753 |
| | US-5,541,448 | 07-30-1996 | Carpenter | 257 | 679 |
| | US-D445,428 S | 07-24-2001 | Pattenden | D14 | 488 |
| | US-2005/0282595 A1 | 12-22-2005 | Spence et al. | 455 | 575.3 |
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OPAP AKIMA-18 MAY 0 9 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | EP-2472833-A1 | 07-04-2012 | Nokia Corporation | |
| | JP-2000133973-A | 05-12-2000 | NEC Corp. | |
| | JP-2001007550-A | 01-12-2001 | NEC Corp. | |
| | WO-2007/110771-A2 | 10-04-2007 | Nokia Corporation | |
| | - - | | | |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 05/27/2014 |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

# BIB DATA SHEET

**CONFIRMATION NO. 7955**

| SERIAL NUMBER | FILING or 371(c) DATE<br>RULE | CLASS | GROUP ART UNIT | ATTORNEY DOCKET NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | 379 | 2656 | 891.0013.U4(US) |

**APPLICANTS**

Nokia Corporation, Espoo, FINLAND, Assignee (with 37 CFR 1.172 Interest);

**INVENTORS**

Claus H. Jorgensen, Bronshoj, DENMARK;

**** CONTINUING DATA ***************************

This application is a CON of 13/741,781 01/15/2013 PAT 8615077
and is a CON of 12/860,234 08/20/2010 PAT 8363824
and is a CON of 11/393,510 03/29/2006 PAT 7787618

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

11/13/2013

| Foreign Priority claimed ☐ Yes ☑ No<br>35 USC 119(a-d) conditions met ☐ Yes ☑ No<br>Verified and Acknowledged /TUAN DUC NGUYEN/ Examiner's Signature | ☐ Met after Allowance<br>Initials | STATE OR COUNTRY | SHEETS DRAWINGS | TOTAL CLAIMS | INDEPENDENT CLAIMS |
|---|---|---|---|---|---|
| | | DENMARK | 6 | 18 | 2 |

**ADDRESS**

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484
UNITED STATES

**TITLE**

PORTABLE ELECTRONIC DEVICE

| FILING FEE RECEIVED | | |
|---|---|---|
| 1900 | FEES: Authority has been given in Paper<br>No._____ to charge/credit DEPOSIT ACCOUNT<br>No._____ for following: | ☐ All Fees<br>☐ 1.16 Fees (Filing)<br>☐ 1.17 Fees (Processing Ext. of time)<br>☐ 1.18 Fees (Issue)<br>☐ Other _____<br>☐ Credit |



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000305

| Index of Claims | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

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|---|---|---|---|---|---|---|---|
| ✓ | Rejected | - | Cancelled | N | Non-Elected | A | Appeal |
| = | Allowed | ÷ | Restricted | I | Interference | O | Objected |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| CLAIM | | DATE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Final | Original | 02/04/2014 | 05/27/2014 | | | | | | | |
| 1 | 25 | = | = | | | | | | | |
| 2 | 26 | = | = | | | | | | | |
| 3 | 27 | = | = | | | | | | | |
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| 10 | 34 | = | = | | | | | | | |
| 11 | 35 | = | = | | | | | | | |
| 12 | 36 | = | = | | | | | | | |
| 13 | 37 | = | = | | | | | | | |
| 14 | 38 | = | = | | | | | | | |
| 15 | 39 | = | = | | | | | | | |
| 16 | 40 | = | = | | | | | | | |
| 17 | 41 | = | = | | | | | | | |
| 18 | 42 | = | = | | | | | | | |

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| CPC | | | | | | |
|---|---|---|---|---|---|---|
| **Symbol** | | | | | **Type** | **Version** |
| H04M | | 1 | / | 0264 | A | 20130101 |
| H04M | | 1 | / | 0262 | F | 20130101 |
| H04M | | 1 | / | 0214 | I | 20130101 |
| H04M | | 1 | / | 0277 | I | 20130101 |
| H04M | | 1 | / | 0216 | A | 20130101 |
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| NONE | | **Total Claims Allowed:** | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 5/27/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| US ORIGINAL CLASSIFICATION | | INTERNATIONAL CLASSIFICATION | |
|---|---|---|---|
| CLASS | SUBCLASS | CLAIMED | NON-CLAIMED |
| 379 | 433.08 | H 0 4 M 1 / 00 (2006.01.01) | |
| | | H 0 4 M 9 / 00 (2006.01.01) | |

| CROSS REFERENCE(S) | | | | | |
|---|---|---|---|---|---|
| CLASS | SUBCLASS (ONE SUBCLASS PER BLOCK) | | | | |
| 379 | 433.01 | 433.13 | | | |
| 455 | 575.3 | | | | |

| NONE | | Total Claims Allowed: | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 5/27/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 17 | 41 | | | | | | | | | | | | |
| 2 | 26 | 18 | 42 | | | | | | | | | | | | |
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| NONE | | **Total Claims Allowed:** | |
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 5/27/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000309

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U1(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
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| | US-7,860,536 B2 | 12-28-2010 | Jobs et al. | 455 | 566 |
| | US-7,574,672 B2 | 08-11-2009 | Jobs et al. | 715 | 830 |
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OPAP AKIMA-10 MAY 30 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | JP-11-331333- | 11-30-1999 | NEC Saitama Ltd. | |
| | - - | | | |
| | - - | | | |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

| | |
|---|---|
| | "LG© LX-225 Phone Guide", LG Life's Good, 2004, 208 pgs. |
| | "i560 Phone User's Guide", Motorola iDEN Digital Multi-service Data-capable Phone, 2005, 155 pgs. |
| | "Motorola V3 GSM User Guide", 2005, 34 pgs. |
| | "Motorola V3-RAZR Repair Manual", April 2005, 33 pgs. |
| | "Nokia 3155 Use Guide", 2005, 95 pgs. |
| | "Nokia 3155, Nokia 3155i, and Nokia 3152 User Guide", 2005, 201 pgs. |
| | "Nokia 6101 and Nokia 6102 User Guide", 2005, 87 pgs. |
| | "Nokia USA Launches 3155 CDMA Folder", Oryl, Michael, March 15, 2005, 1 pgs. |
| | "O2X3™-How to use it", O2 (UK) Limited, August 2004, 125 pgs. |
| | "O2X4™-How to use it", O2 (UK) Limited, March 2005, 118 pgs. |
| | |
| | |
| | |

Examiner's Signature: /Tuan Nguyen/ Date Considered: 07/03/2014

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U1(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | - -<br>- -<br>- -<br>- - | | | |

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| | "BT Zenith Flip-Issue 1-Edition 04, User Guide", 08/09/2005, 88 pgs. |
| | "User Guide for the Kyocera Candid KX16 Phone, 82-N8302-1EN, Rev.001", Kyocera Wireless Corp., 2005, 64 pgs. |
| | "Digital Wireless Telephone User's Guide", Motorola, 2002, 106 pgs. |
| | "Handbook for Palm™ Zire™ Handheld" , Palm Inc., 2002, 208 pgs. |
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| | "How a BlackBerry Works", Wilson, Tracy V., http://electronics .howstuffworks.com/blackberry.htm/printable, January 7, 2014, 4 pgs. |
| | "i930 Phone User's Guide", Nextel iDEN Digital Multi-serice Data-capable Phone, Microsoft, 2005, 194 pgs. |
| | "C3300 User Guide CE0168", LG Life's Good, February 20, 2005, 99 pgs. |
| | "User Guide for the Kyocera Milan KX9B/KX9C Phones 82-N8274-1EN, Rev. 002", Kyocera, 2005, 63 pgs. |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 07/03/2014 |
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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

10948 7590 07/09/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER | |
|---|---|
| NGUYEN, TUAN DUC | |
| ART UNIT | PAPER NUMBER |
| 2656 | |

| NOTIFICATION DATE | DELIVERY MODE |
|---|---|
| 07/09/2014 | ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@hspatent.com
Nokia.IPR@nokia.com



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000312

| ***Supplemental Notice of Allowability*** | **Application No.** 14/067,249 | **Applicant(s)** JORGENSEN, CLAUS H. | |
|---|---|---|---|
| | **Examiner** TUAN D. NGUYEN | **Art Unit** 2656 | **AIA (First Inventor to File) Status** No |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *5/09/2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-42 and renumbered as 1-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   **Certified copies:**

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE**.

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 5/30/2014
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TUAN D NGUYEN/
Primary Examiner, Art Unit 2656



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000313

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US- | | | | |
| | US- | | | | |
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| | US- | | | | |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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| | - - | | | |
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Examiner's Signature: /Tuan Nguyen/ Date Considered: 07/03/2014

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 07/03/2014 |
|---|---|

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MAY 30 2014
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

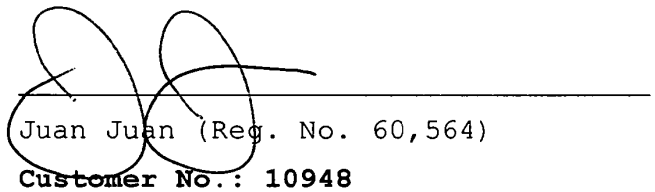
The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission

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that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)).

If there are any additional charges with respect to this Information Disclosure Statement or otherwise, please charge deposit account 50-1924 for any fee deficiency.

Respectfully submitted,



5/30/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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OPAP AKIMA-10
MAY 3 0 2014
PATENT & TRADEMARK OFFICE

IN THE U.S. PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of:

Applicant: Jorgensen, Claus H.

Serial No.: 14/067,249

Filed: October 30, 2013

Title: Portable electronic Device

Attorney Docket No.: 891.0013.U4(US)

Express Mail Certificate

I hereby certify that the following correspondence:

Information Disclosure Statement

PTO 1449

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 , **Express Mail No. EM 519 542 695 US** on the date shown below, first class mail, in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, Mail Stop Amendment .

May 30, 2014

Date

Blair Ribeiro

Blair Ribeiro

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U1(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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Examiner's Signature: /Tuan Nguyen/ Date Considered: 07/03/2014

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| | "BT Zenith Flip-Issue 1-Edition 04, User Guide", 08/09/2005, 88 pgs. |
| | "User Guide for the Kyocera Candid KX16 Phone, 82-N8302-1EN, Rev.001", Kyocera Wireless Corp., 2005, 64 pgs. |
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| | "Handbook for Palm™ Zire™ Handheld" , Palm Inc., 2002, 208 pgs. |
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| | "i930 Phone User's Guide", Nextel iDEN Digital Multi-serice Data-capable Phone, Microsoft, 2005, 194 pgs. |
| | "C3300 User Guide CE0168", LG Life's Good, February 20, 2005, 99 pgs. |
| | "User Guide for the Kyocera Milan KX9B/KX9C Phones 82-N8274-1EN, Rev. 002", Kyocera, 2005, 63 pgs. |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 07/03/2014 |
|---|---|

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PTO/SB/30 (07-09)
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# Request for Continued Examination (RCE) Transmittal

Address to:
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Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

| | |
|---|---|
| Application Number | 14/067,249 |
| Filing Date | October 30, 2013 |
| First Named Inventor | Claus H. Jorgensen |
| Art Unit | 2656 |
| Examiner Name | NGUYEN, TUAN DUC |
| Attorney Docket Number | 891.0013.U4(US) |

**This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.**
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. See Instruction Sheet for RCEs (not to be submitted to the USPTO) on page 2.

1. Submission required under 37 CFR 1.114 Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

   a. [✓] Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

      i. [ ] Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

      ii. [ ] Other _____

   b. [✓] Enclosed

      i. [ ] Amendment/Reply

      ii. [ ] Affidavit(s)/ Declaration(s)

      iii. [✓] Information Disclosure Statement (IDS)

      iv. [ ] Other _____

2. Miscellaneous

   a. [ ] Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of _____ months. (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

   b. [ ] Other _____

3. Fees The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

   a. [✓] The Director is hereby authorized to charge the following fees, any underpayment of fees, or credit any overpayments, to Deposit Account No. 50-1924 .

      i. [✓] RCE fee required under 37 CFR 1.17(e) (2nd RCE - $1700.00)

      ii. [ ] Extension of time fee (37 CFR 1.136 and 1.17)

      iii. [ ] Other _____

   b. [ ] Check in the amount of $ _____ enclosed

   c. [ ] Payment by credit card (Form PTO-2038 enclosed)

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***SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED***

| | | | |
|---|---|---|---|
| Signature | | Date | August 28, 2014 |
| Name (Print/Type) | Juan Juan | Registration No. | 60,564 |

***CERTIFICATE OF MAILING OR TRANSMISSION***

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| | | | |
|---|---|---|---|
| Signature | Blair Ribeiro | | |
| Name (Print/Type) | Blair Ribeiro | Date | August 28, 2014 |

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SE ND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Mail Stop RCE, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H. Filed: October 30, 2013
Art Unit: 2656 Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)

VIA EFS

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-847 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record a Responsive Claim Construction Brief (including Exhibits 1-34) that was filed in the United States International Trade Commission for Investigation 337-TA-847. The opinions included in the Responsive Claim Construction Brief are not the opinions of the Applicant or Applicant's Attorney. Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

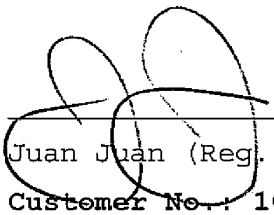


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Applicant's Attorney notes that due to the large number of pages for this Responsive Claim Construction Brief, this IDS may require more than one EFW-Web submission to include all of the submitted material.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



8/28/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

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| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US- | | | | |
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| | US- | | | | |

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| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

# Electronic Patent Application Fee Transmittal

| | |
|---|---|
| **Application Number:** | 14067249 |
| **Filing Date:** | 30-Oct-2013 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Filer:** | Robert J. Mauri/blair ribeiro |
| **Attorney Docket Number:** | 891.0013.U4(US) |

Filed as Large Entity

## Utility under 35 USC 111(a) Filing Fees

| Description | Fee Code | Quantity | Amount | Sub-Total in USD($) |
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| **Basic Filing:** | | | | |
| **Pages:** | | | | |
| **Claims:** | | | | |
| **Miscellaneous-Filing:** | | | | |
| **Petition:** | | | | |
| **Patent-Appeals-and-Interference:** | | | | |
| **Post-Allowance-and-Post-Issuance:** | | | | |
| **Extension-of-Time:** | | | | |

| Description | Fee Code | Quantity | Amount | Sub-Total in USD($) |
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| **Miscellaneous:** | | | | |
| RCE - 2nd and Subsequent Request | 1820 | 1 | 1700 | 1700 |
| | | **Total in USD ($)** | | **1700** |

# Electronic Acknowledgement Receipt

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| **EFS ID:** | 19926715 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Robert J. Mauri/blair ribeiro |
| **Filer Authorized By:** | Robert J. Mauri |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 28-AUG-2014 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 14:17:31 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

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| Submitted with Payment | yes |
| Payment Type | Deposit Account |
| Payment was successfully received in RAM | $1700 |
| RAM confirmation Number | 489 |
| Deposit Account | 501924 |
| Authorized User | |
| The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:<br>Charge any Additional Fees required under 37 C.F.R. Section 1.16 (National application filing, search, and examination fees) | |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
|---|---|---|---|---|---|
| 1 | Non Patent Literature | 1-250.pdf | 25927481<br>ab86e2b08f78dc5c9d5078bb353ba76161934f65 | no | 250 |
| **Warnings:** | | | | | |
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| 2 | Non Patent Literature | 251-425.pdf | 24438179<br>51414c2c5545e102de287b415b75d89ed4bf7adf | no | 175 |
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| 3 | Non Patent Literature | 426-620.pdf | 25327141<br>3fb62493cfbde45e6a14ee67143c73c45c8f6583 | no | 195 |
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| 4 | Non Patent Literature | 621-821.pdf | 26124529<br>6965170148bceb6f99e89b6010cb18c8ee3326b6 | no | 201 |
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| 60 | Information Disclosure Statement (IDS) Form (SB08) | NC51996US-8910013U4US-IDSandPTO1449-08-28-2014.PDF | 59021<br>860716286a30be8172711ae07aa880e870043973 | no | 3 |
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**New Applications Under 35 U.S.C. 111**
**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

**National Stage of an International Application under 35 U.S.C. 371**
**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**
**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

US005570369A

# United States Patent [19]

Jokinen

[11] Patent Number: 5,570,369

[45] Date of Patent: Oct. 29, 1996

[54] **REDUCTION OF POWER CONSUMPTION IN A MOBILE STATION**

[75] Inventor: **Harri Jokinen**, Hiisi, Finland

[73] Assignee: **Nokia Mobile Phones Limited**, Salo, Finland

[21] Appl. No.: **404,040**

[22] Filed: **Mar. 14, 1995**

[30] **Foreign Application Priority Data**

Mar. 15, 1994 [FI] Finland ..... 941221

[51] **Int. Cl.**[6] ..... **H04B 7/00**; H04Q 7/00

[52] **U.S. Cl.** ..... **370/95.3**; 370/79; 379/59; 455/33.1; 455/38.3

[58] **Field of Search** ..... 370/77, 79, 95.1, 370/95.2, 95.3, 18, 60, 60.1, 94.1, 94.2, 94.3; 455/38.3, 54.1, 343, 33.1; 395/750; 379/59, 60

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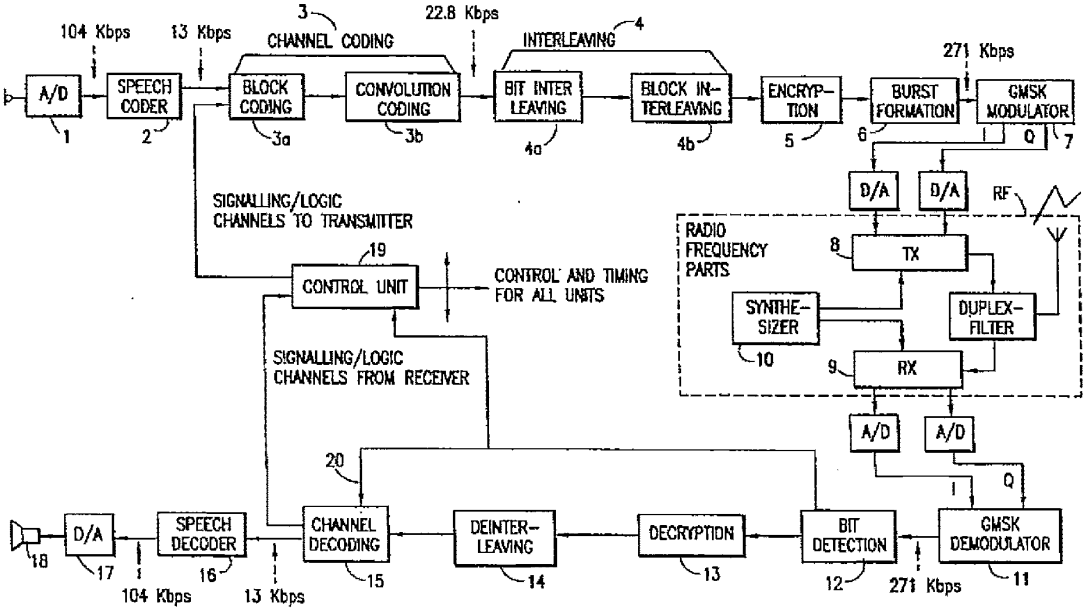
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*Primary Examiner*—Hassan Kizou
*Attorney, Agent, or Firm*—Perman & Green

[57] **ABSTRACT**

A method for reducing the power consumption in a mobile system is disclosed. The mobile system includes a base station broadcasting message such as signaling messages to the mobile stations, and a receiver for receiving and processing messages broadcast from the base station. The signaling message time period is divided in parts and transmitted in a number of TDMA time slots. When possible, the signaling message broadcast from the base station is reconstructed from only a part of the signaling message, and a part of the receiver of the mobile station is switched to a power saving mode during the remainder of said period. If necessary, more of the signaling message can be received to complete the reconstruction of the signaling message.

**13 Claims, 6 Drawing Sheets**




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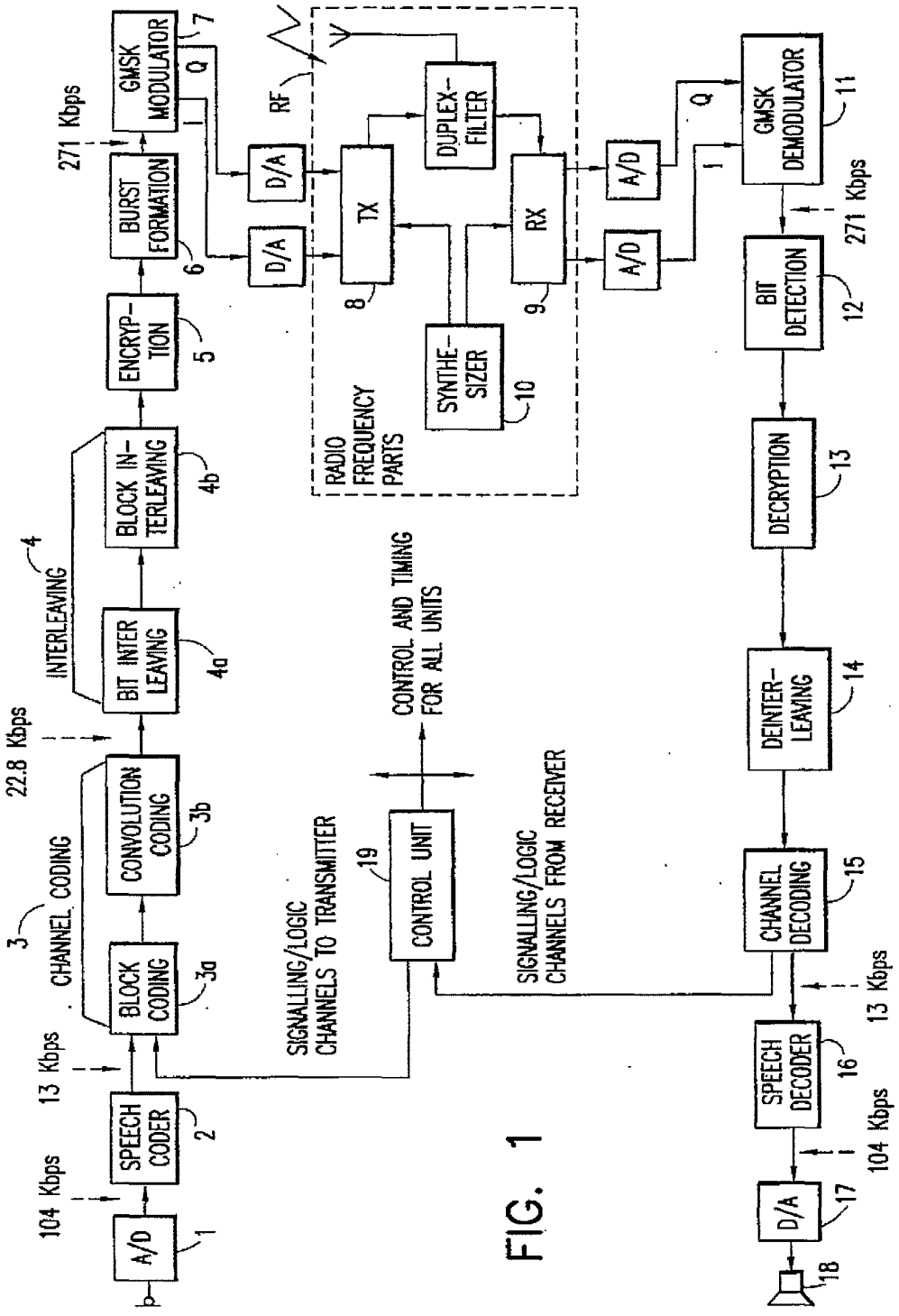



FIG. 1

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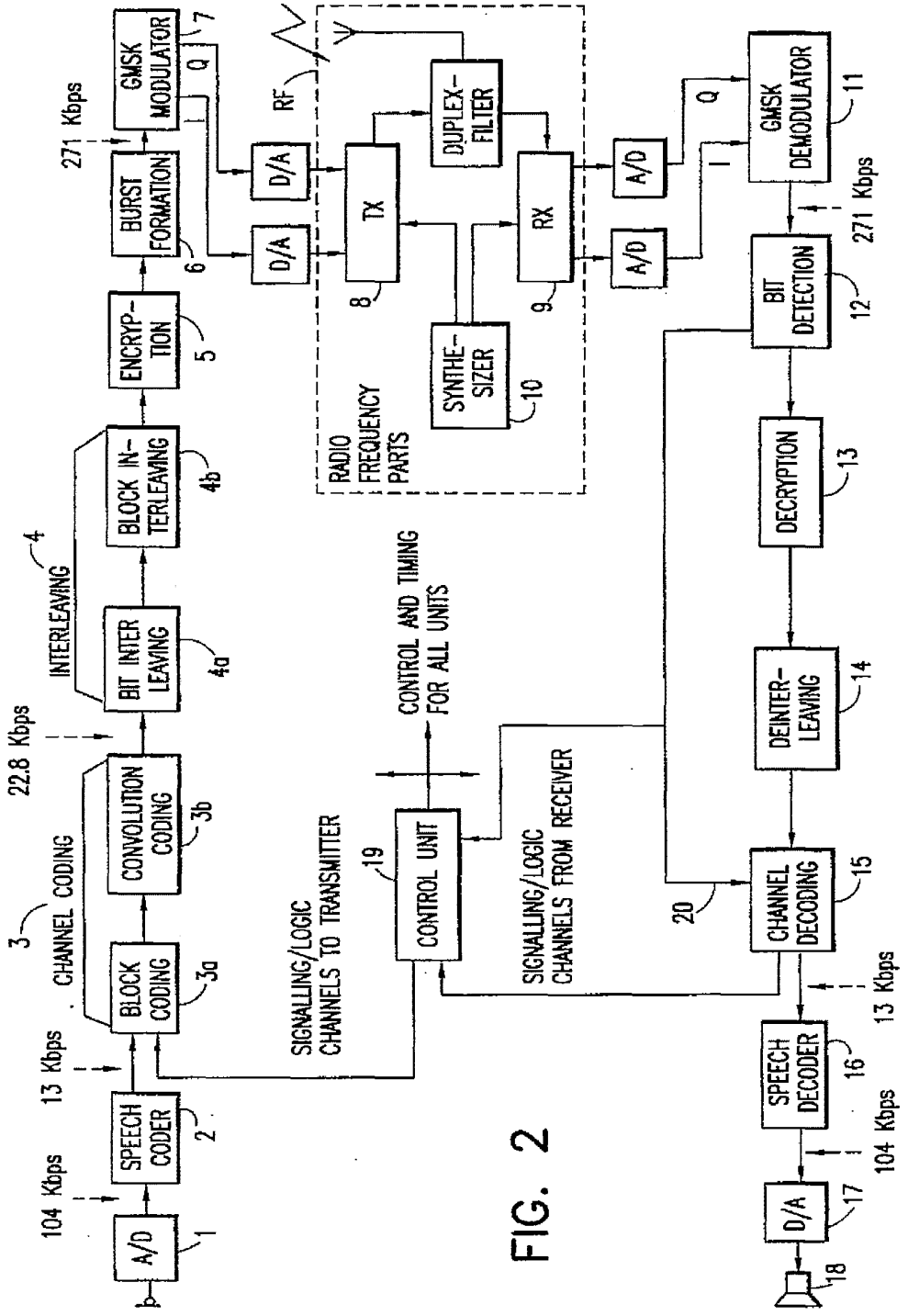



FIG. 2

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| TDMA FRAME | CHANNEL | |
|---|---|---|
| 0 | FCCH | |
| 1 | SCH | |
| 2 | BCCH | |
| 3 | BCCH | |
| 4 | BCCH | |
| 5 | BCCH | |
| 6 | PCH | |
| 7 | PCH | |
| 8 | PCH | |
| 9 | PCH | |
| 10 | FCCH | |
| 11 | SCH | |
| 12 | PCH | |
| 13 | PCH | |
| 14 | PCH | |
| 15 | PCH | |
| 16 | PCH | |
| 17 | PCH | |
| 18 | PCH | |
| 19 | PCH | |
| 20 | FCCH | |
| 21 | SCH | |
| 22 | PCH | |
| 23 | PCH | |
| 24 | PCH | |
| 25 | PCH | |
| 26 | PCH | |
| 27 | PCH | |
| 28 | PCH | |
| 29 | PCH | |
| 30 | FCCH | |
| 31 | SCH | |
| 32 | PCH | |
| 33 | PCH | |
| 34 | PCH | |
| 35 | PCH | |
| 36 | PCH | |
| 37 | PCH | |
| 38 | PCH | |
| 39 | PCH | |
| 40 | FCCH | |
| 41 | SCH | |
| 42 | PCH | |
| 43 | PCH | |
| 44 | PCH | |
| 45 | PCH | |
| 46 | PCH | |
| 47 | PCH | |
| 48 | PCH | |
| 49 | PCH | |
| 50 | | |

FIG. 3

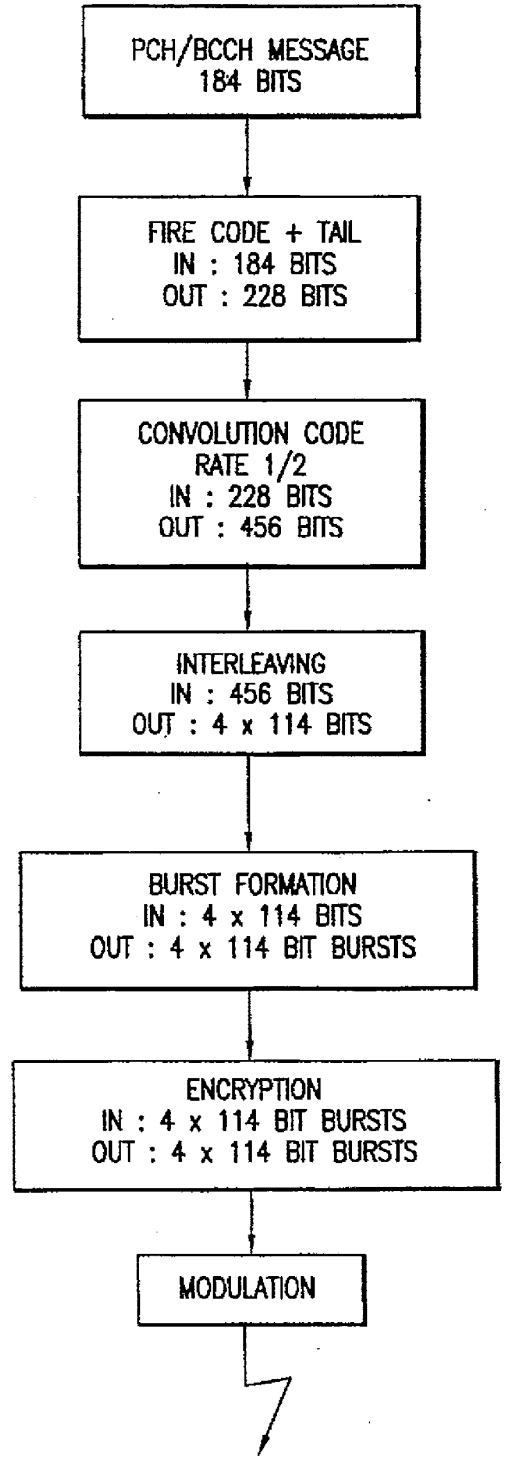
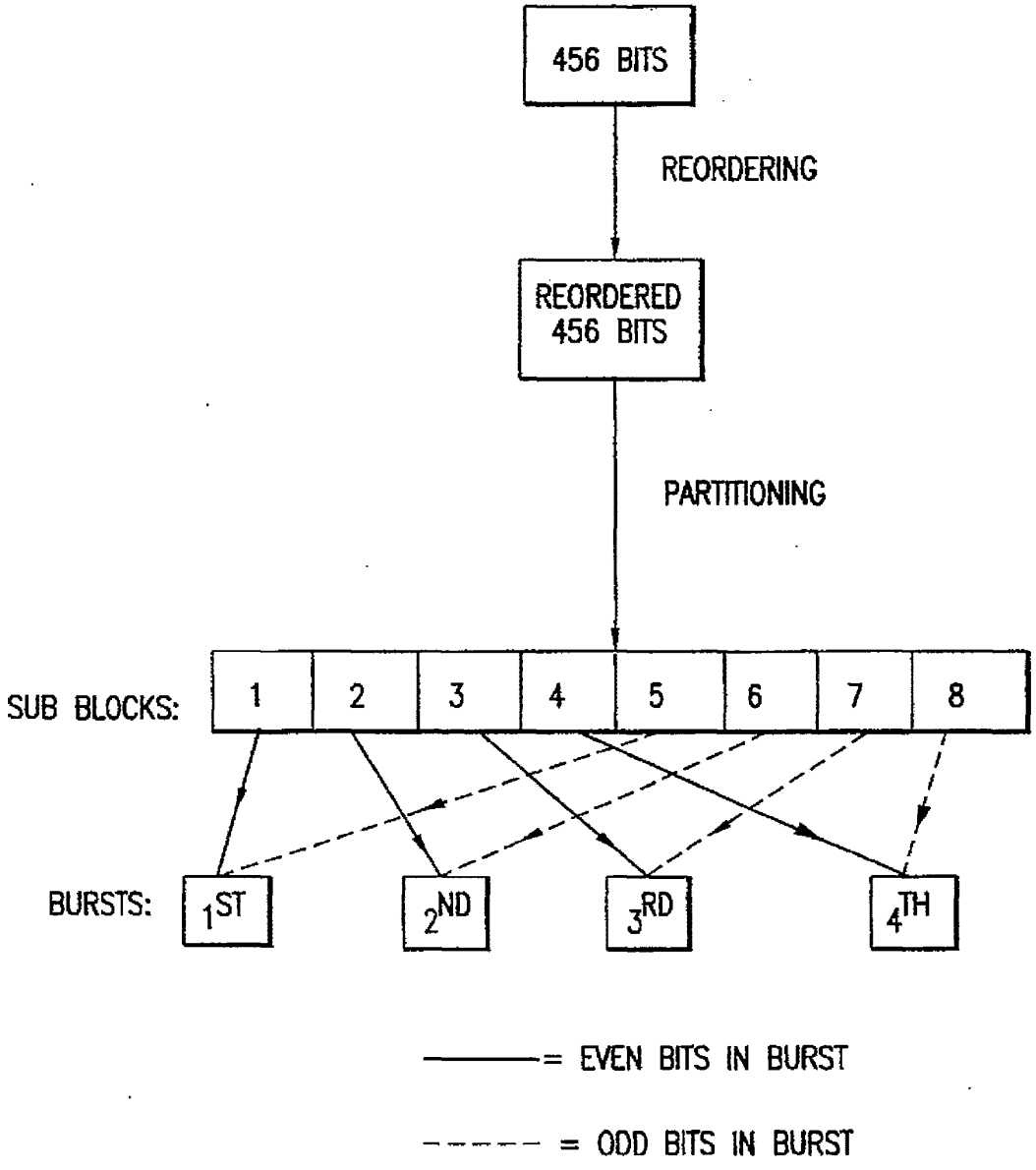



FIG. 4

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FIG. 5




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```
*   10              DECONV
*
*   10.1            FUNCTIONAL DESCRIPTION
*   SUBROUTINE FOR 2 SLOT DECONVOLUTION
    SUBROUTINE DECONV (BITBFR, SYMB)
*
*   10.2            VARIABLES
*   IMPLICIT NONE
*   10.2.1          EXTERNAL VARIABLES
*   10.2.1.1        INPUTS
    INTEGER BITBFR (456)
*   10.2.1.1.       OUTPUTS
    INTEGER SYMB (300)
*   10.2.2          LOCAL VARIABLES
    INTEGER DECO (2)
    INTEGER ORIG (0:300)
    INTEGER IK,M,N,CL,C2,C3
*   10.2.3          COMMON VARIABLES
    REAL P1,P12                 !* CONSTANTS: PI & 2* PI
    COMMON/MATH/P1,P12
    INTEGER DEBTX,DEBCH,DEBRX,DEBUG,DEBERR
    COMMON/DEBUG/DEBTX,DEBCH,DEBRX,DEBUG,DEBERR
    INTEGER LOGNUT,FITUNT,DTXUNT,DRXUNT,DEBUNT,DERUNT,DCHUNT
    COMMON/UNIT/LOGUNT,FITUNT,DTXUNT,DRXUNT,DEBUNT,DERUNT,DCHUNT
*
*   10.3    STRUCTURE
*   DECONV
*
*   10.4    MODULE
C   M: DECODER USES ODD (M=0) OR EVEN (M=2)
    M = 0
    CL = 0
    C2 = 0
    C3 = 0
    DECO(1) = 0
    DECO(2) = 0
    N = 1
    DO IK = 1 + M,456+M,4
          DECO(1) = BITBFR(IK)
          DECO(2) = BITBFR(IK+1)
          ORIG(N+3)    =  DECO(1).NEQV.DECO(2)
          ORIG(N+4)    =  CL.NEQV.C2.NEQV.DECO(1)
               CL      =  C3
               C2      =  ORIG(N+3)
               C3      =  ORIG(N+4)
          N = N+2
    END DO
    DO N = 1,228
          SYMB(N) = ORIG(N+4)
    END DO
    RETURN
    END
```

FIG. 6

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# REDUCTION OF POWER CONSUMPTION IN A MOBILE STATION

## BACKGROUND OF THE INVENTION

The present invention relates to a method and apparatus for reducing the power consumption of a mobile station in a cellular radio system.

Known cellular radio systems include a plurality of base stations for providing service in predetermined geographical areas, or cells. Mobile stations situated in the cells are serviced by one or more base stations covering that particular cell.

A mobile station will typically operate in one of two modes depending on the needs of the user. When the user is making a telephone call the mobile station is said to be in dedicated mode in which the mobile station is actively transmitting and receiving on a channel allocated for its own use. However at any other time when the mobile station is powered up the mobile station is said to be in idle mode and may be contacted by other users. In idle mode the mobile station is still in contact with the base station but there is no dedicated channel for sending and receiving speech or data. Contact is achieved with the base station through the mobile station listening to broadcast channels which constantly update the mobile stations within the cell with necessary information.

Methods of transmitting and receiving speech and data in dedicated mode are known in the art and are detailed with reference to the GSM (Groupe Speciale Mobile) system in the publication M. R. L. Hodges "The GSM radio interface, British Telecom Technological Journal", Vol. 8, No 1, 1990, p. 31–43, section 4, the content of which is hereby incorporated by reference.

For handheld mobile stations which are battery powered the maximum time in which the mobile station can operate in idle mode is typically about 16 hours.

For a similar mobile station in dedicated mode the maximum operational time is typically about 1 to 2 hours. These periods of operation are dependent almost entirely on the power consumption of the mobile station in the respective modes. A reduction of the power consumption in either mode would result in increased operational times. In idle mode the main contributor to the power consumption typically comes from the RF (Radio Frequency) sections of the mobile station. Therefore to reduce power consumption it is favorable for the RF section to only be on for limited periods of time. As the main purpose of the RF section in idle mode is to listen to broadcast messages it is further noted that the receiving side of the RF section is the most significant.

Generally broadcast messages sent by a base station which are specific to one mobile station will normally be received by all the mobile stations in idle mode within the cell. This obviously has an adverse effect on the operational time of these mobile stations and to this avail European patent publication EP 473465 suggests that for messages containing an identifying part and an information part, the mobile station first receives and decodes the identifying part. If the mobile station then discovers that the message is intended for itself the information part is further received and decoded. However, if the mobile station discovers that the message is intended for another mobile station the receiving circuits are switched to power saving mode during reception of the information part. Battery saving according to EP 473 465 is therefore based on a method for receiving two-word message, the first word of which contains the address. If this address indicates that the message is intended for another mobile station then, according to EP 473 465, it is not necessary to receive the second word of the message. Thus it is possible for the mobile station to switch a considerable part of its receiving circuits into the power saving mode until the next message is expected to arrive. This power saving mode is controlled by a timing circuit, which may be programmed with the time intervals between messages. The receiving of a message according to EP 473 465 is discontinued on the basis of receiving an address part of a complete message.



The prior art will now be discussed further with reference to the GSM system of communication. However, it should be noted that the invention is not restricted purely to this system but that reference to the GSM system aids a clear description and understanding of the state of the art for the present invention.

The idle mode and the dedicated mode in the GSM system have two classes of channels associated with them, notably dedicated channels for dedicated mode and common channels for idle mode. Referring to the common channels used in idle mode the most frequently used are the downlink channels, i,e. the channels for sending information from the base station to the mobile station. These are divided still further into channels for control information such as the FCCH (Frequency Correction CHannel) and the SCH (Synchronisation CHannel) and those for sending messages, the BCCH (Broadcast Control CHannel) and PCH (Paging CHannel). It is these downlink channels the mobile station listens to and they represent the main power consumption when in idle mode. The form of these channels are shown in FIG. 3.

The BCCH and PCH are similar in that they are encoded in exactly the same way and are sent over the same number of TDMA (Time Division Multiple Access) frames. However, the actual messages they convey differ substantially. The BCCH is used for sending messages to all mobile stations, relating to, for example, cell selection, network identification, as well as others. The PCH is used for paging specific mobile stations but is nevertheless monitored by all mobile stations within the cell. To describe how these messages are received it is necessary to first understand the basics of how these messages are transmitted.

Firstly the PCH or BCCH message originates in digital form from the infrastructure of the GSM system. From there channel coding is performed on the data which introduces redundancy into the message by adding extra information relating to the original data. This allows messages to be reconstructed even when information is lost over the radio link. The channel encoded message is then interleaved to mix up the data within the message in a predetermined way. Following this the message is then encrypted, formatted for burst formation, modulated, then transmitted. The resulting message is transmitted in four transmission bursts (timeslots) in four consecutive TDMA frames.

Mobile stations in idle mode receive all the four timeslots corresponding to the complete message. Then the message is reconstructed according to the inverse operations of the transmission. The process involves receiving the signal from the antenna, demodulating the signal, de-encrypting the message, de-interleaving the message, then channel decoding the message. The result is the original message sent from the base station.

## SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a method for controlling the power consumption

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of a mobile station in a cellular radio system. The method comprises the steps of: a) receiving a first predetermined portion of a message; b) determining a reconstruction accuracy for the message corresponding to the received portion of the message; and c) receiving a next predetermined portion of the message and returning to step b) if the reconstruction accuracy fails to fulfill a predetermined criterion and the complete message has not been received, and according to a second aspect of the present invention there is provided an apparatus for controlling the power consumption of a mobile station in a cellular radio system, the apparatus comprising; a) a receiving means for receiving a portion of a message; and b) determining means for determining a reconstruction accuracy for a message corresponding to the received portion of the message; and c) means for deciding if a reconstruction accuracy for a message fulfills a predetermined criterion.

A method and apparatus in accordance with the invention has an advantage that if the reconstruction accuracy meets with the predetermined criterion then the message can be reconstructed based only on the received portion of the message.

In a preferred method there further comprises a step d) initiating switching of the mobile station into a power saving mode during a time period reserved for a remaining portion of the message provided the complete message has not been received, and in a preferred apparatus there further comprises means for activating a power saving mode in the mobile station operable for the reconstruction accuracy fulfilling the predetermined criterion.

An advantage of the preferred method and apparatus is that the receiving of the complete message can be discontinued by initiating switching to a power saving mode. Thus power consumption of the mobile station can be reduced relative to the prior art in idle mode the main contributor to the power consumption typically comes from the RF (Radio Frequency) sections of the mobile station. Therefore to reduce power consumption it is favorable for the RF section to only be on for limited periods of time. As the main purpose of the RF section in idle mode is to listen to broadcast messages it is further noted that the receiving side of the RF section is the most significant.

In a suitable method the reconstruction accuracy is determined by a measurement of the reliability of data from the received portion of the message.

This method allows the reconstruction accuracy to be determined by such measurements as the signal to noise ratio of the received portion of the message.

In another method the reconstruction accuracy is determined by reconstructing the message based on the received portion of the message and detecting the correctness of this reconstruction.

This method allows use of channel codes, which can detect the correctness of a reconstruction, to determine the reconstruction accuracy.

In a preferred method the message is coded to contain redundant data, is interleaved over four time slots, and is broadcast for reception by mobile stations in idle mode.

## BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example, with reference to the accompanying drawings, in which:

FIG. 1 shows a block diagram of state of the art transmit/receive sections of a mobile station operating in a GSM system;

FIG. 2 shows a block diagram or the transmit/receive sections of a mobile station operating in a GSM system in accordance with the invention;

FIG. 3 shows a diagram representing the format of the common channels used in idle mode;

FIG. 4 shows a flow chart of the encoding of common channel messages in a base station;

FIG. 5 shows a diagram of the interleaving of common channel messages;

FIG. 6 shows a FORTRAN code for de-convoluting a message in accordance with the invention.

## DETAILED DESCRIPTION OF THE INVENTION

To gain a greater understanding of the invention the common channels used for downlinking in idle mode of the GSM system will be described here in greater detail.

The GSM system is based on TDMA (Time Division Multiple Access) with FDMA (Frequency Division Multiple Access) and some frequency hopping. For simplicity the common channels in idle mode all reside on a single frequency known as the 'beacon frequency' and are divided into channels by their position in time, often referred to as their allocated timeslots. The general organisation of the common channels is based on a 51 TDMA frame cycle, each TDMA frame comprising 8 timeslots.

Referring to FIG. 3 there is shown the format of the common channels within the 51 TDMA frame cycle. Each frame of the 51 TDMA frames (apart from frame 50 which is an idle frame) has a channel associated with it. However the actual data associated with that channel is sent only on the first timeslot of the eight timeslots in each TDMA frame. The BCCH (Broadcast Control Channel) and PCH (Paging Channel) use 40 Timeslots in each 51 TDMA frame cycle, these timeslots being built as 10 groups of 4 timeslots each. A single group comprising 4 timeslots is said to contain all the information from a single BCCH or PCH message. The first group (frames 2–5) in the cycle is used for a BCCH message whilst the 9 other subsequent groups (frames 6–9, 12–15, 16–19, 22–25, 26–29, 32–35, 36–39, 42–45, 46–49) are used for PCH messages. Other timeslots in the cycle are reserved for the FCCH (Frequency Control Channel), used to ensure that the correct 'beacon frequency' is used by the mobile station, and the SCH (Synchronisation Channel), used to maintain synchronisation of the mobile station's internal clock with that of the base station.

As mentioned previously the PCH and BCCH channels are encoded and transmitted in exactly the same way, each message originating as a data packet of 184 bits and proceeding as shown in FIG. 4. The first two steps involve applying channel coding to the 184 bit message. The first code used is the FIRE code which is a form of CRC (Cyclic Redundancy Check) and is dedicated to The detection and correction of burst-like errors. The FIRE code increases the redundancy of the 184 bit message by an extra 40 bits. Following this is the convolution coding which is only used for correction purposes. This form of coding is extremely efficient but also doubles the size of the message form 228 bits to 456 bits. These 456 bits are then interleaved such that the bits are shuffled around in a predetermined way and are then divided into a succession of 4 blocks, each containing 114 bits. This form of interleaving is known as block rectangular interleaving and is shown diagrammatically in FIG. 5. Usually transmission errors occur as error bursts, therefore the object of the interleaving process is to spread

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the errors evenly over the transmitted data, allowing the channel decoding in the receive sequence to achieve error correction more efficiently. During de-interleaving in the receive sequence an error burst is converted into single error bits, which can be corrected more easily by the channel decoding. The next step in the transmission sequence is the data encryption. The encryption is performed by an algorithm individually on each of the 4 blocks output by the interleaving process. The encryption prevents unauthorisecl listeners from eavesdropping on conversations, a problem associated with analogue systems. The 4 encrypted data blocks are formed into 4 transmission bursts by adding to them a training sequence, trailing bits and a protection period. The transmission bursts are supplied at a far higher data bit rate to a GMSK modulalor, which modulates the 4 bursts for the transmission. The GMSK modulation method (Gaussian Minimum Shift Keying) is a digital modulation method with a constant amplitude, where the information is contained in phase shifts. With the aid of one or several intermediate frequencies the transmitter up-converts the 4 modulated bursts to 900 MHz, and transmits them through the antenna and onto the radio path. Each timeslot in FIG. **3** corresponds to one of these bursts, with the group of 4 timeslots corresponding to the 4 bursts produced by transmission of one message.

Receiving of a PCH or BCCH message is conventionally the inverse of the transmission sequence with the complete number of timeslots corresponding to the complete message being received before the reconstruction of the message is attempted. In accordance with the invention receiving a PCH or BCCH message using less than four timeslots may be achieved.

Referring to FIG. **2** the antenna of the RF section receives the first two timeslots of the four timeslot PCH or BCCH message. Demodulation **11** is then performed on each of the 2 received timeslots followed by bit detection **12**. The bit detection is performed by a channel equalizer which detects the bits in the two received timeslots, i.e. it reproduces the transmitted bit sequence from each of the two timeslots. After the bit detection operation a decryption algorithm is performed on each of the two timeslots followed then by a de-interleaving process. Referring to FIG. **2** it can be seen that the de-interleaving process which is the inverse of interleaving would normally require all four Timeslots to enable complete recovery of the 456 bit coded message. However, in accordance with the invention, the third and fourth timeslots which have not been received are marked as comprising "unreliable" bits, i.e. it is uncertain if they are 1's or 0's. De-interleaving is then performed as normal, yielding a 456 bit message in which the first two bits are "reliable" followed by two "unreliable"bits followed by two "reliable" bits and so on. The next process in the receiving sequence is the de-convolution of the 456 bit message. One method in accordance with the invention would be to use the standard Viterbi code used to de-convolute fully received messages in which many of the bits are "reliable"bits. This method would retrieve in full the 228 bits of information required. However as only half the 456 bits are "reliable" the error correction processes used in the Viterbi decoding would be unlikely achieve anV worthwhile results. A more efficient de-convolution code applicable when no error correction is used and when only half the data is "reliable" is presented in the FORTRAN code of FIG. **6**, This code was written for use in this method using information given in the publication Y-M. Wang, S. Lin "A Modified Selective-Repeat Type-II Hybrid ARQ. System and Its Performance Analysis", IEEE Transactions on communications, Vol. COM-31, No. 5, 1983, p. 593–608, the content of which is hereby incorporated by reference.

The 228 bit message is then operated on by the FIRE code which is able to perform a limited amount of error correction. Another feature of the FIRE code though is that it gives a very good indication of whether a message has been reconstructed correctly. To reconstruct a 184 bit message by receiving 228 bits of the two received timeslots the data must contain few errors. If too many errors existed such that the FIRE code detected an incorrect reconstruction then the method according to the invention suggests that a further timeslot of the PCH or BCCH message is received, i.e. the third timeslot.

The procedure of receiving the third timeslot is the same as for receiving the first and second timeslots up to the de-interleaving. Upon de-interleaving the third timeslot the extra "reliable" bits can be added to the already de-interleaved 456 bit message to replace half the "unreliable" bits. De-convolution is now possible using error correction such that a more suitable choice of de-coder would be to use a Viterbi algorithm. As before the 228 bits resulting from the de-convolution are operated on by the FIRE code and the reconstructed 184 bit message is detected for incorrect reconstruction. If the reconstruction was still not correct based on the first, second and third timeslots then the fourth timeslot is received and the reconstruction is performed as in the prior art.

During the receiving of a PCH or BCCH message in accordance with the invention the message may have been reconstructed after receiving only 2 of the 4 timeslots or only 3 of the 4 timeslots. Therefore it is possible to switch the receiving RF sections to a power saving mode during the period when of the remaining timeslots of the message are to be received. The receiver can be switched into the power saving mode by, for example, the control unit **19** shown in FIG. **2**. It is already known that a receiver comprising both an RF receiver **9** and digital receiver sections (A/D converters and sections **11–16**) can be switched in the power saving mode when it is not receiving a message, Thus, if the receiving of a PCH or BCCH message is discontinued after receiving a part of the message, the RF receiver **9** can be switched into power saving mode during the time when the rest of the message is arriving. A power saving mode like this can be realised in a number of different ways, as is known in the art. For instance, it is possible to disconnect all voltages from the RF receiver, or all operating voltages can be disconnected and the internal circuits of the RF receiver left in a state that consumes little power.

An enhanced method of receiving the PCH or BCCH message in accordance with the invention would be to include a coarse filtering of the data before it entered the reconstruction phase. A by-product of the bit detection (channel equalizer) is information relating to the signal to noise ratio of each burst processed. To implement the enhanced method a series of simulations may be performed on the second and third timeslot portions of four timeslot messages within a range of signal-to-noise ratio values. The threshold values for which satisfactory rates of reconstruction are achieved by the channel decoding would then be recorded and programmed into the mobile station. As shown in FIG. **2** the mobile station could include an output **20** from the bit detector, **12** to the channel decoding section **15**, and also the control unit **19**, that provides imformation relating to the likelihood of correct reconstruction given the portion of the message received. If the likelihood is below the threshold value then no reconstruction would even be attempted using the received portions. Instead, the next

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timeslot would be received and the bit detection repeated. Alternatively, if the likelihood exceeded the threshold value, then reconstruction of the message would be attempted using the received portions as discussed earlier. Other coarse filtering techniques could also be included along the receiving path using additional detection means, for example: a signal-to-noise ratio detector arranged in front of the channel decoding section.

In view of the foregoing description it will be evident to a person skilled in the art that various modifications may be made within the scope of the invention. For example, the invention is not restricted to the PCH or BCCH messages in the GSM system, but it may be applied also to other systems in which the signaling messages have sufficient redundancy and the messages are transmitted in parts or time slots, such as Code Division Multiple Access (CDMA) systems.

The scope of the present disclosure includes any novel feature or combination of features disclosed therein either explicitly or implicitly or any generalisation thereof irrespective of whether or not it relates to the claimed invention or mitigates any or all of the problems addressed by the present invention. The applicant hereby gives notice that new claims may be formulated to such features during prosecution of this application or of any such further application derived therefrom.

What is claimed is:

**1.** A method for controlling the power consumption of a mobile station in a cellular radio system when receiving a message, the method comprising the steps of:

a) providing power for receiving a first predetermined portion of a message;

b) determining whether the message can be reconstructed from the received portion of the message; and

c) if the message cannot be reconstructed from the previous predetermined portion of the message, providing power for receiving a next predetermined portion of the message, receiving a second predetermined portion of the message, and returning to step b) if the complete message has not been received.

**2.** A method as claimed in claim **1**, wherein the method further comprises a step d) if the message can be reconstructed operating the mobile station in a power-saving mode during a time period reserved for a remaining portion of the message.

**3.** A method as claimed in claim **1**, wherein the reliability of data from the received portion of the message determines whether the message can be reconstructed from said received portion.

**4.** A method as claimed in claim **1**, wherein reconstructing the message based on the received portion of the message and detecting the correctness of this reconstruction determines whether the message an be reconstructed from said received portion.

**5.** A method as claimed in claim **1**, wherein the message is coded to contain redundant data.

**6.** A method as claimed claim **1**, wherein the message is a broadcast message for reception by mobile stations in idle mode.

**7.** A method as claimed in claim **1**, wherein the message is broadcast in an interleaved form over four timeslots.

**8.** A method as claimed in claim 1, wherein the first predetermined portion of the message is two timeslots.

**9.** A method as claimed in claim **1**, wherein the next predetermined portion of the message is a single timeslot.

**10.** An apparatus for controlling the power consumption of a mobile station in a cellular radio system, when receiving a message, the apparatus comprising:

a) supply means for selectively supplying power to a receiving means for receiving a predetermined portion of the message;

b) determining means for determining whether the message can be reconstructed from the received portion of the message; and

c) means for deciding if the reconstruction of the message fulfills a predetermined criterion and if the complete message has been received.

**11.** An apparatus as claimed in claim **10**, wherein the apparatus further comprises means responsive to said determining means for activating a power saving mode in the mobile station.

**12.** An apparatus as claimed in claim **10**, wherein the determining means comprises a signal to noise ratio detector.

**13.** An apparatus as claimed in claim **10**, wherein the determining means comprises a means for reconstructing a message given only a portion of the message.

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US005884190A

# United States Patent [19]

Lintula et al.

[11] Patent Number: 5,884,190

[45] Date of Patent: Mar. 16, 1999

[54] METHOD FOR MAKING A DATA TRANSMISSION CONNECTION FROM A COMPUTER TO A MOBILE COMMUNICATION NETWORK FOR TRANSMISSION OF ANALOG AND/OR DIGITAL SIGNALS

[75] Inventors: **Olli-Pekka Lintula**, Helsinki; **Petri Tapig Nykänen**, Tampere; **Arto Juhani Suomi**, Tampere, all of Finland

[73] Assignee: **Nokia Mobile Phones**, Salo, Finland

[21] Appl. No.: **663,330**

[22] Filed: **Jun. 7, 1996**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] ..... **H04Q 7/20**

[52] **U.S. Cl.** ..... **455/557**; 455/556; 455/552; 364/705.05

[58] **Field of Search** ..... 364/705.05; 455/556, 455/552, 553, 424, 558, 557

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*Primary Examiner*—Edward F. Urban

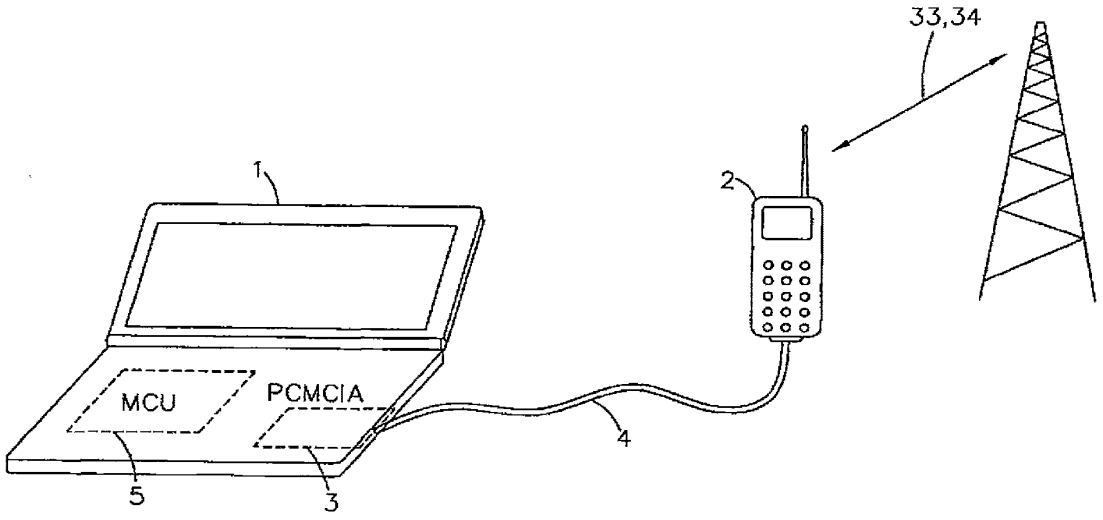
*Assistant Examiner*—Tilahun Gesesse

*Attorney, Agent, or Firm*—Perman & Green, LLP

[57] **ABSTRACT**

In a method for making a data transmission connection from a computer to a mobile communication network for transmission of analog and/or digital signals, the computer is connected to the mobile communication network by means of a telecommunication terminal which is in local data transmission connection with the computer. The telecommunication terminal utilizes at least a first operation mode and a second operation mode for connection to different types of mobile communication networks. There is testing to determine which operation modes of the telecommunication terminal are available in the mobile communication network. One of the operation modes of the telecommunication terminal available in the mobile communication network is selected for connecting the communication terminal to the mobile communication network. The telecommunication terminals set in the selected operation mode, and a data transmission connnection is set according to the selected operation mode.

**25 Claims, 12 Drawing Sheets**




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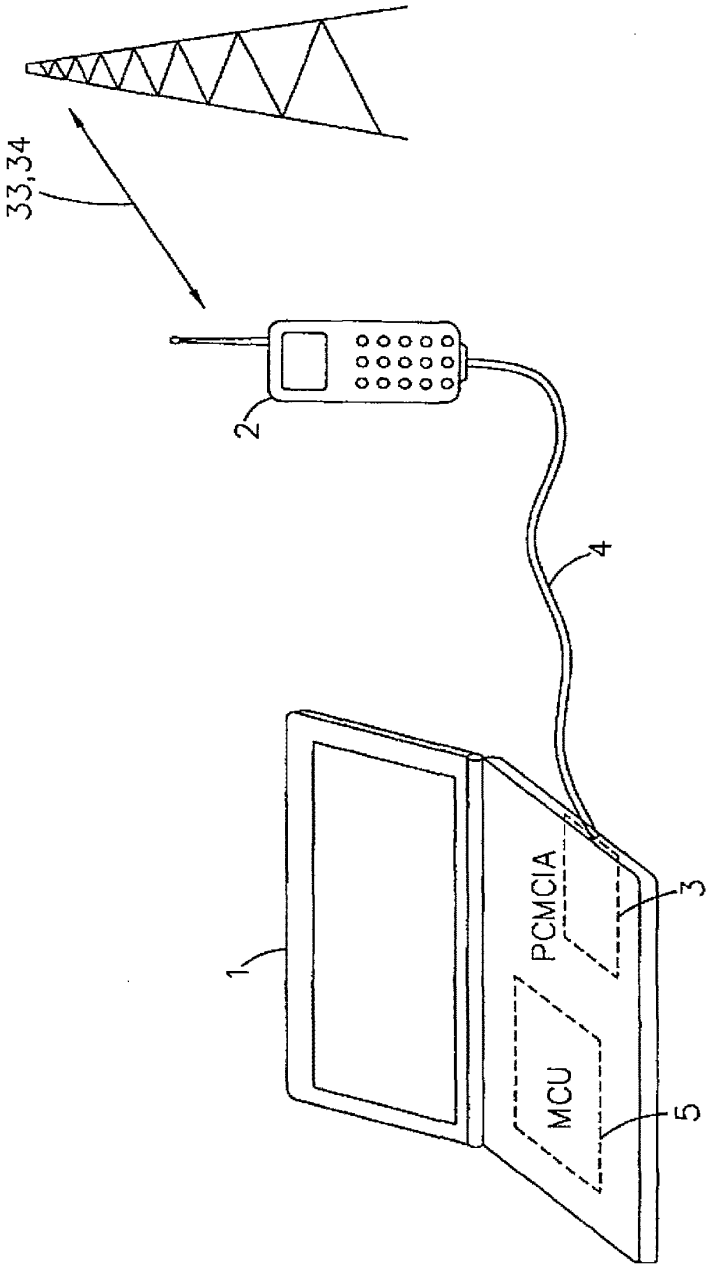



FIG. 1

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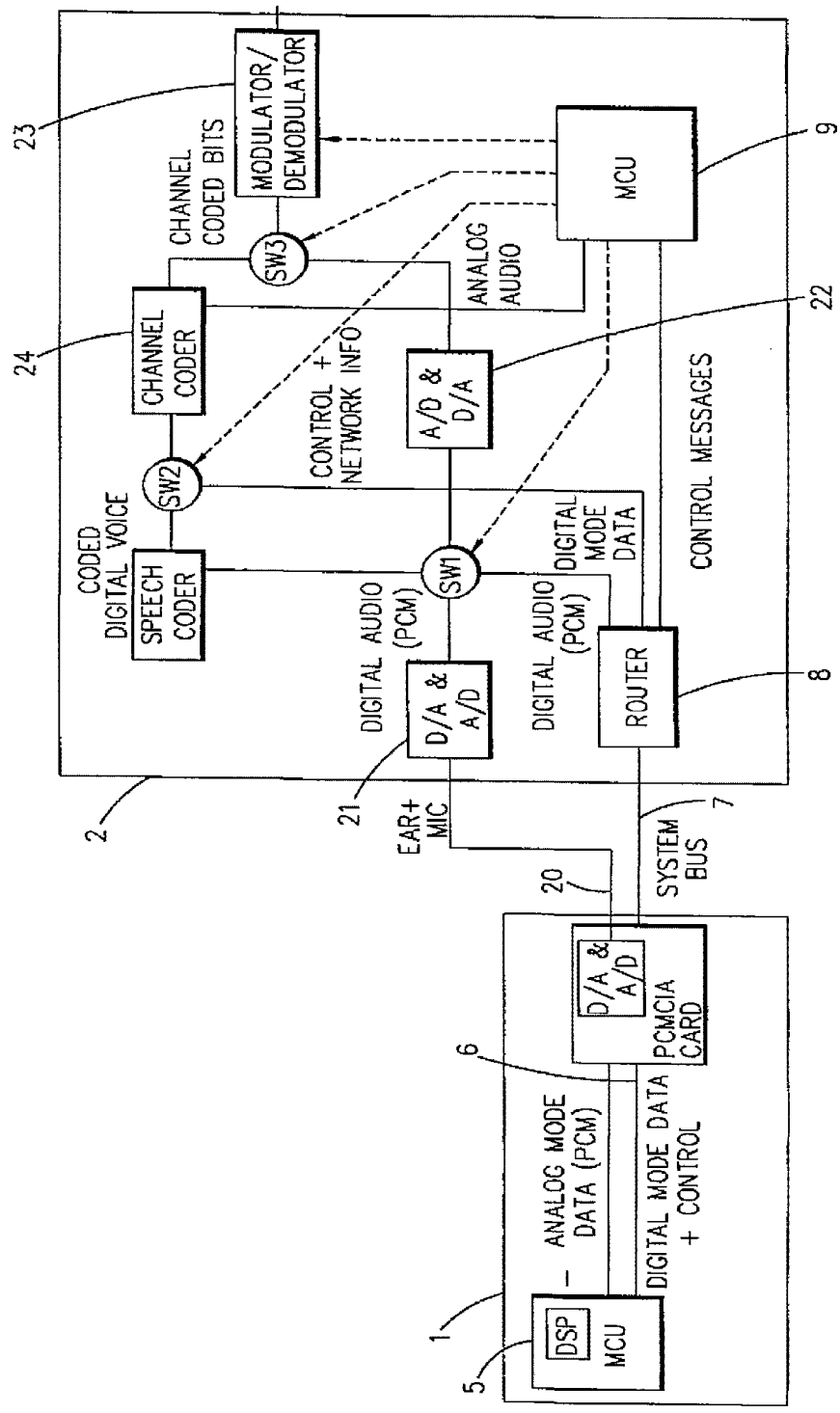



FIG. 2

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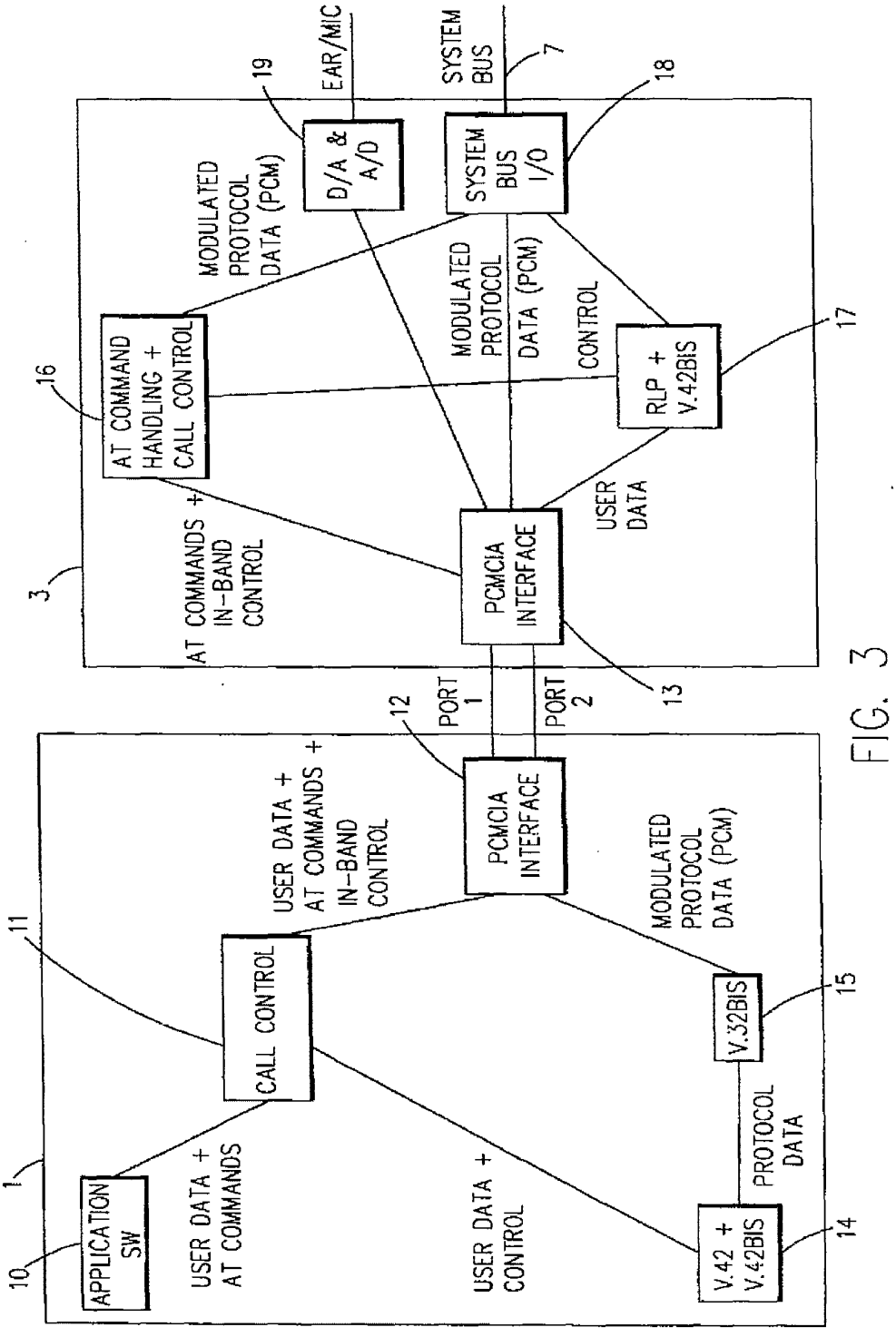



FIG. 3

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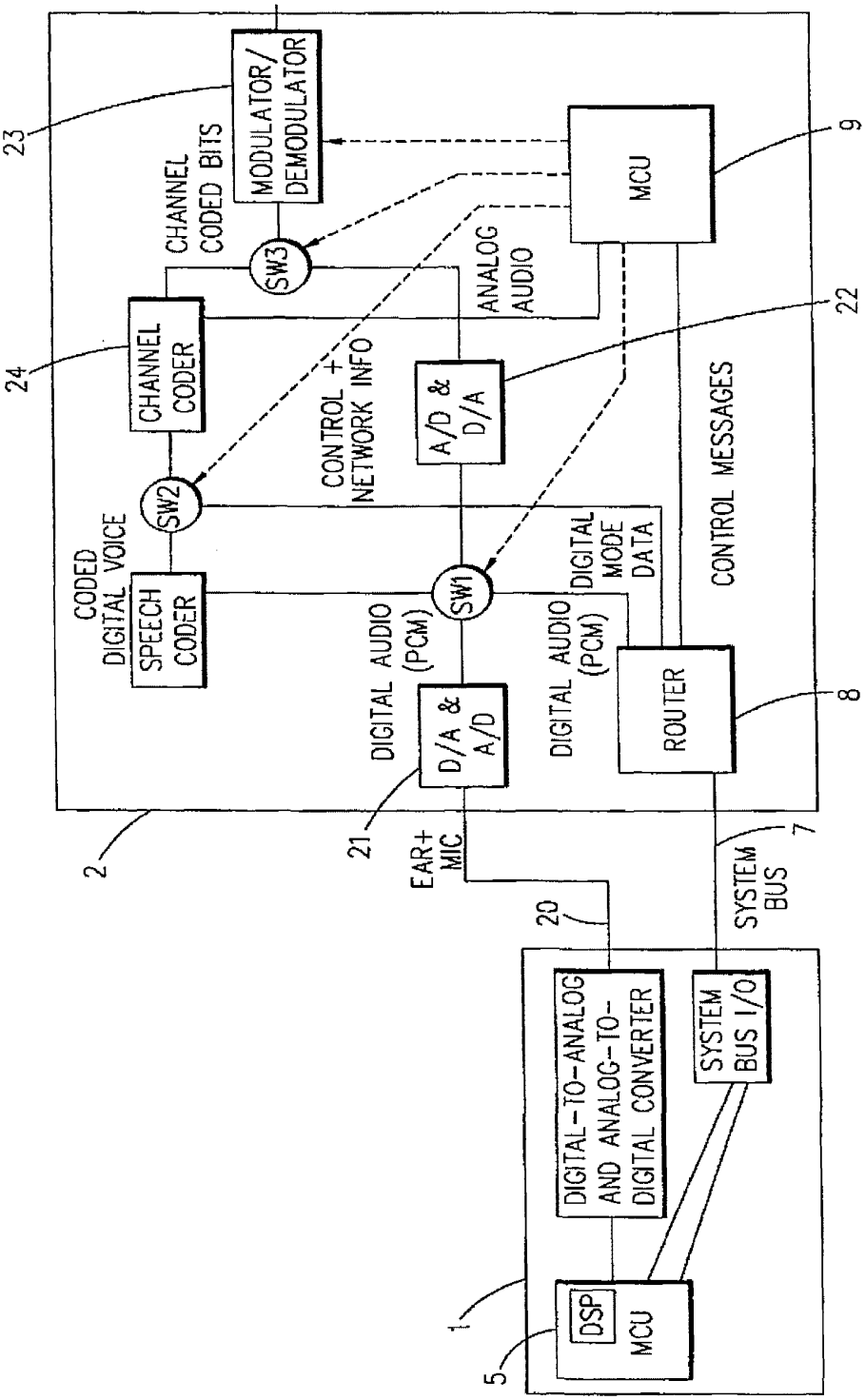

MODULATOR/ DEMODULATOR
CHANNEL CODED BITS
SW3
ANALOG AUDIO
MCU
CHANNEL CODER
A/D & D/A
CONTROL + NETWORK INFO
SW2
CODED DIGITAL VOICE
SPEECH CODER
SW1
DIGITAL MODE DATA
CONTROL MESSAGES
DIGITAL AUDIO (PCM)
D/A & A/D
DIGITAL AUDIO (PCM)
ROUTER
EAR+ MIC
SYSTEM BUS
DIGITAL-TO-ANALOG AND ANALOG-TO-DIGITAL CONVERTER
SYSTEM BUS I/O
DSP
MCU
23
9
24
22
2
21
8
7
20
1
5

FIG. 4

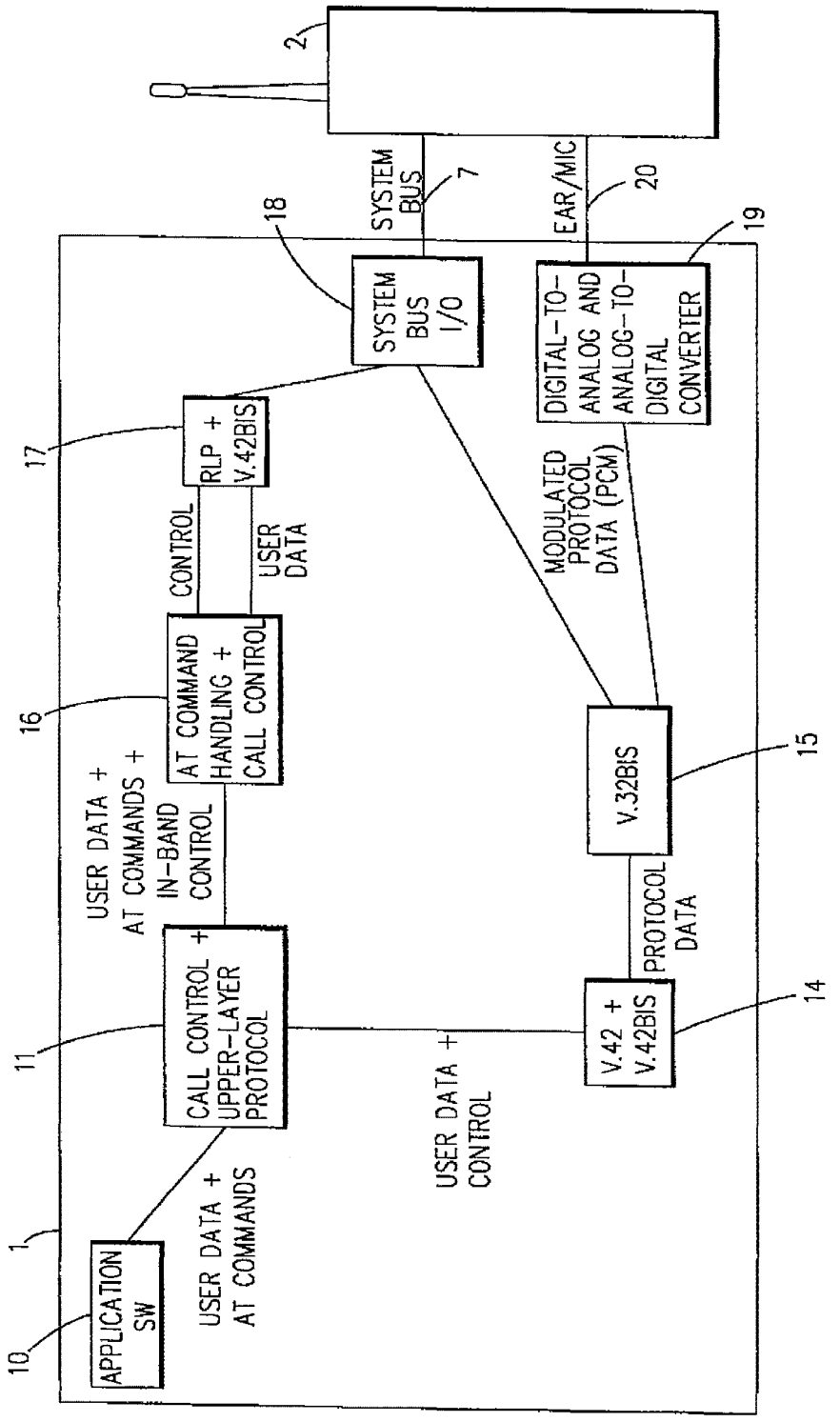



FIG. 5

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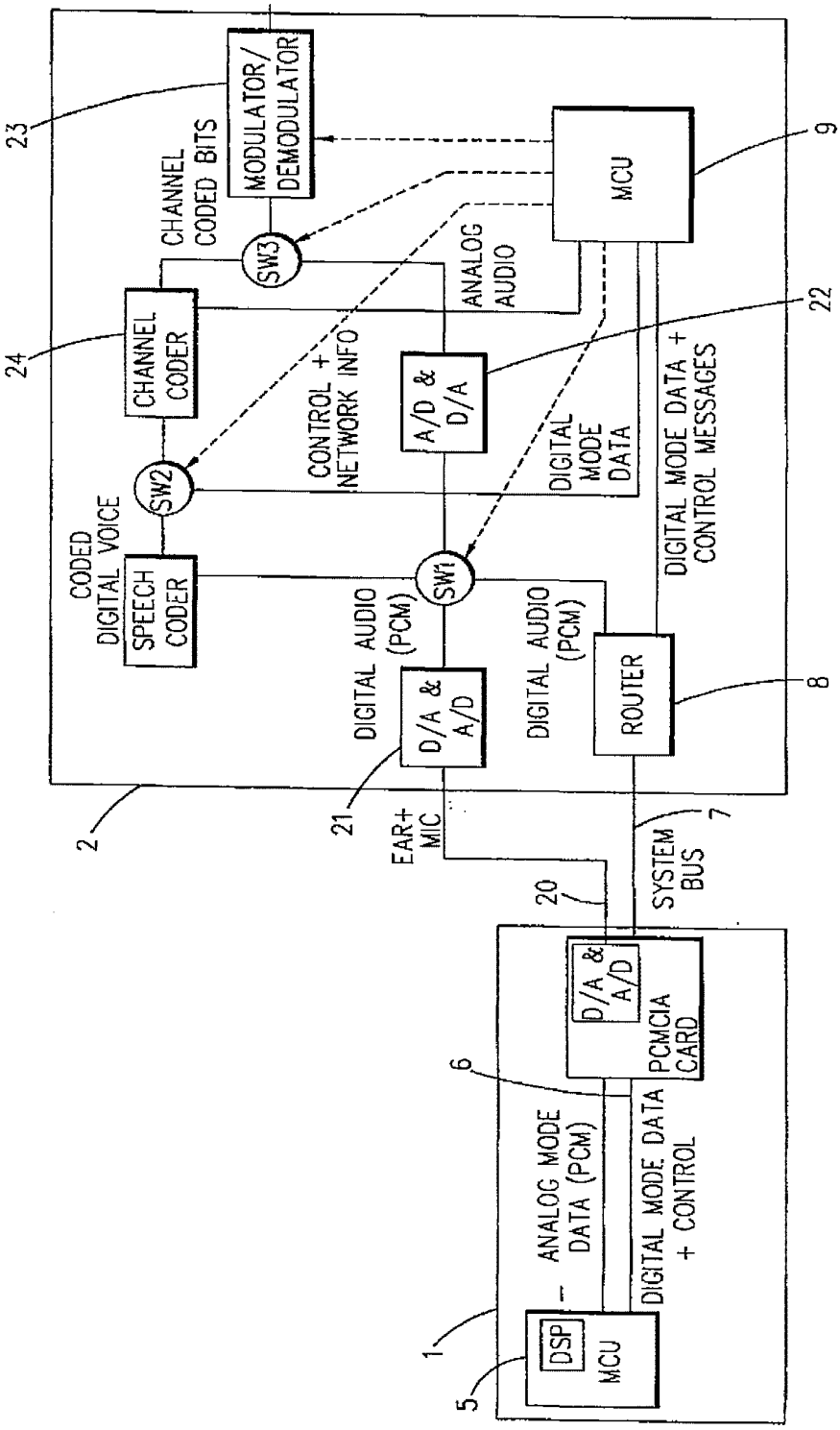



FIG. 6

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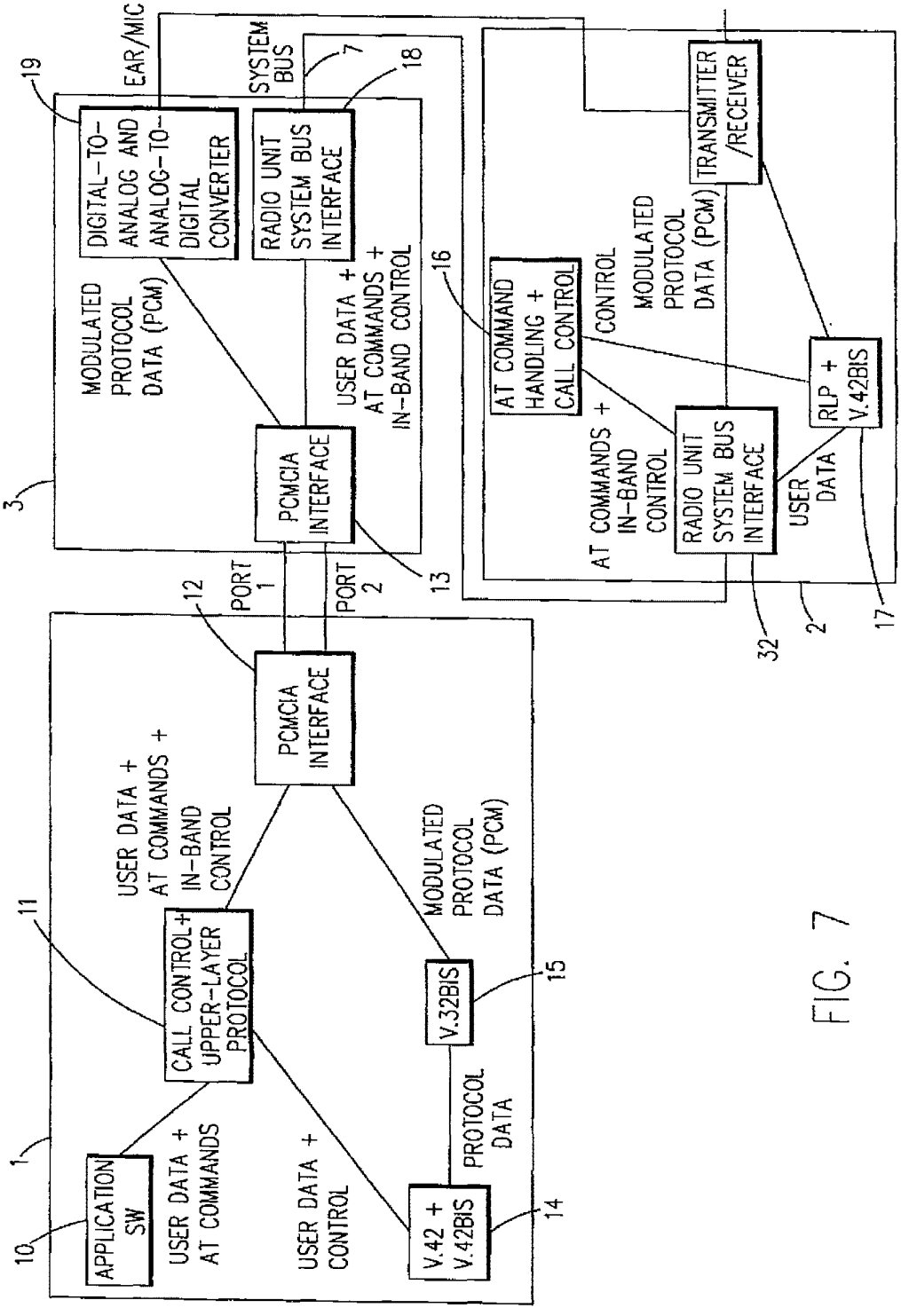



FIG. 7

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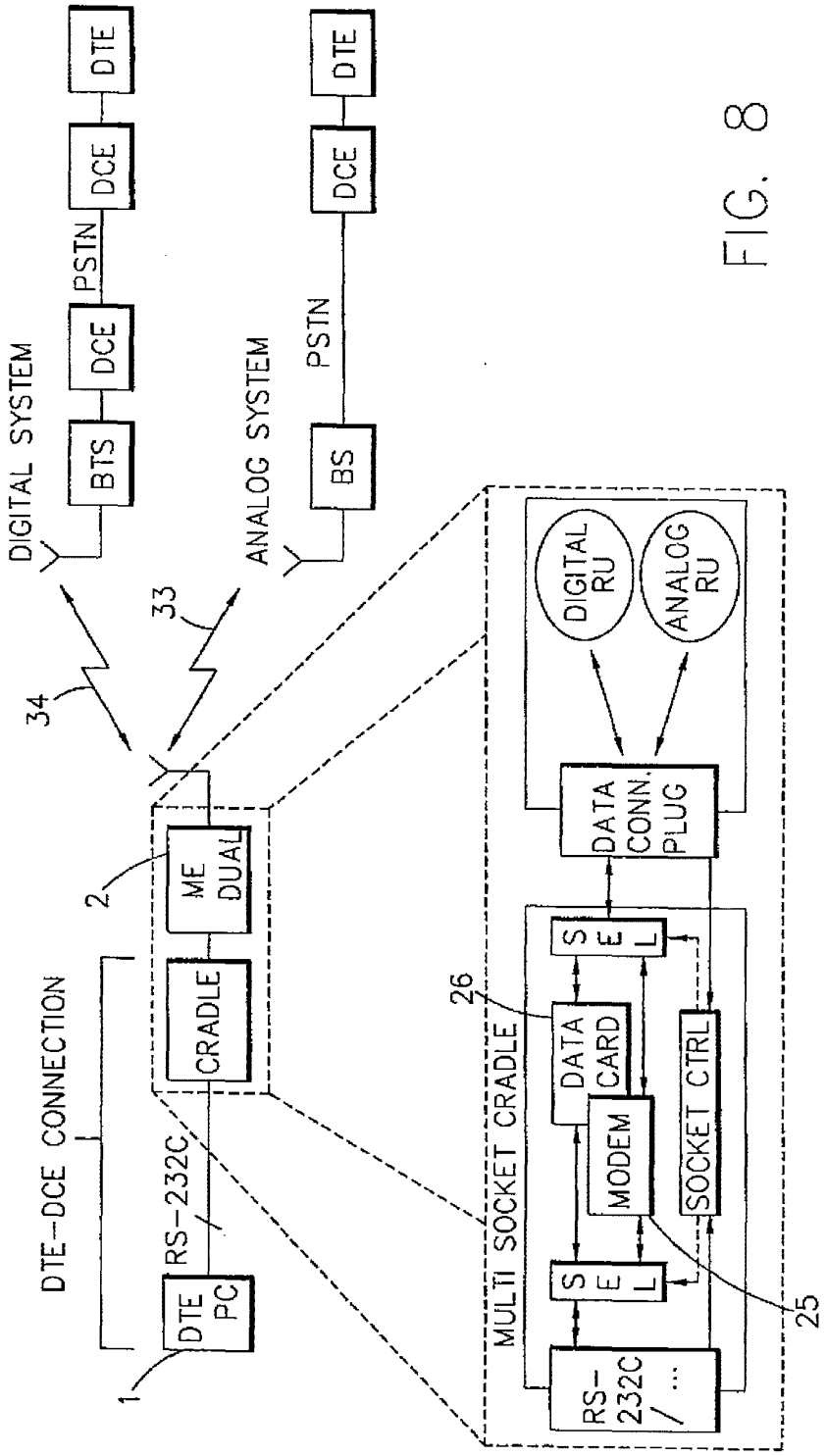



FIG. 8

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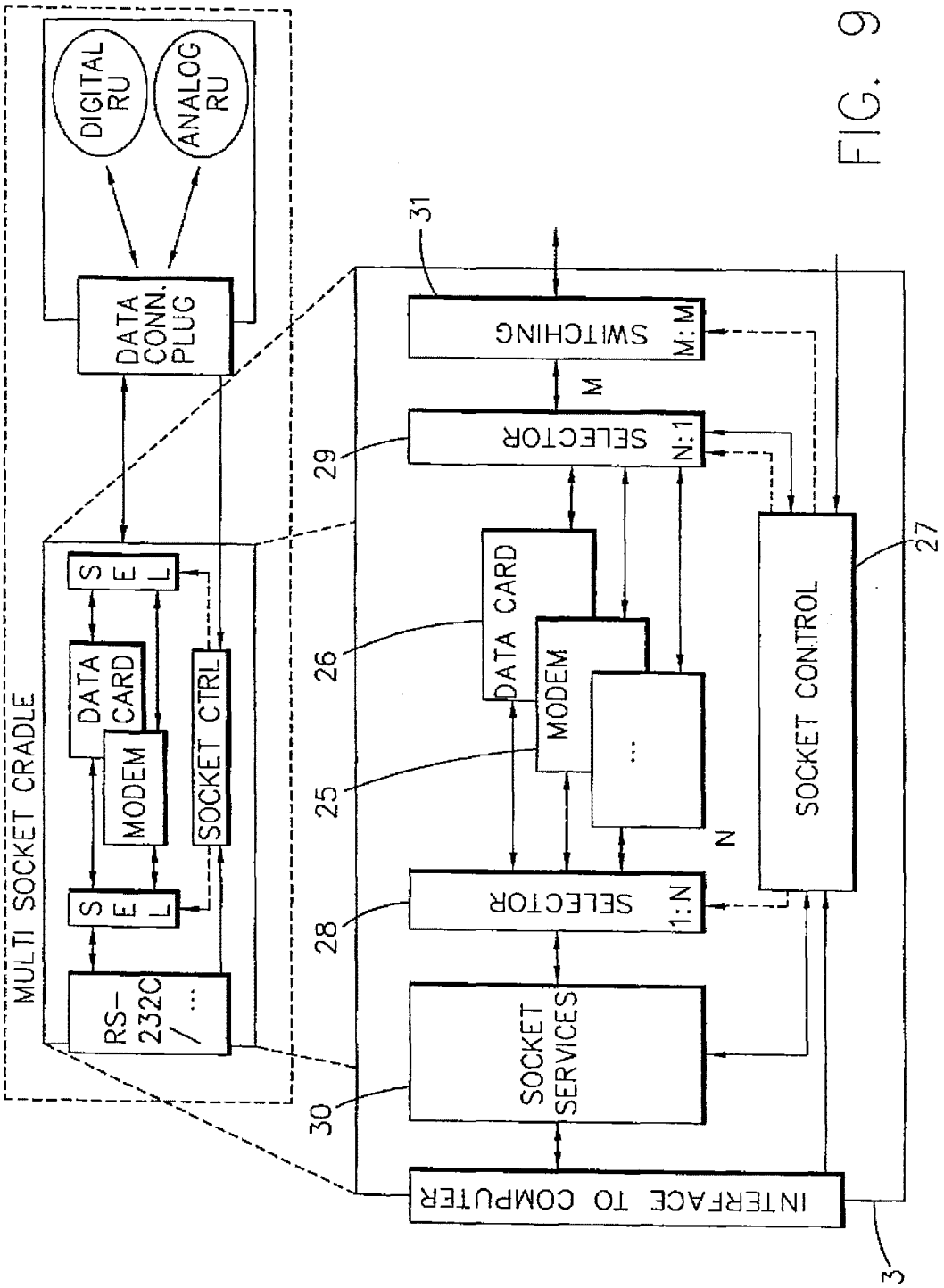

DIGITAL RU
ANALOG RU
DATA CONN. PLUG
MULTI SOCKET CRADLE
S E L
DATA CARD
MODEM
SOCKET CTRL
S E L
RS-232C / ...
31
SWITCHING
M:M
M
SELECTOR
N:1
29
DATA CARD
MODEM
...
26
25
N
SOCKET CONTROL
27
SELECTOR
1:N
28
SOCKET SERVICES
30
INTERFACE TO COMPUTER
3

FIG. 9

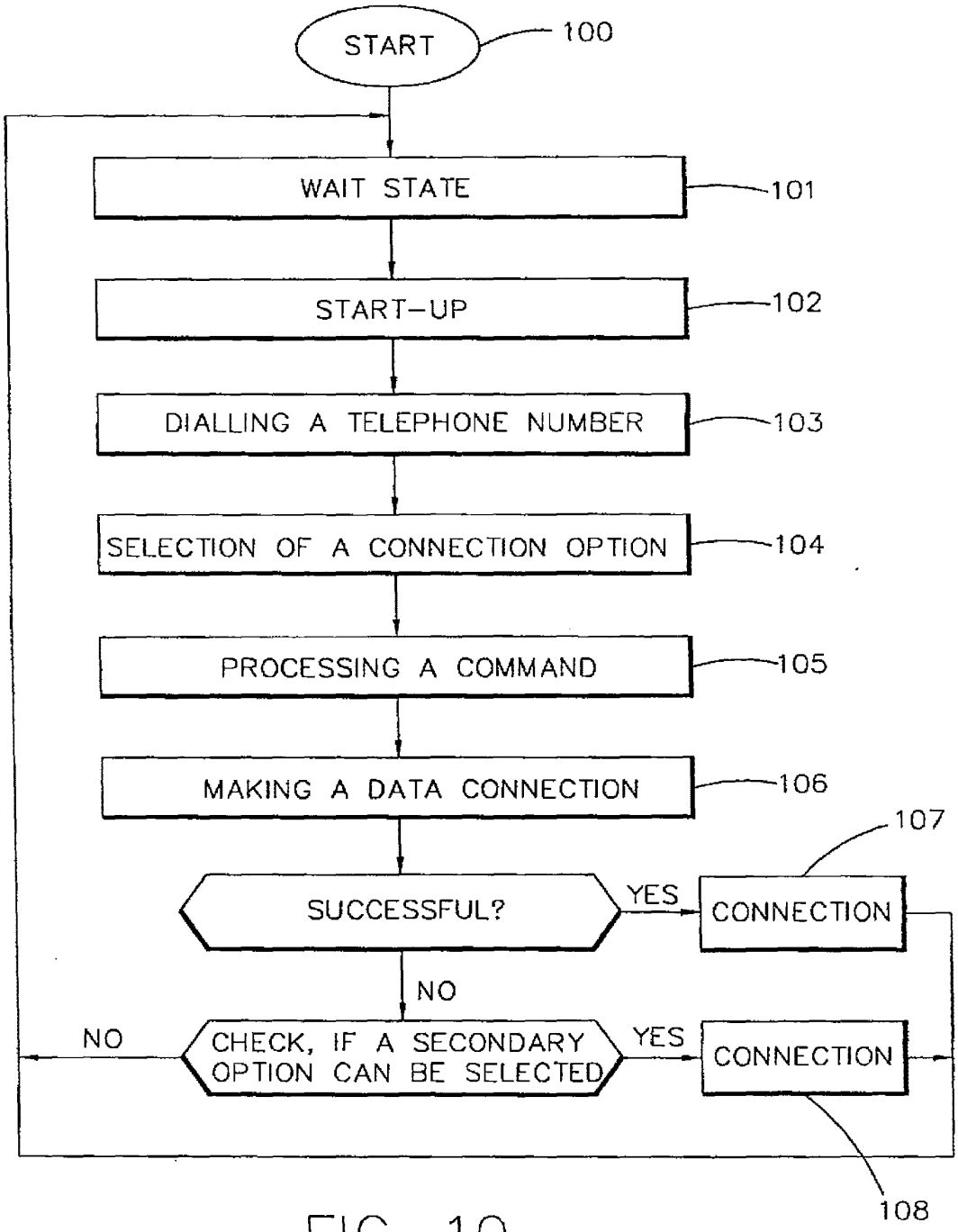



FIG. 10

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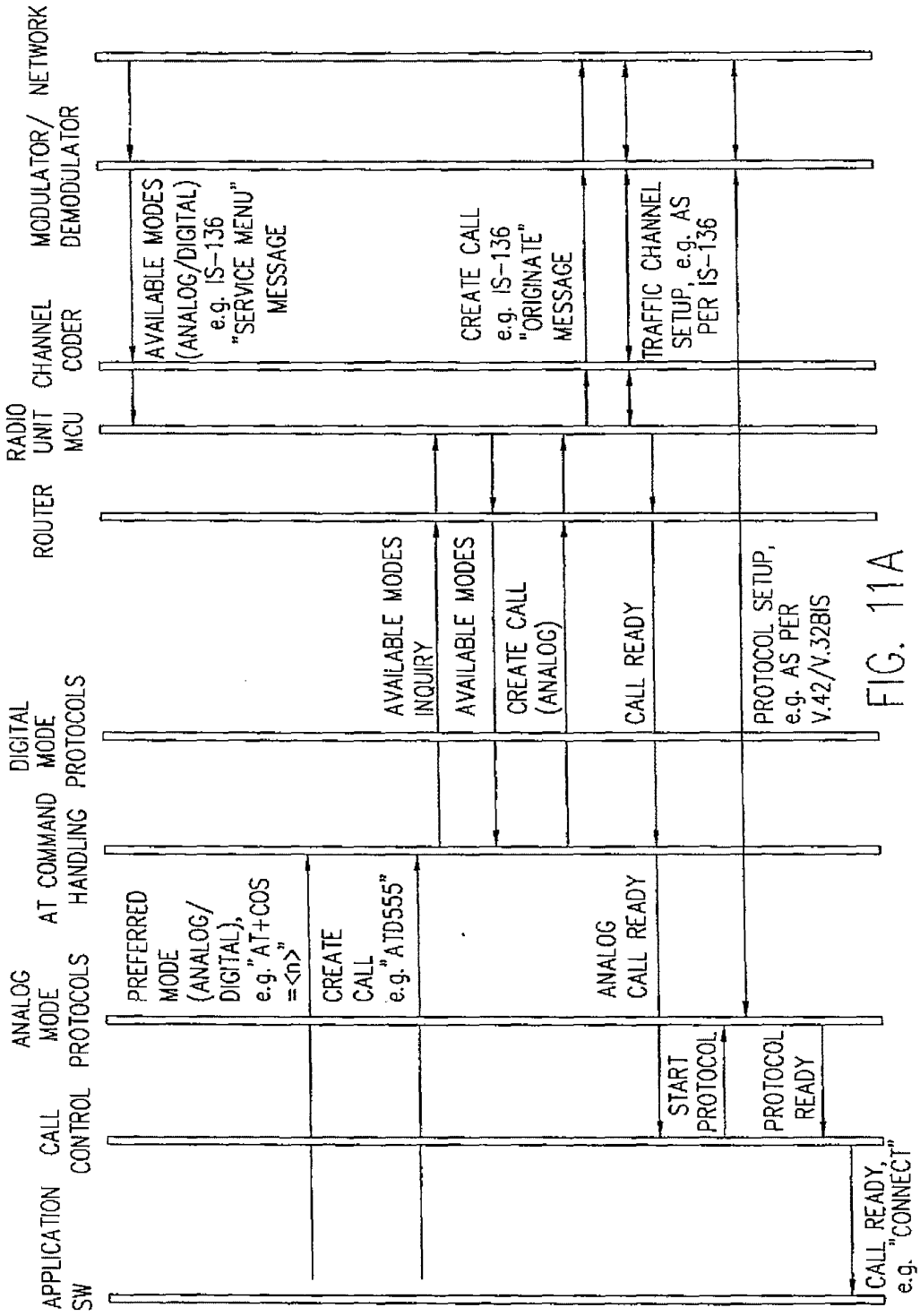



FIG. 11A

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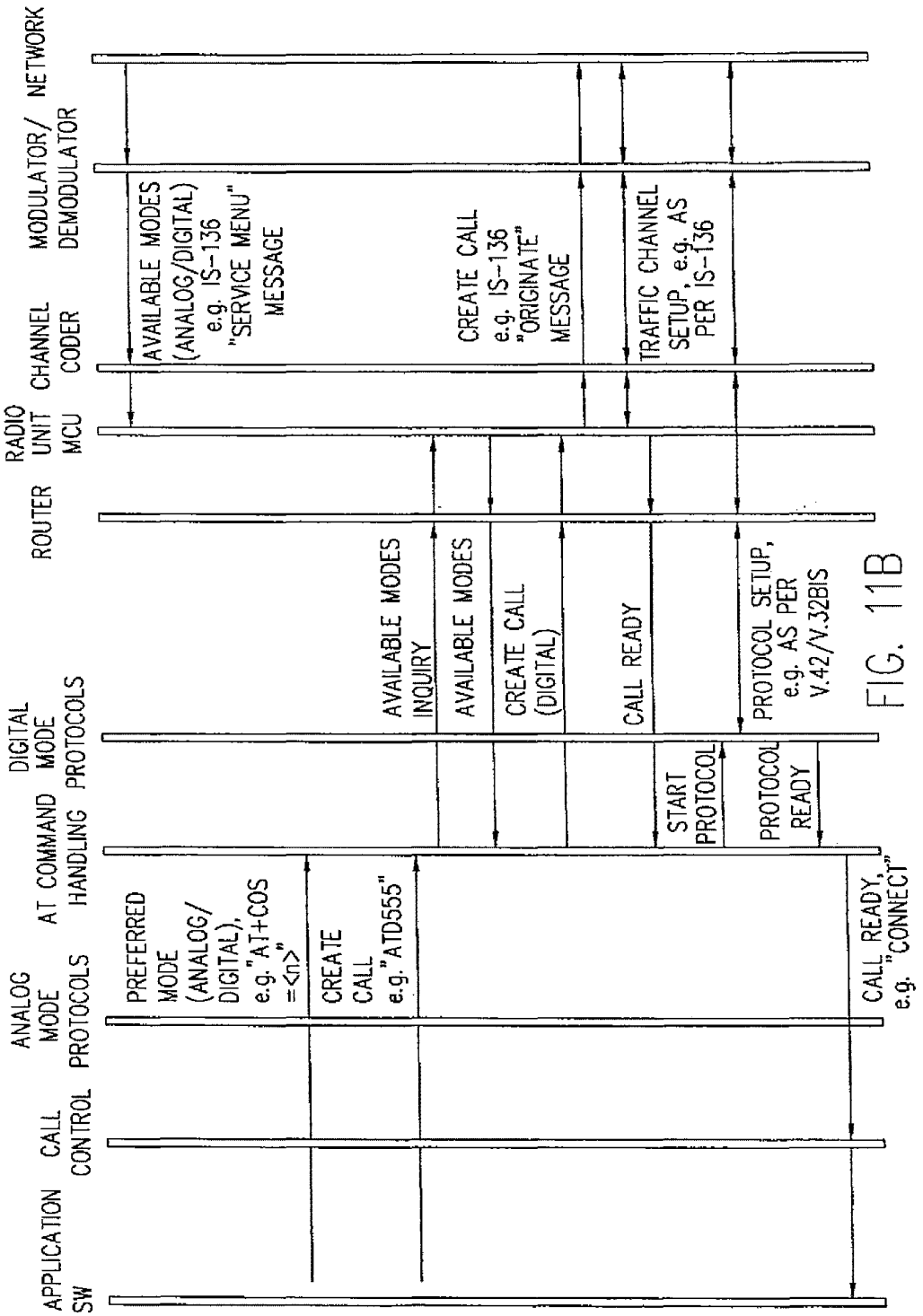



FIG. 11B

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# METHOD FOR MAKING A DATA TRANSMISSION CONNECTION FROM A COMPUTER TO A MOBILE COMMUNICATION NETWORK FOR TRANSMISSION OF ANALOG AND/OR DIGITAL SIGNALS

## BACKGROUND OF THE INVENTION

The invention relates to a method for making a data transmission connection from a computer to a mobile communication network for transmission of analog and/or digital signals, wherein the computer is connected with the mobile communication network with a telecommunication terminal which is in local data transmission connection with the computer. The telecommunication terminal utilises at least a first operation mode for connection with a first telecommunication network and a second operation mode for connection with a second telecommunication network.

The number of computers, such as personal computers (PC), is still increasing very rapidly. Computers are used in an increasing number of jobs to make tasks easier and faster to perform. Recently also the properties of so-called portable computers have been developed so that they correspond to desk-top computers in capacity but are considerably smaller in size. This has contributed to the popularity of portable computers particularly on travels. Increased use of computers has also resulted in the growing need for data transmission between computers. In many cases, computers between which data transmission is needed are located far from each other geographically, wherein advantageously a telecommunication network must be used for data transmission. Thus, the computer requires a connection device (data adapter, for example modem) for connecting the computer with a telecommunication terminal connected with a telecommunication network. In landline telecommunication networks, the data adapter can also be used as a telecommunication terminal which can be connected directly to the telecommunication network.

Landline telecommunication networks are primarily analog or digital telecommunication networks. Also mobile communication networks can be divided into analog and digital mobile communication networks. Because different types of telecommunication networks have different technical properties, this must be considered when connecting a data adapter with a computer. Generally, each telecommunication network type requires a data adapter designed precisely for that telecommunication network. Particularly in the case of portable computers, there is often a need for using the computer at different locations, whereby the user does not necessarily know what kind of a telecommunication network is available. For avoiding this problem, the portable computer should thus be equipped with a sufficient number of different data adapters to enable connecting the computer with the local telecommunication network.

Recently, mobile stations have been developed which can be connected with both analog and digital telecommunication networks. The range of use of such a mobile station can thus be expanded. Even in this case, problems may arise upon connecting a computer with the telecommunication network, because the type of network may change during the transmission from one telecommunication network area to another, whereby also the data adapter card connected with the computer should be replaced by one of the correct type. This may require unnecessary tries, because the user may not know what type of a telecommunication network is available in the area of the user.



U.S. Pat. No. 5,249,218 presents a data adapter by means of which a computer can be connected with both a landline telecommunication network and a mobile communication network. The data adapter is connected with a telecommunication terminal via a suitable connector and a cable. The data adapter identifies the type of the telecommunication terminal by signals received through the connector, if identification signals of the said telecommunication terminal are recorded in the memory of said data adapter. Next, a driver software is loaded in the data adapter, the driver software being compatible with the telecommunication terminal and allowing a data transmission connection from the computer to a telecommunication network. However, one disadvantage of the data adapter disclosed in the above U.S. Patent is that it does not take into account mobile stations which can be used in different types of mobile telecommunication networks, such as in analog and digital mobile telecommunication networks. In such a case a data transmission connection is not necessarily achieved.

## SUMMARY OF THE INVENTION

For eliminating the above-mentioned disadvantages and for raising the level of prior art in the field, it is an aim of the present invention to provide a novel method for making a data transmission connection from a computer to a mobile communication network for transmission of analog and/or digital signals.

The invention is based on the idea that there is a testing to determine to which telecommunication networks a connection can be made from the telecommunication terminal, after which one of the available mobile communication networks is selected and the telecommunication terminal is set into an operation mode corresponding to the selected mobile communication network. Next, a data transmission connection is set from the computer to the mobile communication network according to the operation mode selected in the telecommunication terminal, wherein a data transmission connection is formed from the computer to the mobile communication network. The operation mode is selected primarily by the telecommunication terminal, or also by the user or by an application used in the computer, if necessary.

The method according to the invention is characterized in that

- it is tested, to which mobile communication networks a connection can be made with the telecommunication terminal,
- one of the available mobile communication networks is selected,
- the telecommunication terminal is set into an operation mode corresponding to the selected mobile communication network, and
- the data transmission connection is set according to the selected operation mode.

The invention provides considerable advantages. By using the method of the invention, the formation of the data transmission connection can be automated, wherein the user does not need to take care of the selection and installation of a suitable data adapter card. Further, the data adapter according to the invention can be arranged in an advantageous manner as a single integrated unit, wherein the number of separate data adapter cards to be carried with the computer can be minimised.

According to the fourth embodiment of the invention, using a data adapter consisting of several data adapter cards gives the advantage that it is possible to utilise already existing data adapter cards for carrying out the invention,

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wherein the selection of the data adapter card to be used in the data transmission connection can be advantageously made by a selection logic.

## BRIEF DESCRIPTION OF THE DRAWING

The invention will be described more closely below with reference to the appended drawings, in which

FIG. **1** shows the composition of an apparatus according to the first and third embodiments of the invention in a reduced schematic form,

FIG. **2** shows an apparatus according to the first embodiment of the invention in a reduced block diagram,

FIG. **3** illustrates the operation of an apparatus according to the first embodiment of the invention in a block diagram,

FIG. **4** shows an apparatus according to the second embodiment of the invention in a reduced block diagram,

FIG. **5** illustrates the operation of an apparatus according to the second embodiment of the invention in a block diagram,

FIG. **6** shows an apparatus according to the third embodiment of the invention in a reduced block diagram,

FIG. **7** illustrates the operation of an apparatus according to the third embodiment of the invention in a block diagram,

FIG. **8** shows an apparatus according to the fourth embodiment of the invention in a reduced schematic form,

FIG. **9** shows the block diagram of a data adapter unit according to the fourth embodiment of the invention,

FIG. **10** illustrates the formation of a connection in a reduced block diagram,

FIG. **11***a* is an arrow diagram illustrating the formation of a connection when an analog operation mode is used, and

FIG. **11***b* is an arrow diagram illustrating the formation of a connection when a digital operation mode is used.

## DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** illustrates a first embodiment of the method according to the invention, the computer **1** being a portable computer. The computer **1** is connected to a telecommunication terminal by a data adapter unit **3** and a connection cable **4**. In this embodiment, the telecommunication terminal **2** is a mobile station with two operation modes for forming a data transmission connection, whereby the first operation mode can be used upon entering a first telecommunication network **33** and the second operation mode can be used upon entering a second telecommunication network **34**. The first operation mode is an analog operation mode for entering an analog mobile communication network and the second operation mode is a digital operation mode for entering a digital mobile communication network. However, the invention is not limited to dual-mode telecommunication terminals only, but it can be advantageously applied also in telecommunication terminals with several operation modes. Further, the invention can be applied in telecommunication terminal using two or several digital operation modes, such as GSM (Group Special Mobile), PDC (Personal Digital Communication), DECT (Digital European Cordless Telecommunications), PHS (Personal Handy Phone), Wireless ATM (Asynchronous Transfer Mode), or PCS+AMPS (Advanced Mobile Phone Service). Some other potential operation modes are operation modes suitable for mobile communication networks based on TDMA (Time Division Multiple Access), CDMA (Code Division Multiple Access) and FDMA (Frequency Division Multiple Access) techniques.

In the embodiment of FIG. **1**, the data adapter unit **3** is a so-called PCMCIA (Personal Computer Memory Card International Association) card, because this type of a card can be connected to almost all portable computers. The connection cable **4** is used advantageously with a connector that is suitable for the telecommunication terminal **2** and whose structure can vary for different types of a telecommunication terminal **2**. When forming a local data transmission connection, also wireless data transmission methods known as such can be used, e.g. infrared, inductive or radio connection.

In the first embodiment according to the invention, the first operation mode of the telecommunication terminal **2** can be used for both audio and data connections, and the second operation mode can be used both in asynchronous data communication and in facsimile transmissions. The mobile communication network **33, 34** informs the telecommunication terminal **2** about the different operation modes available for forming a connection.

For forming a connection, the telecommunication terminal **2** transmits a service request to the mobile communication network **33, 34**. The service request can be advantageously one of the following:

I. an analog audio connection,

II. a digital audio connection,

III. an analog audio connection preferred, but also a digital audio connection accepted,

IV. a digital audio connection preferred, but also an analog audio connection accepted, and

V. a digital data connection, such as asynchronous data and/or fax.

A connection is possible in situations where the service request corresponds to the operation modes available in the mobile communication network **33, 34**. For example when the telecommunication terminal sends a service request to the mobile communication network **33, 34** for forming an analog audio connection, making the connection is only possible if the first operation mode is available in the mobile communication network **33, 34**. If a service request I or II has been used when forming the connection, a channel exchange between a digital and analog channel is not possible during the connection.

If the telecommunication terminal **2** sends a service request III or IV, the mobile communication network **33, 34** can make a connection using either an analog or a digital channel. When service requests III and IV are used, a channel exchange between an analog and a digital channel is possible during the connection.

If a data connection is desired, service requests I and V can be used. Thus, the service request sent by the telecommunication terminal **2** to the mobile communication network **33, 34** is selected, among other things, on the basis of which operation modes are available in the mobile communication network **33, 34** and possibly also according to a selection made by the user or an application, if it is possible for the user or the application to select the operation mode. The connection options can advantageously be the following:

A. analog data only,

B. digital data only,

C. analog data preferred, but also digital data accepted, and

D. digital data preferred, but also analog data accepted.

If the option A is selected, the telecommunication terminal **2** sends a service request I. If an analog channel is not available in the mobile communication network **33, 34**, the call attempt fails.

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If the option B is selected, the telecommunication terminal 2 sends a service request V. If a digital channel is not available in the mobile communication network 33, 34, the call attempt fails.

If the option C is selected, the telecommunication terminal 2 sends a service request I, if an analog channel is available in the mobile communication network 33, 34. If an analog channel is not available in the mobile communication network 33, 34, the telecommunication terminal 2 sends a service request V. If the mobile communication network 33, 34 cannot assign a digital nor an analog channel for connection, the call attempt fails.

If the option D is selected, the telecommunication terminal 2 sends a service request V, if a digital channel is available in the mobile communication network 33, 34. If a digital channel is not available in the mobile communication network 33, 34, the telecommunication terminal 2 sends a service request I. If the mobile communication network 33, 34 cannot assign a digital data channel nor an analog channel for connection, the call attempt fails.

During a data connection, a channel exchange between a digital data channel and an analog channel is not possible. In case the mobile station used as the telecommunication terminal 2 moves during the data connection to an area where the operation mode used in the data connection is not possible, the data connection call is released.

FIG. 2 shows an apparatus implemented by the method according to the invention. The main parts of the apparatus are a computer 1, which in this embodiment is advantageously a portable computer, and a mobile station used as a telecommunication terminal 2 with two operation modes, the first operation mode being an analog operation mode and the second operation mode being a digital operation mode. A data adapter unit 3 is installed in connection with the computer 1 and it is advantageously a PCMCIA card and may comprise also a microcontroller. FIG. 2 is a block diagram of only the most important operations for implementing the method according to the invention. In the following, the formation of a data connection in a device of FIG. 2 will be described in more detail.

A processor block 5 is an important element in the operation of the computer 1, comprising e.g. a central processing unit MCU. The computer 1 can advantageously comprise also a digital signal processor chip DSP specially designed for signal processing. The operation of the computer 1 is usually based on an operating system controlling the operation of the software installed in the computer 1. The operation of a computer 1 is known to an expert in the field; consequently a more detailed description is unnecessary in this context.

FIG. 10 illustrates the formation of a data transmission connection in a reduced flow chart, which will be described in more detail below, with reference to FIG. 2. The signal level will be described below in connection with the description of FIGS. 11*a* and 11*b*. After turning the apparatus on (block 100), it turns into a wait state (block 101). The formation of a data transmission connection is started advantageously by an application being run in the computer 1. The start-up (block 102) can take place either upon selection by the user or automatically when a certain condition is fulfilled, such as at a predetermined moment of time. The formation of a data transmission connection is advantageously started by dialling a phone number (block 103), e.g. by AT commands used for controlling the data adapter, known as such. From the processor block 5, the dialling command and the data on the connection option A, B, C, D selected by the user or the application (block 104) is transmitted via a first control bus 6 to the data adapter unit 3. The data adapter unit 3 processes the command (block 105) and transmits it further via a system bus 7 to a router 8 located in the telecommunication terminal 2. The router 8 recognises the command as a command for dialling a phone number and transmits it further to a processor block 9 in the telecommunication terminal 2. The processor block 9 of the telecommunication terminal 2 comprises a processor unit, a read-only memory and a read/write memory, which is known to an expert in the field.

For making a data transmission connection (block 106), the telecommunication terminal 2 tests which mobile communication networks 33, 34 are available for making a connection, and which are the operation modes corresponding to them. If only a first mobile communication network 33, such as an analog mobile communication network, is available, a data transmission connection is made in the case that the telecommunication terminal 2, the user or the application has selected a data transmission A according to the first operation mode; primarily a data transmission A according to the first operation mode and secondarily a data transmission C according to the second operation mode; or primarily a data transmission according to the second operation mode and secondarily a data transmission D according to the first operation mode. In a corresponding manner, if only a second mobile communication network 34, such as a digital mobile communication network, is available, the data connection is made in case the telecommunication terminal 2, the user or the application has selected a data transmission B according to the second operation mode; primarily a data transmission according to the second operation mode and secondarily a data transmission D according to the first operation mode; or primarily a data transmission according to the first operation mode and secondarily a data transmission C according to the second operation mode.

If both the first mobile communication network and the second mobile communication network are available for making a connection, the data transmission connection is made according to the operation mode of primary option (block 107). If the data transmission connection is not successful according to the operation mode of primary option, an attempt is made to make a connection according to the operation mode of secondary option (block 108).

When the telecommunication terminal 2, the user or the application has selected the operation mode to be used in the data transmission connection, the processor block 9 of the telecommunication terminal 2 transmits data on the selected operation mode to the data adapter unit 3 and sets the data transmission connection of the telecommunication terminal 2 to correspond to the selected operation mode preferably by means of switches sw1, sw2, sw3. The data adapter unit 3 transmits data on the selected operation mode further to the processor block 5 of the computer 1. On the basis of this data, the processor block 5 starts data transmission by using a data transmission method suitable for the selected operation mode.

FIG. 3 is a block diagram on the operation of an apparatus according to the first embodiment of the invention, for the part of the computer 1 and the data adapter unit 3. The application block 10 is e.g. an ordinary terminal emulation program, by means of which the user can control the data transmission. From the application block 10, the data to be transmitted and the commands controlling the data transmission operation, such as AT commands, are transmitted to a command control block 11. If the second operation mode is used, the data to be transmitted and the AT commands are transmitted further to a first connection block 12, through

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which the data and the commands are moved to a second connection block **13** in the data adapter unit **3**. When the first operation mode is used, the control commands are transmitted from the command control block **11** directly to the first connection block **12**, but the data to be transmitted is conveyed from the command control block **11** to a first protocol block **14**. The first protocol block **14** converts the data to be transmitted into data frames according to a predetermined data transmission protocol. Such protocols include V.42 and V.42bis. The data frames are transmitted into a modulation block **15**, where a carrier wave is modulated by a pulse code modulation (PCM) known as such. The modulated signal is conveyed further to the first connection block **12** for transmission to the data adapter unit **3**.

From the second connection block **13**, the commands are transmitted to a command processing block **16** which interprets the commands and takes the measures corresponding to them, such as transmission of a service request to the telecommunication terminal **2** and further to the mobile communication network **33**, **34**. The command processing block **16** also controls the operation of a second protocol block **17**, when the second operation mode is used. Thus, the data to be transmitted is conveyed from the second connection block **13** to the second protocol block **17**, where the quantity of the data to be transmitted is reduced by compression and the reliability of data transmission is improved by adding error correction data to the data to be transmitted.

The data to be transmitted in digital form is conveyed from the second protocol block **17** to a first system bus connection block **18**, through which the data is conveyed to the system bus **7** for transmission to the telecommunication terminal **2**. If the first operation mode is used in data transmission, the data to be transmitted is conveyed from the second connection block **13** either to a first modulation block **19** or to the first system bus connection block **18**. In the apparatus shown in FIG. **3**, the data to be transmitted is at this stage pulse code modulated. In the first modulation block **19**, the pulse code modulated signal is converted analog and transmitted to the telecommunication terminal **2** via an audio line **20**. Thus, the signal is converted back to a pulse code modulated signal in a second modulation block **21** in the telecommunication terminal **2** and conveyed further to the first switch sw1 (FIG. **2**). The pulse code modulated signal can also be conveyed via the first system bus connection block **18** to the system bus **7** and further to the router **8**. From the router **8**, the pulse code modulated signal is conveyed to the first switch sw1. Next, the pulse code modulated signal is conveyed to a third modulation block **22**, where the pulse code modulated signal is converted to an analog audio signal. The analog audio signal is conveyed via the third switch sw3 to a modulator/demodulator block **23**.

When the second operation mode is used in data transmission, the digital data coming from the system bus **7** and the router **8** is conveyed to the second switch sw2 and further to a channel coder **24**. From the channel coder **24** the channel coded bytes are conveyed to the third switch sw3 and further to the modulator/demodulator block **23** for transmission into the mobile communication network **33**, **34**.

The processing block of the telecommunication terminal controls and configures the modulator/demodulator block **23** according to a selected operation mode. The modulator/demodulator block **23** modulates the signals to be transmitted from the telecommunication terminal **2** to a form suitable for the mobile communication network **33**, **34**. In a corresponding manner, the signals to be received from the mobile communication network **33**, **34** are demodulated in the modulator/demodulator block **23**.

FIG. **5** is a block diagram on the operation of an apparatus according to the second, preferred embodiment of the invention, for the part of the computer **1**. The application block **10** is e.g. an ordinary terminal emulation program, by means of which the user can control the data transmission. From the application block **10**, the data to be transmitted and the commands controlling the data transmission operation, such as AT commands, are transmitted to a command control block **11**. If the second operation mode is used, the data to be transmitted and the AT commands are transmitted further to a command processing block **16**. When the first operation mode is used, the control commands are transmitted from the command control block **11** directly to the command processing block **16**, but the data to be transmitted is conveyed from the command control block **11** to a first protocol block **14**. The first protocol block **14** converts the data to be transmitted into data frames according to a predetermined data transmission protocol. Such protocols include V.42 and V.42bis. The data frames are transmitted into a modulation block **15**, where a carrier wave is modulated by a pulse code modulation (PCM) known as such.

The command processing block **16** interprets the commands and takes the measures corresponding to them, such as transmission of a service request to the telecommunication terminal **2** and further to the mobile communication network **33**, **34**. The command processing block **16** also controls the operation of a second protocol block **17**, when the second operation mode is used. Thus, the data to be transmitted is conveyed to the second protocol block **17**, where the quantity of the data to be transmitted is reduced by compression and the reliability of data transmission is improved by adding error correction data to the data to be transmitted.

The data to be transmitted in digital form is conveyed from the second protocol block **17** to a first system bus connection block **18**, through which the data is conveyed to the system bus **7** for transmission to the telecommunication terminal **2**. If the first operation mode is used in data transmission, the data to be transmitted is conveyed as a modulated signal either to a first modulation block **19** or to the first system bus connection block **18**. In the apparatus shown in FIG. **5**, the data to be transmitted is at this stage pulse code modulated. In the first modulation block **19**, the pulse code modulated signal is converted analog and transmitted to the telecommunication terminal **2** via an audio line **20**. Thus, the signal is converted back to a pulse code modulated signal in a second modulation block **21** in the telecommunication terminal **2** and conveyed further to the first switch sw1 (FIG. **4**). The pulse code modulated signal can also be conveyed via the first system bus connection block **18** to the system bus **7** and further to the router **8**. From the router **8**, the pulse code modulated signal is conveyed to the first switch sw1. Next, the pulse code modulated signal is conveyed to a third modulation block **22**, where the pulse code modulated signal is converted to an analog audio signal. The analog audio signal is conveyed via the third switch sw3 to a modulator/demodulator block **23**.

When the second operation mode is used in data transmission, the digital data coming from the system bus **7** and the router **8** is conveyed to the second switch sw2 and further to a channel coder **24**. From the channel coder **24** the channel coded bytes are conveyed to the third switch sw3 and further to the modulator/demodulator block **23** for transmission into the mobile communication network **33**, **34**.

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The processing block of the telecommunication terminal controls and configures the modulator/demodulator block **23** according to a selected operation mode. The modulator/demodulator block **23** modulates the signals to be transmitted from the telecommunication terminal **2** to a form suitable for the mobile communication network **33, 34**. In a corresponding manner, the signals to be received from the mobile communication network **33, 34** are demodulated in the modulator/demodulator block **23**.

In the preferred, second embodiment of the invention, the first protocol block **14**, the modulation block **15**, and the second protocol block **17** are placed in the computer **1**, wherein they can be implemented advantageously by using one or more processors. This corresponds the disposition shown later in table **9**. Thus, the data adapter unit **3**, the first connection block **12** and the second connection block **13** are not required, but the telecommunication terminal **2** is connected advantageously to the connections of the computer **1**, for instance the system bus **7** to the series connection (RS-232C) and the audio line **20** to audio connection or telephone connection.

FIG. **6** shows the main elements of the apparatus according to a third embodiment of the invention, and FIG. **7** is a block diagram illustrating the operation of the apparatus according to the third embodiment of the invention. The difference to the first and second embodiment lies primarily in the fact that in the data to be transmitted in the second operation mode is processed mainly in the telecommunication terminal **2**.

When the first operation mode is used, the operation of the apparatus of FIG. **6** corresponds to the operation of the apparatus of FIG. **2**.

In the following, the operation according to the second operation mode will be described in an apparatus according to FIGS. **6** and **7**.

From the application block **10**, the data to be transmitted and the commands controlling the data transmission operation, such as AT commands, are conveyed to the command control block **11**. If the second operation mode is used, the data to be transmitted and the control commands are conveyed further to the first connection block **12**, through which data and the commands are moved to the second connection block **13** located in the data adapter unit **3**.

From the second connection block **13**, the commands are moved via the system bus connection block **18**, the system bus **7**, and a system bus connection block **32** of the telecommunication terminal to the command processing block **16**, which interprets the commands and takes the measures corresponding to them, such as transmission of a service request to the mobile communication network **33, 34**. The command processing block **16** controls also the operation of the second protocol block **17**, when the second operation mode is used. Thus, the data to be transmitted is conveyed from the system bus connection block **32** of the telecommunication terminal to the second protocol block **17**, where the quantity of the data to be transmitted is reduced by compression and the reliability of data transmission is improved by adding error correction data to the data to be transmitted.

The data to be transmitted in digital form is conveyed preferably from the second protocol block **17** located in the processor block **9** of the telecommunication terminal advantageously to the second switch sw2 (FIG. **6**) and further to the channel coder **24**. From the channel coder **24**, the channel coded bytes are conveyed to the third switch sw3 and further to the modulator/demodulator block **23** for transmission to the mobile communication network **33, 34**.

The modulator/demodulator block **23** modulates the signals to be transmitted from the telecommunication terminal **2** to a form suitable for the mobile communication network **33, 34**. In a corresponding manner, the signals to be received from the mobile communication network **33, 34** are demodulated in the modulator/demodulator block **23**.

In the example of FIG. **3**, the modulation of the data to be transmitted in the first operation mode to a form corresponding to the operation mode is carried out in the computer **1**, and the data to be transmitted in the second operation mode is modulated in the data adapter unit **3**, whereby the first protocol block **14** and the modulation block **15** are placed in the computer **1** and the second protocol block **17** is placed in the data adapter unit **3**, also indicated by letters "X" in Table **1**. In the example of FIG. **7**, the modification of data to be transmitted in the first operation mode into a form corresponding to the operation mode is conducted in the computer **1**, and the data to be transmitted in the second operation mode is modified in the telecommunication terminal **2**, whereby the first protocol block **14** and the modulation block **15** are placed in the computer **1** and the second protocol block **17** is placed in the telecommunication terminal **2**, which is also indicated by letters "X" in the Table. Within the scope of the invention, the blocks can also be placed in another manner, as shown in the following Tables **1–10**. The horizontal lines of the tables indicate the most important blocks for data modulation, i.e. the first protocol block **14**, the modulation block **15** and the second protocol block **17**. The vertical columns include the different location options for the blocks. The letter "X" indicates the position of the blocks.

TABLE 1

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | X | | |
| Second protocol block 17 | | X | |

TABLE 2

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | | X | |
| Modulation block 15 | | X | |
| Second protocol block 17 | | | X |

TABLE 3

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | X | | |
| Second protocol block 17 | | | X |

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TABLE 4

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | | X | |
| Second protocol block 17 | | | X |

TABLE 5

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | | X | |
| Second protocol block 17 | | X | |

TABLE 6

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | | | X |
| Second protocol block 17 | | | X |

TABLE 7

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | | X | |
| Modulation block 15 | | | X |
| Second protocol block 17 | | | X |

TABLE 8

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | | | X |
| Modulation block 15 | | | X |
| Second protocol block 17 | | | X |

TABLE 9

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | X | | |
| Modulation block 15 | X | | |
| Second protocol block 17 | X | | |

TABLE 10

| | Computer 1 | Data adapter unit 3 | Tele communication terminal 2 |
|---|---|---|---|
| First protocol block 14 | | X | |
| Modulation block 15 | | X | |
| Second protocol block 17 | | X | |

FIGS. 8 and 9 show a fourth advantageous embodiment of the invention, where the data adapter unit **3** is implemented with several separate data adapter cards which are each designed for a certain operation mode, such as a data adapter card **25** for an analog operation mode and a data card **26** for a digital operation mode. Also in this embodiment, the telecommunication terminal **2** tests which operation modes can be used in the mobile communication network **33**, **34** and conveys information on the available operation modes to the data adapter unit **3**. The data adapter unit **3** comprises a selection logic which sets the data adapter card corresponding to the selected operation mode in operation, whereby this data adapter card carries out conversion of the data to be transmitted to a form corresponding to the operation mode.

The selection logic consists advantageously of a first selector **28**, a second selector **29** and a selector block **27** controlling the selectors. The selectors **28**, **29** can be e.g. semiconductor switching circuits, whereby the durability of the selectors **28**, **29** can be improved and the power consumption reduced in comparison with mechanical switches, such as relays. The selector block **27** receives control commands from both the computer **1** and the telecommunication terminal **2** and conducts selection according to these commands. The selector block **27** can consists of a microcontroller, known as such, and of peripheral circuits required for its operation, as is known to an expert in the field.

When an analog operation mode is used, the selector block **27** sets the data adapter card **25** in operation by switching the first and second selectors **28**, **29** in a position where a data transmission connection is made from the computer **1** via the data adapter card **25** to the telecommunication terminal **2**. In a digital operation mode, the selector block **27** sets the first and second selectors **28**, **29** in a position where a data transmission connection is made from the computer **1** via the data adapter card **26** to the telecommunication terminal **2**. In a fourth embodiment of the invention, the operation mode of the telecommunication terminal **2** is irrelevant for the computer **1**, because the data adapter cards **25**, **26** of the data adapter unit can process data received from the computer **1** and convert it to a form corresponding to the set operation mode.

The data adapter unit **3** according to FIGS. **8** and **9** comprises, in addition to the selection logic mentioned above, also a computer adapter block **30** for adapting the signal system between the computer **1** and the data adapter unit **3** to a form suitable for the data adapter unit **3**. For example in a signal system according to the RS-232C standard, usually signals of ±12 V are used, and in TTL couplings, 0 V and 5 V are used. For such adaptations, numerous semiconductor circuits have been developed for easy implementation.

The data adapter unit **3** comprises the adaptation block **31** of the telecommunication terminal, for carrying out adaptation of the signal system between the data adapter unit **3** and the telecommunication unit **2**, such as changing the voltage levels.

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Also in the fourth embodiment of the invention, information can be conveyed from the computer **1** to the telecommunication terminal **2** about the preferred operation mode. This can be conducted advantageously by AT commands, as also presented in the first embodiment of the invention.

The data adapter unit **3**, shown in FIG. **8** and in more detail in FIG. **9**, can be a separate unit, whereby it comprises connectors both for linking the computer **1** e.g. according to the RS-232C standard, and connectors for linking the data adapter unit **3** with the telecommunication terminal **2**. The fourth embodiment of the invention can also be implemented by placing the data adapter cards, such as the data adapter card **25** and the data card **26** with the computer **1**, preferably with an internal accessory bus of the computer **1**, which can be implemented e.g. according to the PCMCIA card standard. Thus, the first selector **28** and possibly also the selector block **27** are advantageously implemented in the software of the computer **1**, whereby the data adapter unit **3** requires, in addition to the data adapter cards **25**, **26**, also adapter blocks **30**, **31**, the second selector **29** and the selector controlling block **27**, for setting the data transmission connection according to the selected operation mode.

Although only two data adapter cards **25**, **26** are shown in the data adapter unit **3** according to the fourth embodiment of the invention, it is possible within the scope of the present invention to use also several data adapter cards in connection with the data adapter unit **3**. For example, a separate fax card can be used for making a connection for sending and receiving also facsimile copies.

The data adapter unit **3** according to the invention can be advantageously implemented also in a way that at least part of the operation modes are selected by the application, whereby e.g. the application in the processor unit of the data adapter unit comprises functional blocks corresponding to the different operation modes, whereby the blocks corresponding to the operation mode selected are applied for the time of the connection.

In the example of FIG. **8**, also two mobile communication networks are shown. In the first mobile communication network **33**, the first operation mode can be used, and in the second mobile communication network **34**, the second operation mode can be used for data transmission. The first mobile communication network **33** comprises a first base station BS, which is linked with a landline mobile communication network PSTN. Also a second computer DTE is connected with the landline mobile communication network PSTN, via a data adapter DCE. The second mobile communication network **34** comprises a second base station BTS which is linked with the landline mobile communication network PSTN via a data adapter DCE. Also the second computer DTE is linked with the landline mobile communication network PSTN via the data adapter DCE.

In the following, a further example of making a connection will be presented in the apparatus according to the first embodiment shown in FIG. **3**. At the beginning, the application block **10** sends an initialization command (ATD) for a call to the command control block **11**, which transmits it further via the first connection block **12** and the second connection block **13** to the command processing block **16** which examines the sent command and takes the respective measures. In the case of a call initialization command, the command processing block **16** sends a request for forming a connection to the telecommunication terminal **2** via the system bus connection block **18**. The request for forming a connection also includes a service request, such as an analog or digital connection. If the desired operation mode is available in the mobile communication network **33**, **34** and a connection can be made between the telecommunication terminal **2** and the mobile communication network **33**, **34**, the telecommunication terminal **2** sends information on the connection to the command processing block **16**. If the digital operation mode is used, the command processing block **16** controls the second protocol block **17** which conducts compression of the data to be sent and decompression of the data to be received. When the second protocol block **17** is ready for operation, the command processing block **16** sends information on the connection to the application block **10**, whereby data transmission can be started. The route of data to be transmitted is, in the second operation mode, from the application block **10** via the command control block **11**, the first connection block **12**, and the second connection block **13** to the second protocol block **17** and further to the first system bus connection block **18**. From here, the data is transmitted further via the system bus **7** to the telecommunication terminal **2** in which the data is transmitted in a manner described above in connection with a description of the operation of the telecommunication terminal **2**, with reference to FIG. **2**.

Data to be transmitted in the first operation mode is conveyed from the application block **10** via the command control block **11**, the first protocol block **14**, the modulation block **15**, the first connection block **12**, and the second connection block.**13** either to the first modulation block **19** and further to the audio line **20**, or via the first system bus connection block **18** to the system bus **7**. Also the data route corresponding to the analog operation mode in the telecommunication terminal **2** is presented above in connection with the description of FIG. **2**.

When a request for releasing the call is sent from the application block **10**, the command processing block releases the connection by sending a request to the telecommunication terminal **2** for releasing the connection. When the call is released, the command processing block **16** sends information on this to the application block **10**, after which the operation of the apparatus is returned to the wait condition to wait for commands or other impulses to be interpreted as commands from the computer **1** (FIG. **10**).

The connection is presented also as an arrow scheme, the case of the analog operation mode in FIG. **11***a* and the case of the digital operation mode in FIG. **11***b*. The telecommunication terminal **2** (radio unit MCU) receives information advantageously on those mobile communication networks **33**, **34** which are available for connection from the telecommunication terminal, and the operation modes corresponding to them. After this the application SW sends information on the preferred operation mode and a command to dial a phone number for making a connection to the command processing block **16** (AT command handling). The command processing block **16** asks the telecommunication terminal **2**, via the router **8**, which operation modes can be used. After this, the command processing block **16** sends a request for making a connection corresponding to the selected operation mode (analog/digital) via the router **8** to the telecommunication terminal **2** which will make the connection to the communication network **33**, **34** corresponding to the selected operation mode. When the connection is made, the telecommunication terminal **2** will send information on this via the router **8** to the command processing block **16**. Next, the steps will be taken according to the selected operation mode.

If the first operation mode has been selected, which in this example is the analog operation mode, the command processing block **16** will send information on making a connection to the command control block **11** (call control),

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which will send an initialization command to the first protocol block **14** (analog mode protocols). The first protocol block **14**, the modulator/demodulator block **23** and the first telecommunication network **33** will conduct initialization of the protocol, after which the first protocol block **14** will send information on conducted initialization to the command control block **11**, which will send information on the connection to the application **10**, after which data transmission from the computer **1** to the first mobile communication network **33** can be started.

If the second operation mode has been selected, which in this case is the digital operation mode, the command processing block **16** will send an initialization command to the second protocol block **17** (digital mode protocols). The second protocol block **17**, the modulator/demodulator block **23** and the second telecommunication network **34** will conduct initialization of the protocol, after which the second protocol block **17** will send information on conducted initialization to the command processing block **16**, from where information on the connection will be sent via the command control block **11** to the application **10**, after which data transmission from the computer **1** to the second mobile communication network **34** can be started.

The invention is not restricted only to the embodiments presented above, but it can be modified within the scope of the appended claims.

We claim:

**1**. Method for making a data transmission connection from a computer to any one of a plurality of mobile communication networks for transmission of analog and/or digital signals, wherein the computer is connected with one of the mobile communication networks via a telecommunication terminal which is in local data transmission connection with the computer; and wherein the data transmission connection utilises at least a first operation mode for connection with a first of said telecommunication networks and a second operation mode for connection with a second of said telecommunication networks, the method comprising steps of:

testing said communication networks to determine which of said plurality of mobile communication networks are available for a connection to be made via the telecommunication terminal;

selecting one of the available mobile communication networks;

at the telecommunication terminal, setting an operation mode corresponding to the selected one of the mobile communication networks; and

setting the data transmission connection for transmission via the selected operation mode.

**2**. Method according to claim **1**, wherein said computer is connected to said telecommunication terminal by means of a data adapter unit.

**3**. Method according to claim **1**, wherein said first operation mode is an analog operation mode and said second operation mode is a digital operation mode.

**4**. Method according to claim **3**, wherein data transmission in said analog operation mode comprises at least the steps of:

converting the data to be transmitted into data frames according to a predetermined protocol; and

using the data frames for modulating a carrier wave for forming a modulated signal and

wherein data transmission in the digital operation mode comprises at least compressing the data to be transmitted by a predetermined compression method.

**5**. Method according to claim **4**, wherein conversion of the data to be transmitted into data frames is conducted in the computer;

modulation of the carrier wave is conducted in said computer; and

compression of the data to be transmitted is conducted in said data adapter unit.

**6**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said data adapter unit,

modulation of the carrier wave is conducted in said data adapter unit; and

compression of the data to be transmitted is conducted in said telecommunication terminal.

**7**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said computer;

modulation of the carrier wave is conducted in said computer; and

compression of the data to be transmitted is conducted in said telecommunication terminal.

**8**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said computer;

modulation of the carrier wave is conducted in said data adapter unit; and

compression of the data to be transmitted is conducted in said telecommunication terminal.

**9**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said computer;

modulation of the carrier wave is conducted in said data adapter unit; and

compression of the data to be transmitted is conducted in said data adapter unit.

**10**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said telecommunication terminal;

modulation of the carrier wave is conducted in said telecommunication terminal; and

compression of the data to be transmitted is conducted in said telecommunication terminal.

**11**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said computer;

modulation of the carrier wave is conducted in said computer; and

compression of the data to be transmitted is conducted in said computer.

**12**. Method according to claim **4**, wherein:

conversion of the data to be transmitted into data frames is conducted in said data adapter unit;

modulation of the carrier wave is conducted in said data adapter unit; and

compression of the data to be transmitted is conducted in said data adapter unit.

**13**. Method according to claim **4** wherein modulation of the carrier wave is pulse code modulation (PCM).

**14**. Apparatus for making a data transmission connection from a computer to one of a plurality of mobile communication networks for transmission of analog and/or digital signals, said apparatus comprising:

a telecommunication terminal operative via a first operation mode for connection to a first of said mobile

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communication networks and operative via a second operation mode for connection to a second of said mobile communication networks;

a computer which is in local data transmission connection with said telecommunication terminal, and means for making a local data transmission connection between the computer and the telecommunication terminal;

means for testing said mobile communication networks to determine which of said communication networks are available for making a connection via said telecommunication terminal;

means for selecting an available one of said mobile communication networks for making the connection;

means for setting the telecommunication terminal in an operation mode corresponding to the selected mobile communication network; and

means for setting the data transmission connection according to the selected operation mode.

**15**. Apparatus according to claim **14**, wherein the first operation mode is an analog operation mode and the second operation mode is a digital operation mode.

**16**. Apparatus according to claim **14**, further comprising means for forming data frames.

**17**. Apparatus according to claim **14**, further comprising means for modulating data frames.

**18**. Apparatus according to claim **14**, further comprising means for compressing data to be transmitted.

**19**. Apparatus according to claim **14**, further comprising means for making a local data transmission connection in a wireless manner.

**20**. Apparatus according to claim **19**, wherein the wireless data transmission connection is an infrared data transmission.

**21**. Apparatus according to claim **19**, wherein the wireless data transmission connection is an electromagnetic data transmission connection.

**22**. Apparatus according to claim **14**, wherein said computer is connected to the telecommunication terminal by means of a data adapter unit.

**23**. Apparatus according to claim **22**, wherein said data adapter unit comprises one data adapter card (PCMCIA).

**24**. Apparatus according to claim **22**, wherein said data adapter unit comprises at least two data adapter cards.

**25**. Apparatus according to claim **14**, wherein said means for selecting an available mobile communication network for making a connection comprise a selector block, a first selector, a second selector and two or more data adapter cards.

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| **Confirmation Number:** | 7955 |
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| 13 | Non Patent Literature | 1016-1090.pdf | 14498511<br>880d7fdd1d0973bceb2dfeb194801ace7e5e89fe | no | 75 |
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| 14 | Non Patent Literature | 1090-1150.pdf | 11830807<br>480b828c05e11aea400869bab6fe45d171164b31 | no | 61 |
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| **Information:** | | | | | |
| 15 | Non Patent Literature | 1151-1275.pdf | 22037623<br>758fc8f77bb8976639f20aa5373b02e19a8bc059 | no | 125 |
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| 16 | Non Patent Literature | 4111-4300.pdf | 24851750<br>cf9906fca419e283f4bd4debd94b920cfc8862ff | no | 190 |
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| 17 | Non Patent Literature | 12576-12725.pdf | 15580671<br>76ff6e262493b169ae6e4694628044063bed1776 | no | 150 |
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| 18 | Non Patent Literature | 16001-16150.pdf | 24793965<br>403bab7948226516df1da26011f57dee1bc69ed6 | no | 150 |
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| **Information:** | | | | | |
| 19 | Non Patent Literature | 16150-16250.pdf | 21501490<br>f5d7a89dbd49f1d081a87949d7fabd1d49b28abb | no | 101 |
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(12) **United States Patent**
**Murtojärvi et al.**

(10) **Patent No.: US 6,393,260 B1**
(45) **Date of Patent: May 21, 2002**

(54) **METHOD FOR ATTENUATING SPURIOUS SIGNALS AND RECEIVER**

(75) Inventors: **Simo Murtojärvi**, Salo; **Antti Rauhala**, Muurla; **Harri Kimppa**, Salo, all of (FI)

(73) Assignee: **Nokia Mobile Phones Limited**, Espoo (FI)

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(22) Filed: **Apr. 15, 1999**

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(52) **U.S. Cl.** ..... **455/91**; 455/323; 455/333; 455/343; 455/305

(58) **Field of Search** ..... 455/91, 318, 323, 455/333, 326, 317; 327/355, 357, 359, 296, 305, 343, 77, 193.1

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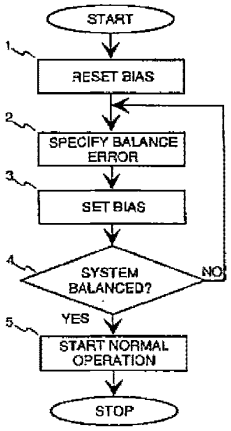
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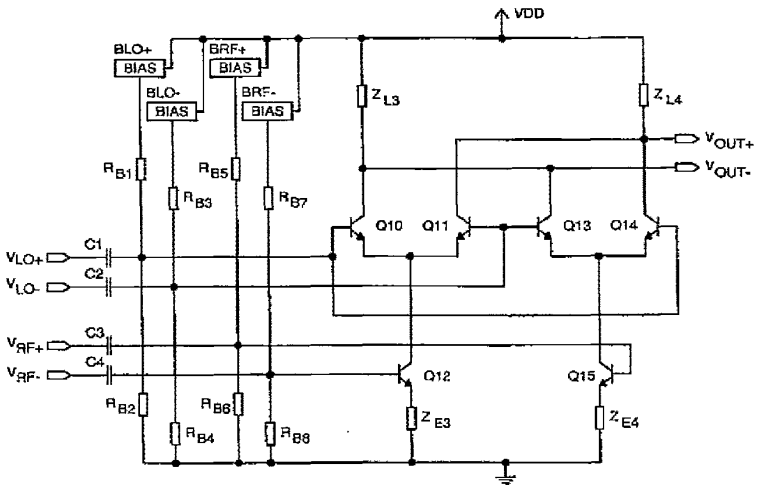
*Primary Examiner*—Dwayne Bost
*Assistant Examiner*—Lewis West
(74) *Attorney, Agent, or Firm*—Perman & Green, LLP

(57) **ABSTRACT**

The invention relates to a method and radio receiver for attenuating spurious signals when receiving (6 to 12) radio signals, when radio signals are mixed (10) to a second frequency, which may be the baseband frequency, for example. Spurious signals are caused by balance errors in the mixer (10) which result from component value fluctuations within tolerance limits. According to the invention, mixing is balanced by setting (12) variable-level bias voltages and/or currents to transistors in the mixer circuit (10). An advantage of the invention is that even-order spurious signals caused by balance errors in the mixing of a signal to a second frequency are considerably attenuated. The invention finds particular utility in a mobile communications device, for example.

**11 Claims, 6 Drawing Sheets**




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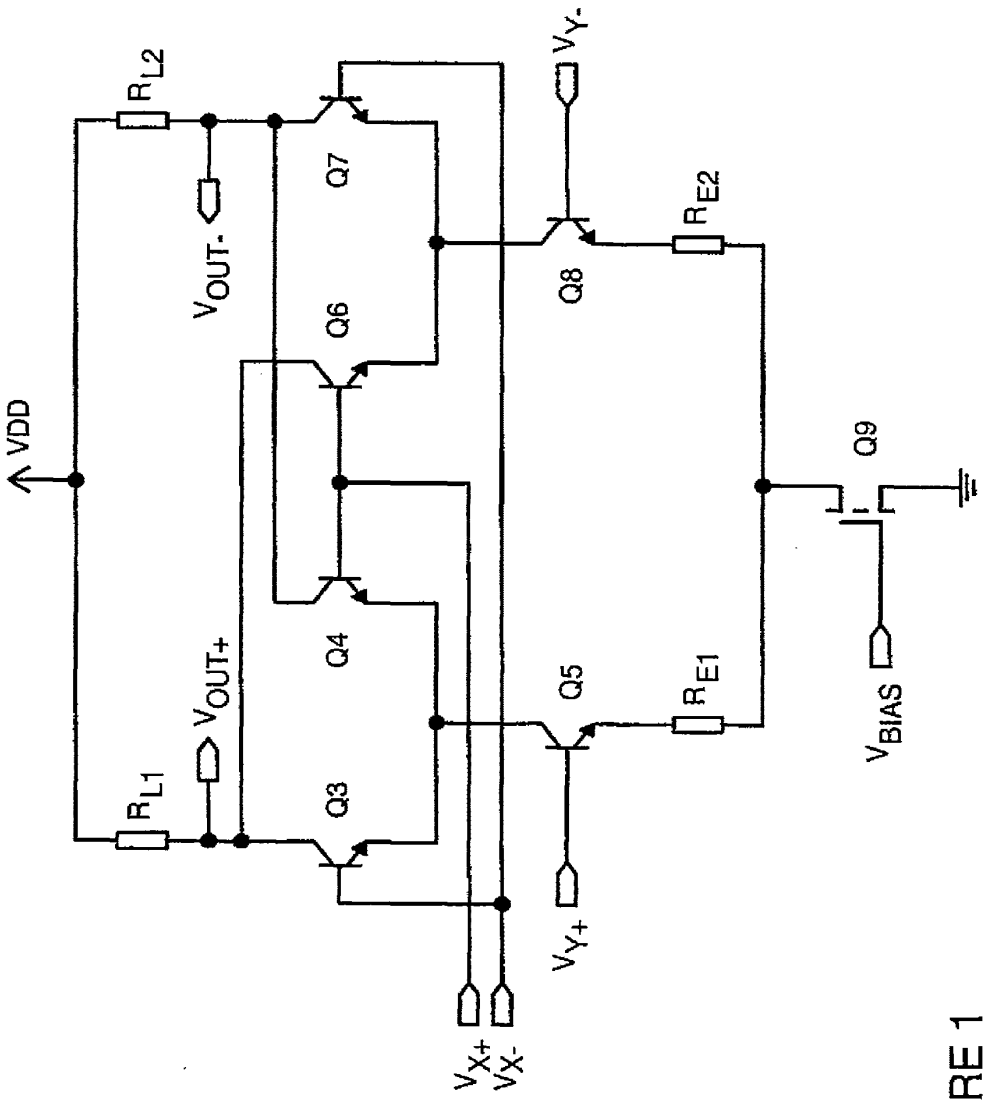

VDD
RL2
RL1
VOUT-
VOUT+
Q7
Q6
Q4
Q3
Q8
Q5
Q9
RE2
RE1
VY-
VY+
VBIAS
VX+
VX-

FIGURE 1

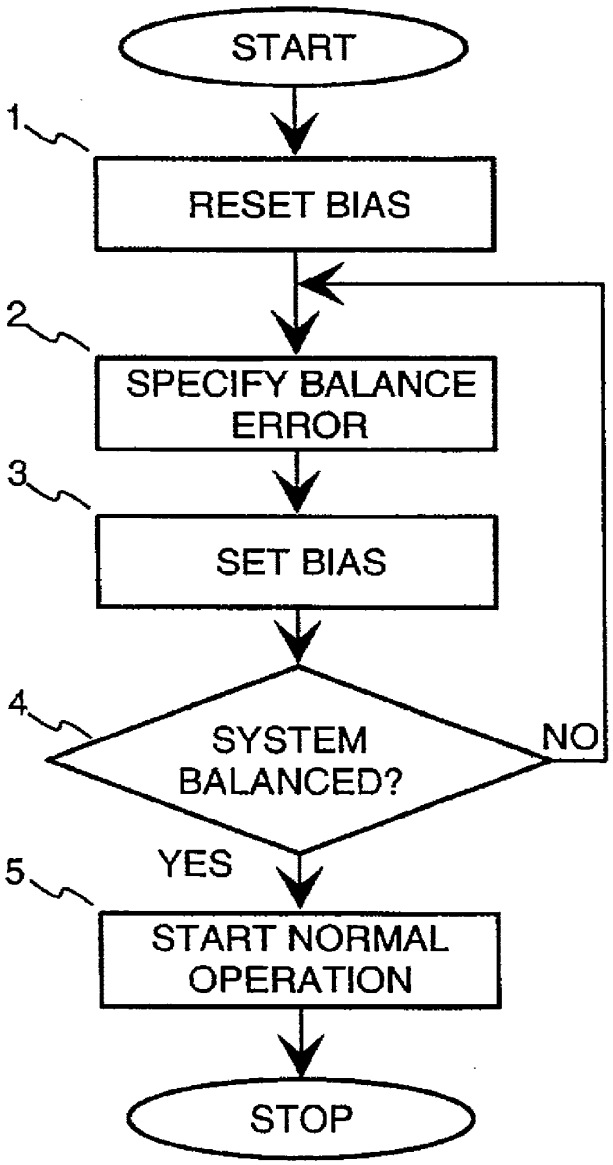

START
1
RESET BIAS
2
SPECIFY BALANCE ERROR
3
SET BIAS
4
SYSTEM BALANCED?
NO
YES
5
START NORMAL OPERATION
STOP

FIGURE 2

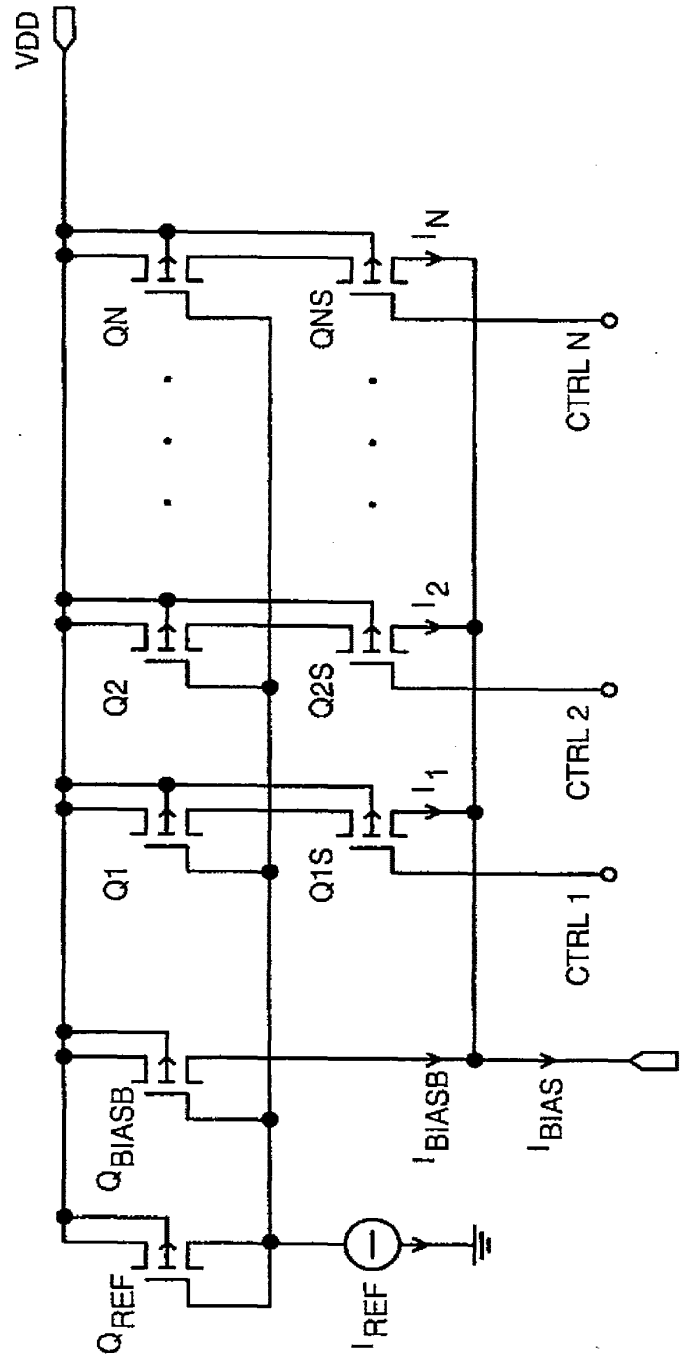

VDD
QN
QNS
$I_N$
CTRL N
Q2
Q2S
$I_2$
CTRL 2
Q1
Q1S
$I_1$
CTRL 1
$Q_{BIASB}$
$I_{BIASB}$
$I_{BIAS}$
$Q_{REF}$
$I_{REF}$

FIGURE 3

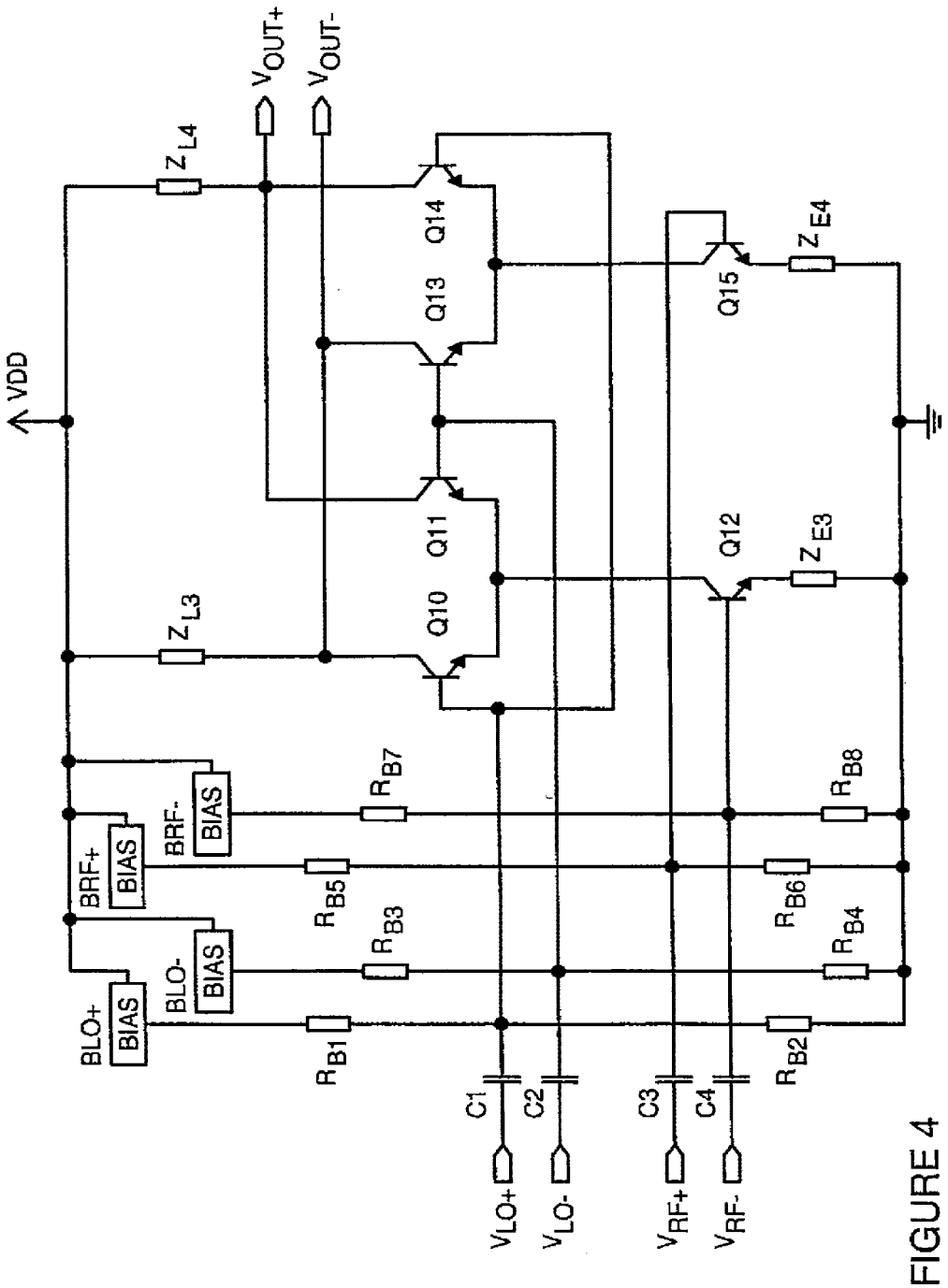

VOUT+
VOUT-
ZL4
Q14
Q13
Q15
ZE4
VDD
Q11
Q10
Q12
ZE3
ZL3
RB7
RB8
BRF-
BIAS
BRF+
BIAS
RB5
RB6
RB3
RB4
BLO-
BIAS
BLO+
BIAS
RB1
RB2
C1
C2
C3
C4
VLO+
VLO-
VRF+
VRF-

FIGURE 4

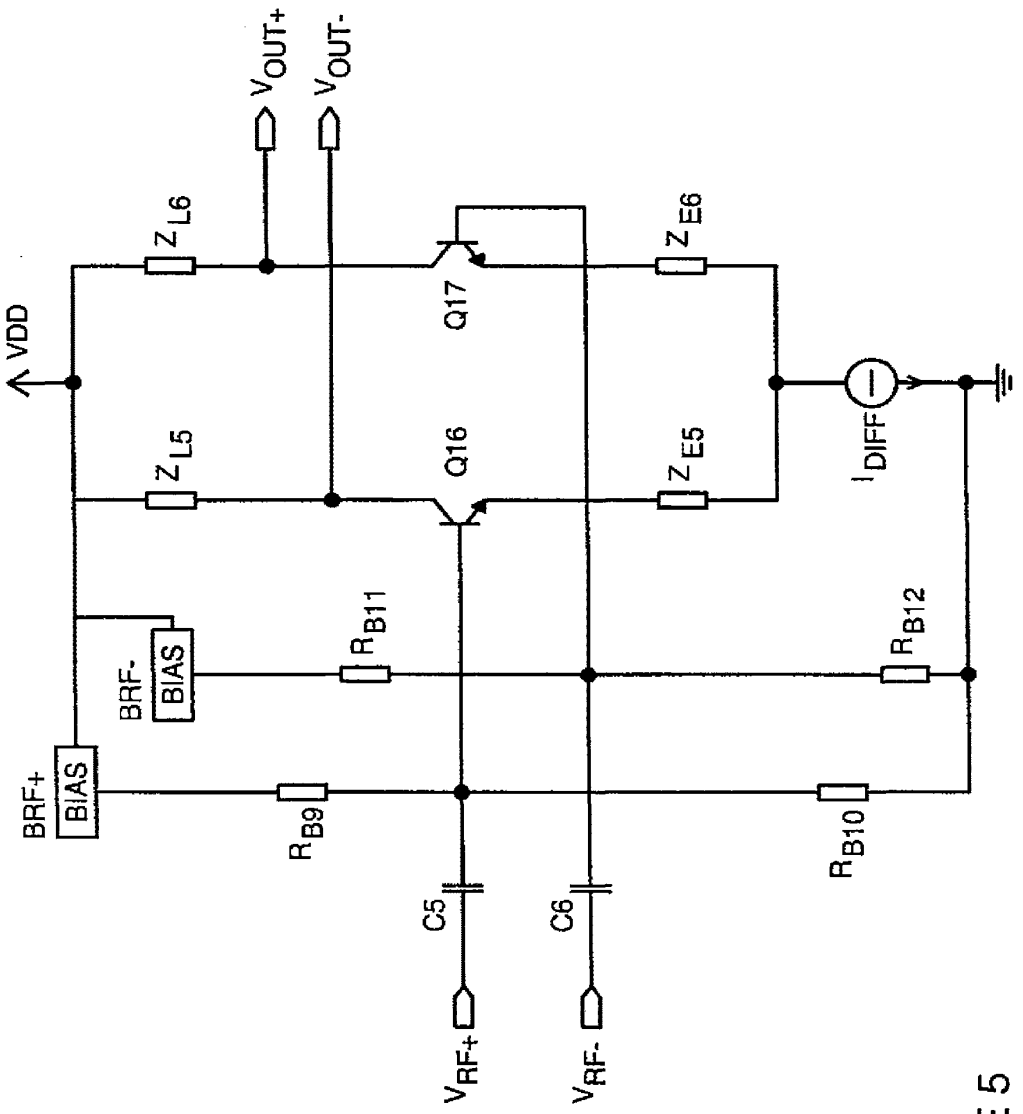

VOUT+
VOUT-
ZL6
ZE6
Q17
VDD
ZL5
Q16
ZE5
IDIFF
RB11
RB12
BRF-
BIAS
BRF+
BIAS
RB9
RB10
C5
C6
VRF+
VRF-

FIGURE 5

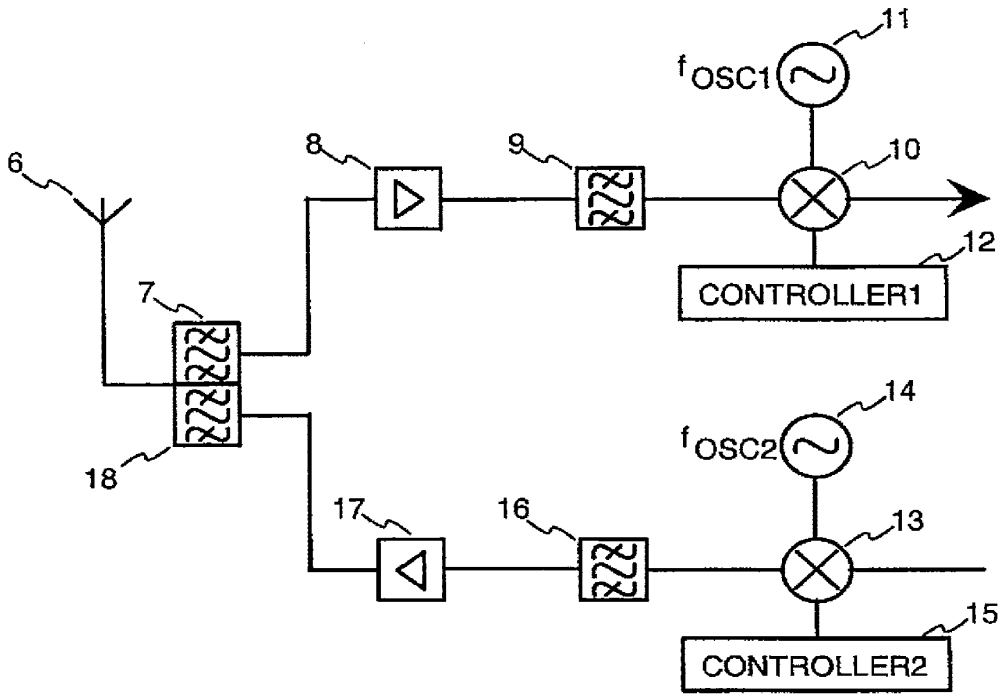



FIGURE 6

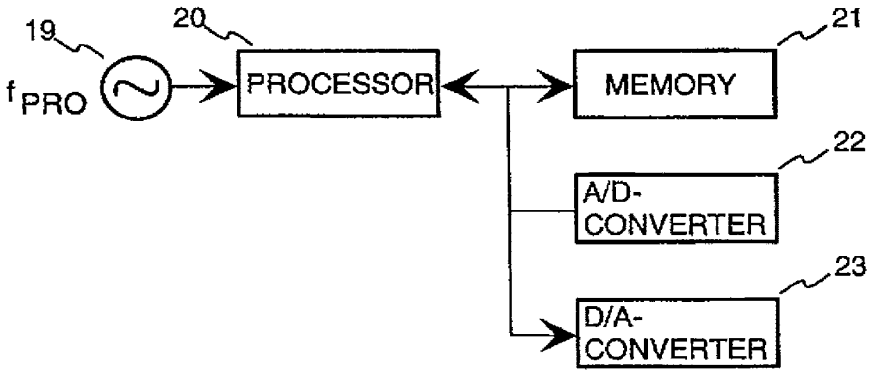



FIGURE 7

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# METHOD FOR ATTENUATING SPURIOUS SIGNALS AND RECEIVER

## CROSS-REFERENCES TO RELATED APPLICATIONS

The invention relates to a method for attenuating spurious signals in a transmitter and/or receiver in which radio signals are mixed to a second frequency, e.g. to an intermediate frequency (IF) or, in the case of so-called direct conversion, straight to the baseband, i.e. 0-Hz IF, and in addition the invention relates to a receiver. The invention thus pertains to a method defined in the preamble of claim 1 and a receiver defined in the preamble of claim 7.

## DESCRIPTION OF THE RELATED ART INCLUDING INFORMATION DISCLOSED UNDER 37 CFR 1.97 AND 1.98

When aiming at good linearity in radio reception, the biggest problem is usually the mixing of the received signal. Mixing is used for converting a high-frequency received signal down to a lower intermediate frequency. Attempts are made to attenuate in different ways the mixing results of even and odd orders which are brought about in the mixing in addition to the desired result. The mixing results of even orders are canceled by means of balanced or double-balanced mixer constructions. In the ideal situation, the even mixing results of two branches of a mixer cancel each other as being opposite. In practice, the attenuation caused by canceling is sufficient when the intermediate frequency is right and frequency-selective filtering is used. Then the frequencies causing the second order are attenuated already before the mixer down to a level where not too many of those frequencies will be generated in the mixer. However, there are receivers in which it is advantageous to use an intermediate frequency that might temporarily have a second-order spurious signal. Such a receiver is found e.g. in a multiple-frequency transceiver using one intermediate frequency and a common local oscillator.

Spurious responses will also be generated in a direct-conversion receiver, the worst being modulation-frequency interference at the receiver's mixer output caused by a strong amplitude-modulated (AM) signal of another transceiver. This will appear even if the frequency of the interfering signal considerably deviated from the receiving frequency. These interferences are mainly caused by the second-order distortion component which contains a variable-level DC component proportional to the amplitude of the interference-causing signal. The variable-amplitude signal produces at the mixer output a signal which comprises a variable DC component and the frequency of which is identical with the varying of the amplitude. This signal is attenuated in accordance with the mixer's balance accuracy and linearity. Sufficient attenuation can be achieved e.g. by using a mixer that has a good signal amplitude tolerance. In this way even spurious signals of a large amplitude will not cause a considerable interfering signal at the mixer output.

From the prior art it is known a so-called Gilbert cell which is widely used in integrated multiplier circuits of communications systems, especially in mobile communication devices. Multiplier circuits are used in integrated IF parts such as mixers and variable gain amplifiers.

A mixer can be based on a Gilbert cell. Such a mixer has to use large currents, high operating voltages and high local oscillator level to achieve a small relative portion of interfering signal and small effect on the mixer operating points. Additionally, the balance of the incoming RF signal, balance



of the amplification of the different branches of the mixer, and the balance of the local oscillator are of great importance to the attenuation of spurious signals of even orders. The low voltage used nowadays because of the tendency to reduce power consumption causes that not all mixer types provide sufficient attenuation of spurious signals. Tolerances of the components used in the mixers are too wide to achieve a balance good enough at low voltages.

It is a problem with known radio receivers that single unbalanced mixers produce, in addition to the desired mixing result, spurious signals of both even and odd orders.

It is another problem with known radio receivers that spurious signals of even orders, which are generated in balanced mixers in addition to the desired mixing result, are insufficiently attenuated at low voltages.

It is an object of the invention to improve the attenuation of spurious signals of even orders so that an adequate end result will be achieved even with low operating voltages and smaller currents.

## BRIEF SUMMARY OF THE INVENTION

The method according to the invention is characterized by what is expressed in claim 1. The receiver according to the invention is characterized by what is expressed in claim 7. Preferred embodiments of the invention are described in the dependent claims.

The invention pertains to a method for attenuating spurious signals in a transmitter and/or receiver in which radio signals are mixed to a second frequency which may also be the baseband frequency. In accordance with the invention, mixing is balanced by adjusting transistor bias voltages and/or currents in the mixer circuit.

The invention also pertains to a receiver that comprises a mixer for mixing radio signals to a second frequency, which may also be the baseband frequency, and means for attenuating spurious signals while receiving radio signals. In accordance with the invention, it comprises balance-adjusting means of mixer circuit to adjust the balance of the circuit by adjusting transistor bias voltages and/or currents in the mixer circuit.

It is an advantage of the invention that in the mixing to a second frequency spurious signals of even orders caused by balance errors resulting from component tolerances considerably attenuated.

## BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

The invention will now be described in more detail with reference to the accompanying drawing wherein

FIG. 1 shows in the form of circuit diagram a known Gilbert cell,

FIG. 2 shows in the form of flow diagram a method according to the invention for adjusting the balance of a mixer,

FIG. 3 shows in the form of circuit diagram a bias voltage adjustment block of a mixer according to the invention,

FIG. 4 shows in the form of circuit diagram a mixer according to the invention,

FIG. 5 shows in the form of circuit diagram a radio-frequency stage according to the invention,

FIG. 6 shows in the form of block diagram essential parts of a transceiver according to the invention, and

FIG. 7 shows in the form of block diagram a controller according to the invention for controlling an adjustment block.

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## DETAILED DESCRIPTION OF THE INVENTION

FIG. **1** shows a known Gilbert cell used for realizing integrated IF parts such as variable gain amplifiers and mixers. In a Gilbert cell two input voltages are multiplied into one output voltage, i.e. the voltage difference at the outputs is the product of the differences in the input voltages. A first voltage difference is coupled to terminals $V_{X+}$ and $V_{X-}$ wherefrom the voltages are taken to the bases of transistors Q3, Q4 and Q6, Q7, respectively. A second voltage difference is coupled to terminals $V_{Y+}$ and $V_{Y-}$ wherefrom the voltage is amplified by transistors Q5 and Q8. Transistors Q5 and Q8 are coupled through resistors $R_{E1}$ and $R_{E2}$ to a field effect transistor (FET) Q9 which is controlled by a bias voltage $V_{BIAS}$ and coupled to a negative operating voltage. Transistors Q3 and Q7 amplify a positive voltage difference $V_{X+}$ and $V_{X-}$, and the amplified voltage difference is coupled to outputs $V_{OUT+}$ and $V_{OUT-}$. The circuit mentioned above is coupled to a positive operating voltage through resistors $R_{L1}$ and $R_{L2}$. Transistors Q2 and Q4 amplify a negative voltage difference $V_{X+}$ and $V_{X-}$, and the amplified voltage difference is cross-coupled to outputs $V_{OUT+}$ and $V_{OUT-}$.

FIG. **2** shows in the form of flow diagram a balance adjustment method for a mixer according to the invention. First, possible previous bias voltages **1** are removed. Then, the balance error **2** of the mixer is determined by coupling a radio signal to the receiver inputs, thus causing a spurious signal in the mixer, which is then measured at the mixer outputs. Next, a bias voltage **3** correcting the balance error is set, preferably by feeding an inversely proportional CTRL byte corresponding to the error to the adjustment block by means of a digital controller. If the error-correcting bias voltage cannot be determined on the basis of the measurement result, a trial bias voltage is set. CTRL byte means a binary number that sets the control for the CTRL lines. The binary lines of the CTRL byte control the switching transistors in the adjustment block, so that $I_{BIAS}$ is changed and the voltages between the terminals of the bias resistors change. The potential of the operating point of the mixer's transistor input is adjusted according to the point between the bias resistors. In other words, the adjustment block forms a variable voltage across the resistor in the series connection when the adjustment is carried out by means of current. The adjustment block may also be implemented using a variable voltage source. The operational input signals of the transistors are alternating voltages conducted by a capacitive component. When the bias voltage that corrects or at least changes the balance error has been generated, it is checked whether the error correction was successful, i.e. whether the mixer is in balance **4**. If not, operation returns to step **2** to determine the remaining error and change the bias voltages on the basis of that determination. If the setting of the bias reduced the balance error, the bias is increased, but if the balance error became bigger the bias is taken back towards zero or, if zero is reached, the bias is set on the second line of the input pair. Thus, bias voltage remains advantageously only on one of the lines of the input pair in the balanced state. When the balancing has succeeded, the data of the balancing controller are stored in memory and normal operation of the mixer is started **5**.

FIG. **3** shows in a circuit diagram an adjustment block for the bias voltage of a mixer according to the invention. In the adjustment block, a current from a reference current source $I_{REF}$ flows via a transistor $Q_{REF}$ from the operating voltage VDD to ground. Current $I_{REF}$ is mirrored to a bias current circuit on the right. Current $I_{BIASB}$ through transistor $Q_{BIASB}$ constitutes the invariable fundamental part of bias current $I_{BIAS}$. Transistors Q1, Q2, . . . QN and Q1S, Q2S, . . . QNS make up N parallel series connections, and a sum current of $I_1, I_2, \ldots I_N$ through said series connections constitutes the variable part of bias current $I_{BIAS}$. Control lines CTRL 1, 2, . . . N control transistors Q1S, Q2S, . . . QNS serving as switches. Transistors Q1, Q2, . . . QN are mutually binarily weighted such that transistors Q1S, Q2S, . . . QNS, which are controlled by control lines CTRL 1, 2, . . . N and connected in series with said transistors, can raise current $I_{BIAS}$ by $2^N-1$ levels, which means the current gets $2^N$ values. Binary weighting of the currents is achieved e.g. by connecting transistors in parallel in such a way that Q1 comprises one transistor, Q2 comprises two transistors, etc. With field effect transistors (FET), the currents may also be set by selecting the channel widths. The currents are weighted preferably according to the following series: 1, 2, 4, 8, etc., i.e. $2^N$, where $N \geq 0$. For example, current $I_1$ is $I_{REF}/200$, current $I_2$ is $I_{REF}/100$ and $I_N$ is $I_{REF}/(200/2^{N-1})$.

Thus the imbalance caused by the tolerances of mixer components can be balanced using the variable part $I_1$, $I_2, \ldots I_N$ of current $I_{BIAS}$. Also, possible small imbalance of input signals can be balanced using the arrangement according to the invention. By changing the number of control lines and the current $I_{REF}$ of the reference current source it is possible to adapt the bias adjustment steps and range to various couplings.

FIG. **4** shows in a circuit diagram a mixer according to the invention. In the upper left corner of FIG. **4** there are four blocks depicted in FIG. **3** that generate the bias current $I_{BIAS}$ to control the bias voltage. The blocks are for local oscillator signal pair $V_{LO+}$ and $V_{LO-}$ and radio-frequency signal pair $V_{RF+}$ and $V_{RF-}$, which control through capacitive elements C1 and C2 as well as C3 and C4 the transistors Q10, Q11, Q13, Q14 and Q12, Q15. Blocks BLO+, BLO−, BRF+ and BRF− are used to produce currents and, thus, voltages to four parallel bias resistor series connections $R_{B1}$ and $R_{B2}$, $R_{B3}$ and $R_{B4}$, $R_{B5}$ and $R_{B6}$ as well as $R_{B7}$ and $R_{B8}$.

If the adjustment block current $I_{BIAS}$ is the same as the necessary base current of the corresponding transistor, e.g. a beta-compensated base current, a resistor connected to ground is not used with that adjustment block. For example, if adjustment blocks BRF+ and BRF− feed the base current of transistors Q15 and Q12, resistors $R_{B6}$ and $R_{B8}$ are left out and the corresponding bias voltage is set by adjusting the base current.

Load impedances $Z_{L3}$, $Z_{L4}$, transistors Q10, Q11, Q12, Q13, Q14, Q15 and emitter impedances $Z_{E3}$, $Z_{E4}$ constitute a known mixer the outputs of which give signals $V_{OUT+}$ and $V_{OUT-}$.

The balance is adjusted preferably as described above, but the most perfect balance is achieved by adjusting the bias voltages of the transistor pair's mutually corresponding transistors Q10, Q11 and Q13, Q14 separately. In other words, the controls of the transistors that get their control from the same line, such as Q10 and Q14, are separated from each other and the bias voltages of them both are adjusted individually.

FIG. **5** shows in a circuit diagram a radio-frequency amplifier stage according to the invention which also can be used to correct a mixer's balance error. In the upper left corner of FIG. **5** there are two blocks depicted in FIG. **3** that generate the bias current $I_{BIAS}$ to control the bias voltage. The blocks are for a radio-frequency signal pair $V_{RF+}$ and $V_{RF-}$ which control through capacitive elements C5 and C6

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transistors Q16 and Q17. Blocks BRF+ and BRF− are used to produce currents and, thus, voltages to two parallel bias resistor series connections $R_{B9}$, $R_{B10}$ and $R_{B11}$, $R_{B12}$.

Load impedances $Z_{L5}$, $Z_{L6}$, transistors Q16, Q17, emitter impedances $Z_{E5}$, $Z_{E6}$ and current source $I_{DIFF}$ constitute a known radio-frequency amplifier stage.

The circuit according to FIG. 5 described above can also be used as local oscillator buffer. Then the balance error of the local oscillator port can be corrected by adjusting the buffer.

FIG. 6 shows in the form of block diagram essential parts of a transceiver according to the invention. The transceiver shares a common antenna 6 from which a signal is received and filtered by a bandpass filter 7 and amplified by an amplifier 8 and refiltered 9. Then the signal at the radio reception frequency is mixed to an intermediate frequency in a balanced mixer 10 according to the invention. A local oscillator 11 feeds the mixer 10 at the frequency of $f_{OSC1}$. The balance of the mixer 10 is adjusted by a controller 12. From the intermediate frequency on the reception continues in accordance with the prior art.

A signal to be transmitted is modulated at the local oscillator 14 frequency $f_{OSC2}$ by means of a modulator 13. The balance of the modulator 13 is adjusted by a controller 15. The modulated signal is bandpass-filtered by a filter 16 and amplified by an amplifier 17 and filtered again by a filter 18 and fed to the antenna 6. Otherwise the transmitter is preferably realized according to the prior art, and this document does not take a position on the use of balancing according to the invention in it.

FIG. 7 shows in a block diagram essential components of a controller of an adjustment block according to the invention. The processor 20 of a digital controller is stepped by an oscillator 19 at frequency $f_{PRO}$. The controller executes a program from memory 21, which preferably is both read only memory (ROM) and random access memory (RAM). Measurement data on the balance is obtained by means of an A/D converter 22. Bias voltages are controlled by a D/A converter 23 which preferably comprises an adjustment block according to FIG. 3 in which current is switched by means of digital binary control to adjust the bias voltages.

For example, let us consider a radio receiver the spurious response of which is to be reduced. The receiver is adjusted preferably only once before use. A test signal is coupled to the receiver input, and the interfering signal level is measured from the receiver output. The test signal is generated in such a way that it produces a spurious response to be minimized. A trial setting is chosen e.g. for the adjustment block BRF+ of the positive line of the RF input, and the interfering signal level is measured again. If the interference was reduced, an optimum setting is found for the adjustment block BRF+ by experimental bracketing, and if the interference got worse, the initial state is restored for the adjustment block BRF+ and a trial setting is chosen for the adjustment block BRF− of the negative line of the RF input and an optimum setting is found for it by experimental bracketing. The same experimental bracketing is also carried out for the local oscillator input by adjustment blocks BLO+ and BLO−. For a good result, both bracketing tunings are repeated. Thanks to the second tuning, a possible residual error, which is not noticed at the first time because it is hidden by an error in one of the input pairs, is corrected. Tuning data for the balance achieved through the minimization of spurious response are stored in the memory of the apparatus wherefrom they can be loaded by means of a micro-processor or digital signal processor (DSP) always on start-up. Fuses, micro-switches, programmable gate circuits and the like can also be used for the immediate control of the adjustment block.

Of course, the selection of the bias voltage initial setting line and the level of the setting can also be realized as a preferably calculatory value based on interference measurement data. Empirical knowledge can also be utilized when estimating the bias voltage value on the basis of the measurement result.

In digital mobile communications devices, such as mobile stations operating in GSM, PCN (Personal Communication Network), DAMPS (Digital Advanced Mobile Phone Standard) or CDMA (Code Division Multiple Access) networks, the received signal is converted digital. In these apparatus the method is advantageously applied in such a way that the spurious response is measured, adjusted as small as possible, and the settings are stored in memory by carrying out the necessary routines with a digital signal processor. Then the tuning is particularly fast as it is carried out by coupling a test signal to the antenna and executing a tuning program. The adjustment blocks are controlled by a microprocessor or preferably with the same digital signal processor. A serial or parallel bus is used for the control. For a serial bus an adjustment block needs a separate logic to control the transistors.

The balance can also be tuned without a test signal while the local oscillator is operating. To that end, a comparative element is coupled to the mixer outputs to compare the voltage difference of the output pair. Particularly the DC component is compared. Tuning is performed by decreasing the voltage difference to its minimum value. However, because of bias voltages in the comparative element itself, the inputs of the comparative element must switch places and the comparison has to be repeated. The average of the tunings gives a result which is as accurate as possible. However, this tuning result is not as accurate as the one achieved using a test signal. If this type of tuning is accurate enough for the application, the tuning can be carried out automatically with a digital signal processor.

The principles according to the invention can also be utilized in the balancing of passive mixers.

The exemplary adjustment block was here realized by field effect transistors but the circuit can also be realized using bipolar transistors, for example.

The invention is not limited to the exemplary embodiments described above but many modifications are possible within the scope of the inventional idea defined by the claims set forth below.

What is claimed is:

1. A method for attenuating spurious signals in at least one of a transmitter and a receiver in which radio signals are mixed to a second frequency, said method comprising balancing the mixing by adjusting at least one of the bias voltages and currents in transistors of the mixer circuit, and

said adjusting step comprises tuning the receiver by measuring the balance from the receiver outputs and empirically adjusting at least one of the bias voltages and currents on the basis of measurements.

2. The method of claim 1, wherein at least one of the bias voltages and currents are adjusted in an input circuit of a radio-frequency signal.

3. The method of claim 1, wherein at least one of the bias voltages and currents are adjusted in an input circuit of a local oscillator.

4. The method of claim 1, wherein at least one of the bias voltages and currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit.

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5. The method of claim 1, wherein the adjustment of at least one of the bias voltages and currents is performed using a digital-to-analog converter to adjust current for the signal line across parallel resistors.

6. A receiver comprising a mixer circuit for mixing radio signals to a second frequency, means for attenuating spurious signals when receiving radio signals, and balance adjustment means in the mixer circuit to adjust the circuit's balance by adjusting at least one of the bias voltages and currents in transistors of the mixer circuit.

7. The receiver of claim 6, wherein the adjustment means comprises an input circuit for a radio-frequency signal to adjust at least one of the bias voltages and currents of an adjustment circuit.

8. The receiver of claim 6, wherein the adjustment means comprises a local oscillator input circuit to adjust at least one of the bias voltages and currents of an adjustment circuit.

9. The receiver of claim 6, wherein the adjustment means comprises an adjustment circuit separately for both transistors of a transistor pair, of a signal line of the mixer circuit to adjust at least one of the bias voltages and currents.

10. The receiver of claim 6, wherein the adjustment means comprises a digital-to-analog converter to adjust at least one of the bias voltages and currents with a digital controller.

11. The receiver of claim 6, wherein it further comprises

an A/D converter to measure the balance,

a D/A converter to adjust at least one of the bias voltages and currents, and

an oscillator, a processor and memory to carry out balance measurement routines as well as at least one of the bias voltage and current adjustment routines.

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# Electronic Acknowledgement Receipt

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| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
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**New Applications Under 35 U.S.C. 111**

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**National Stage of an International Application under 35 U.S.C. 371**

**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**

**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

US005630228A

# United States Patent [19]

Mittel

[11] Patent Number: 5,630,228

[45] Date of Patent: May 13, 1997

[54] **DOUBLE BALANCED MIXER CIRCUIT WITH ACTIVE FILTER LOAD FOR A PORTABLE COMUNICATION RECEIVER**

[75] Inventor: James G. Mittel, Boynton Beach, Fla.

[73] Assignee: Motorola, Inc., Schaumburg, Ill.

[21] Appl. No.: 427,026

[22] Filed: Apr. 24, 1995

[51] Int. Cl.[6] ..... H04B 1/16

[52] U.S. Cl. ..... 455/326; 455/333; 455/343; 327/120; 327/359

[58] Field of Search ..... 455/318-320, 455/324, 323, 325, 326, 330, 333, 343; 327/359, 120, 121

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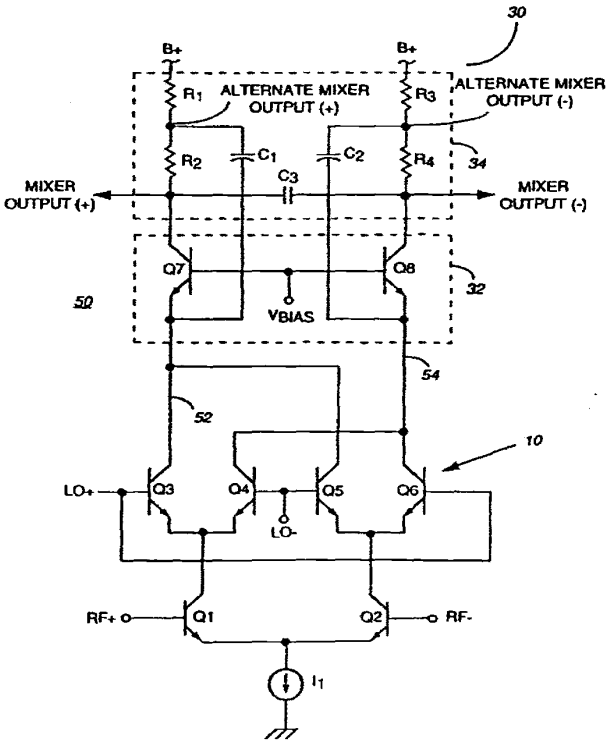
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*Primary Examiner*—Chi H. Pham
*Attorney, Agent, or Firm*—D. Andrew Floam

[57] ABSTRACT

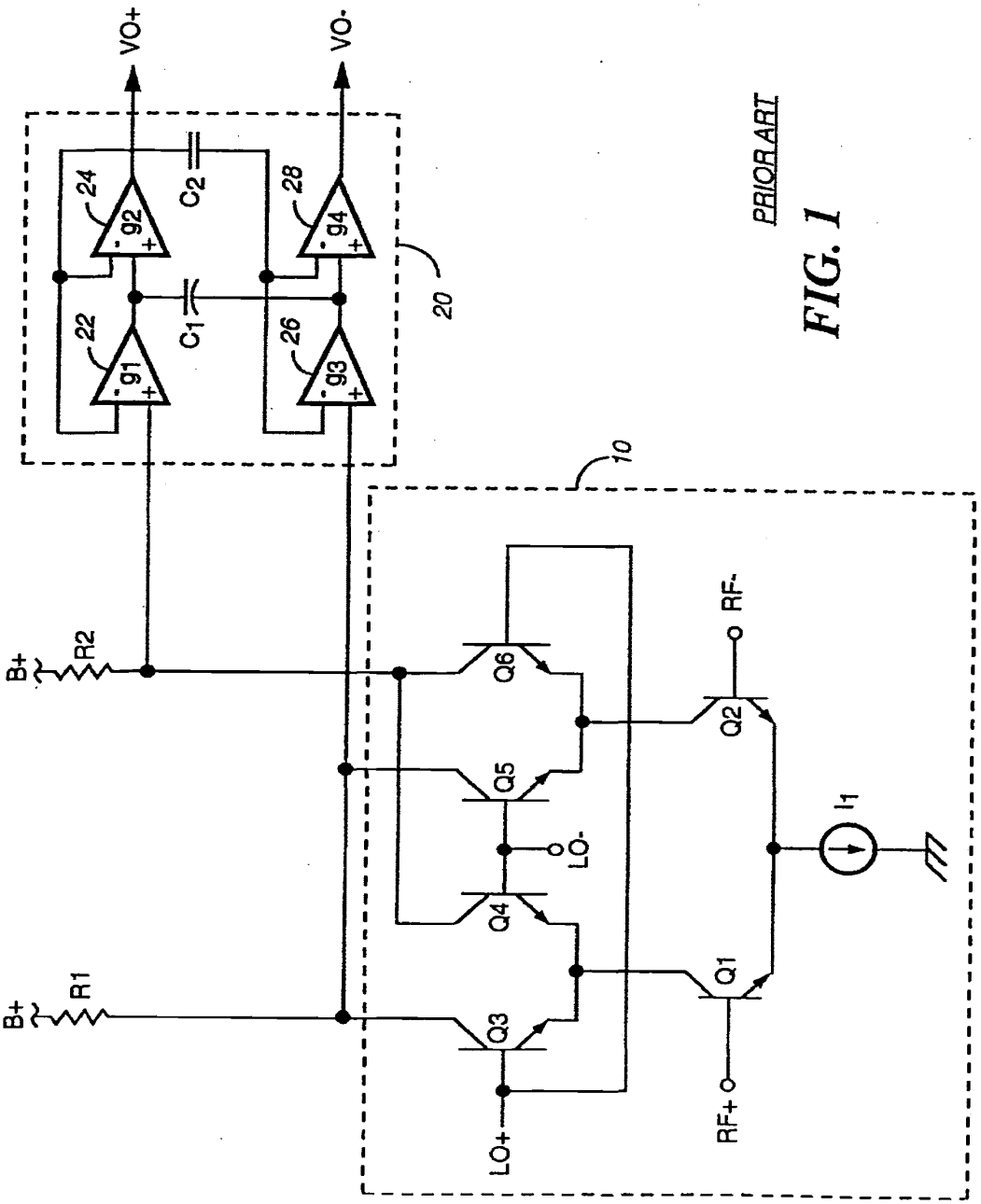
A double balanced mixer circuit (50) having a multiplication circuit (10) and an active filter circuit (30) coupled to the multiplication circuit (10). The active filter circuit (30) has a common-base differential amplifier (32) coupled to the differential outputs (52,54) of the multiplication circuit (10) and generates differential current outputs in response to the differential output current signal of the multiplication circuit (10), and a differential second order low pass active filter (34) coupled to the common-base differential amplifier (32) for filtering the differential current outputs of the common-base differential amplifier (32) and generating a filtered differential mixer output signal. A single direct current source coupled to the multiplication circuit (10) is also used to bias the active filter circuit (30). The mixer circuit (50) has utility in a non-differential mode as well as a fully differential mode.

**15 Claims, 7 Drawing Sheets**






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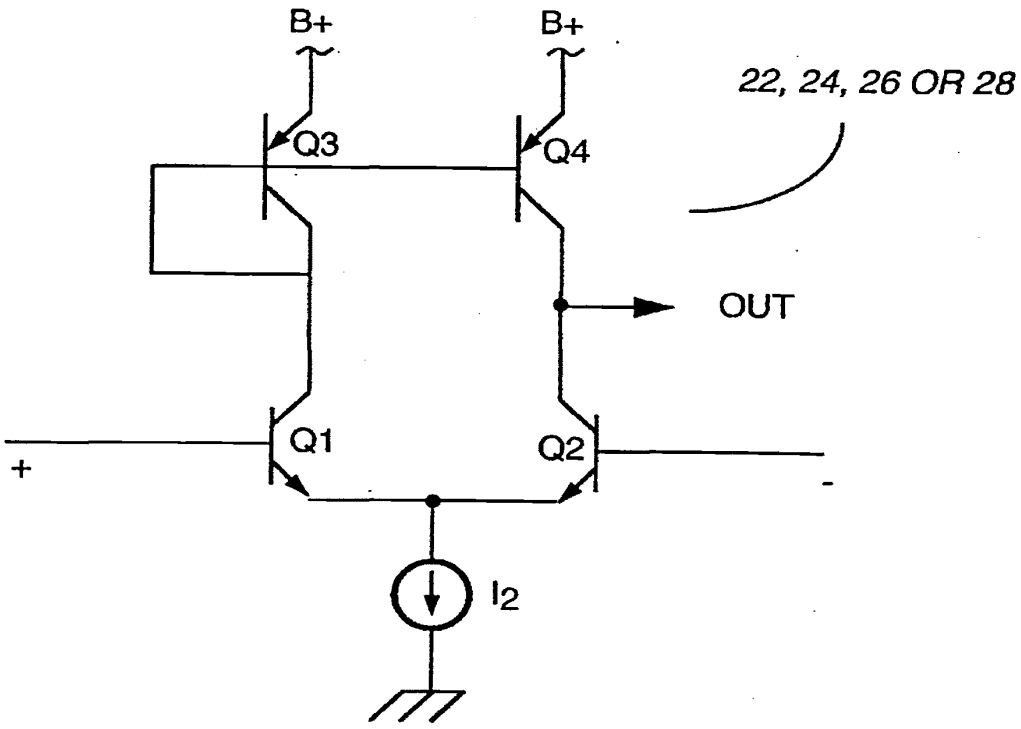



PRIOR ART

FIG. 1



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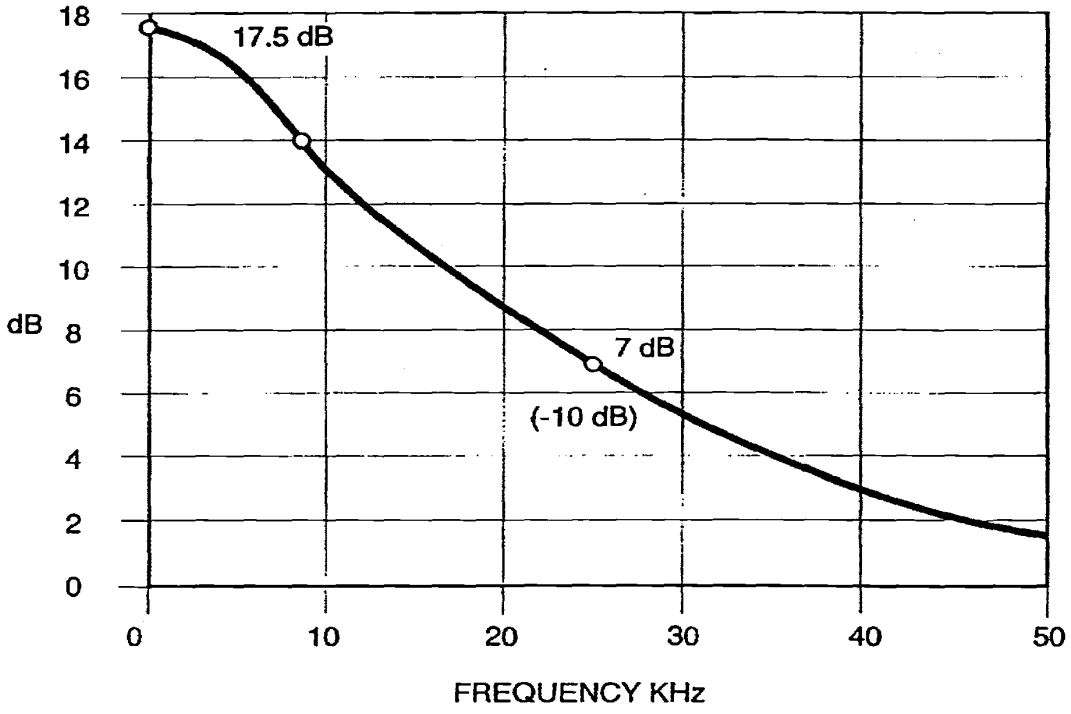



PRIOR ART

FIG. 2



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*PRIOR ART*

***FIG. 3***



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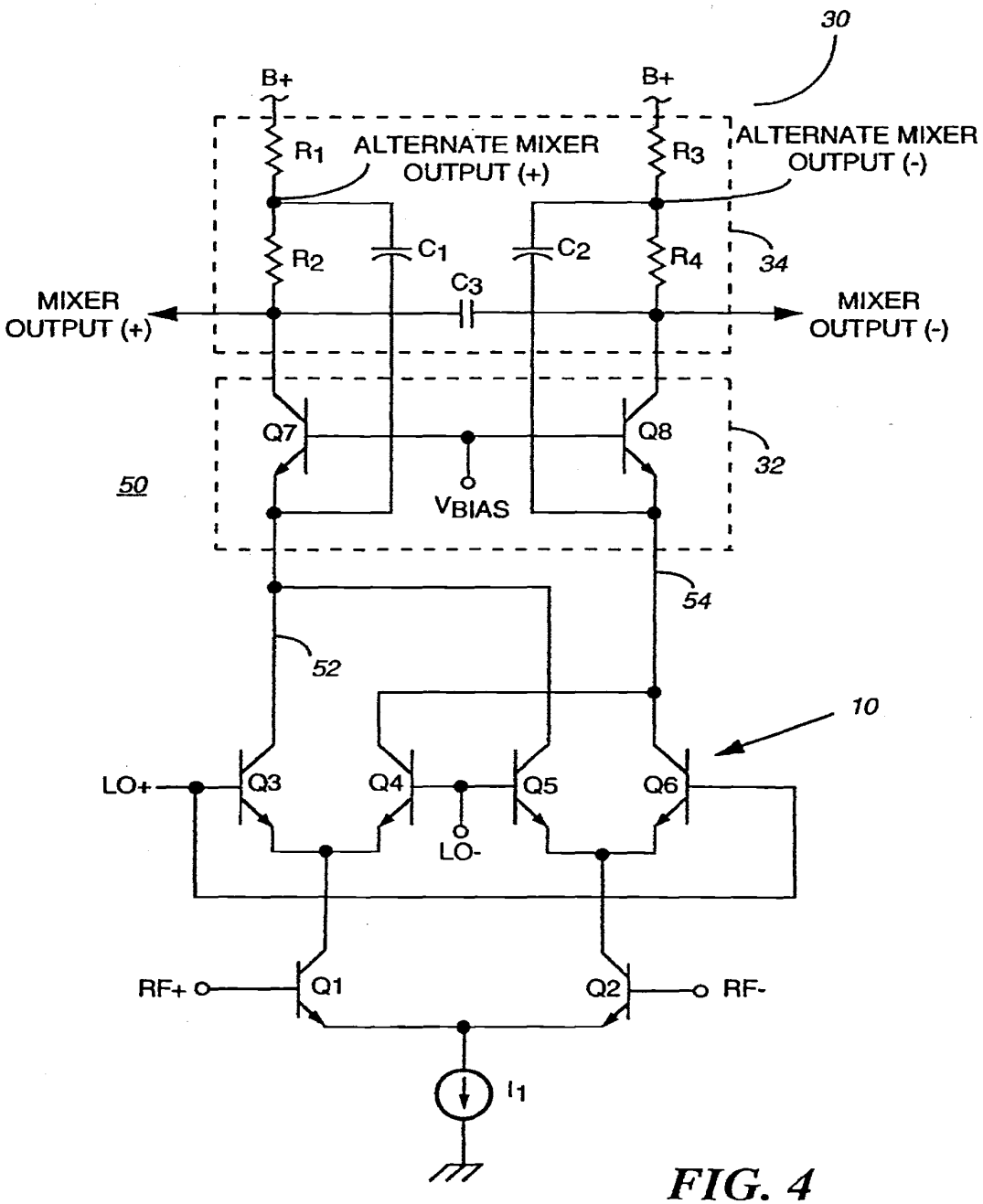



*FIG. 4*



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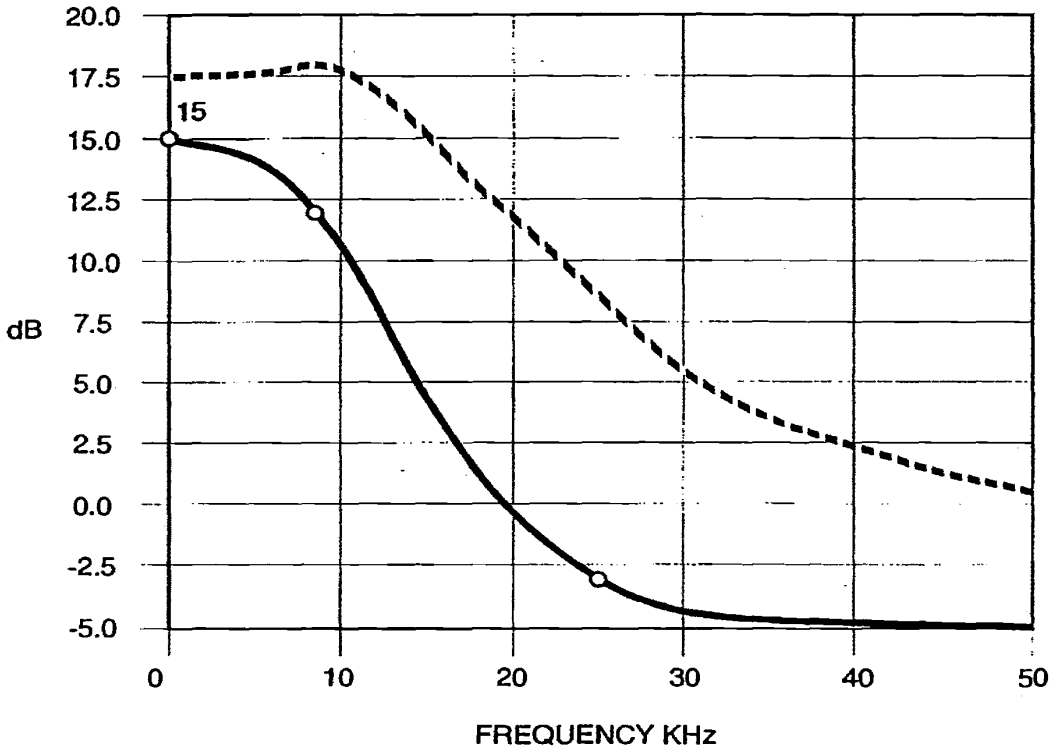



*FIG. 5*



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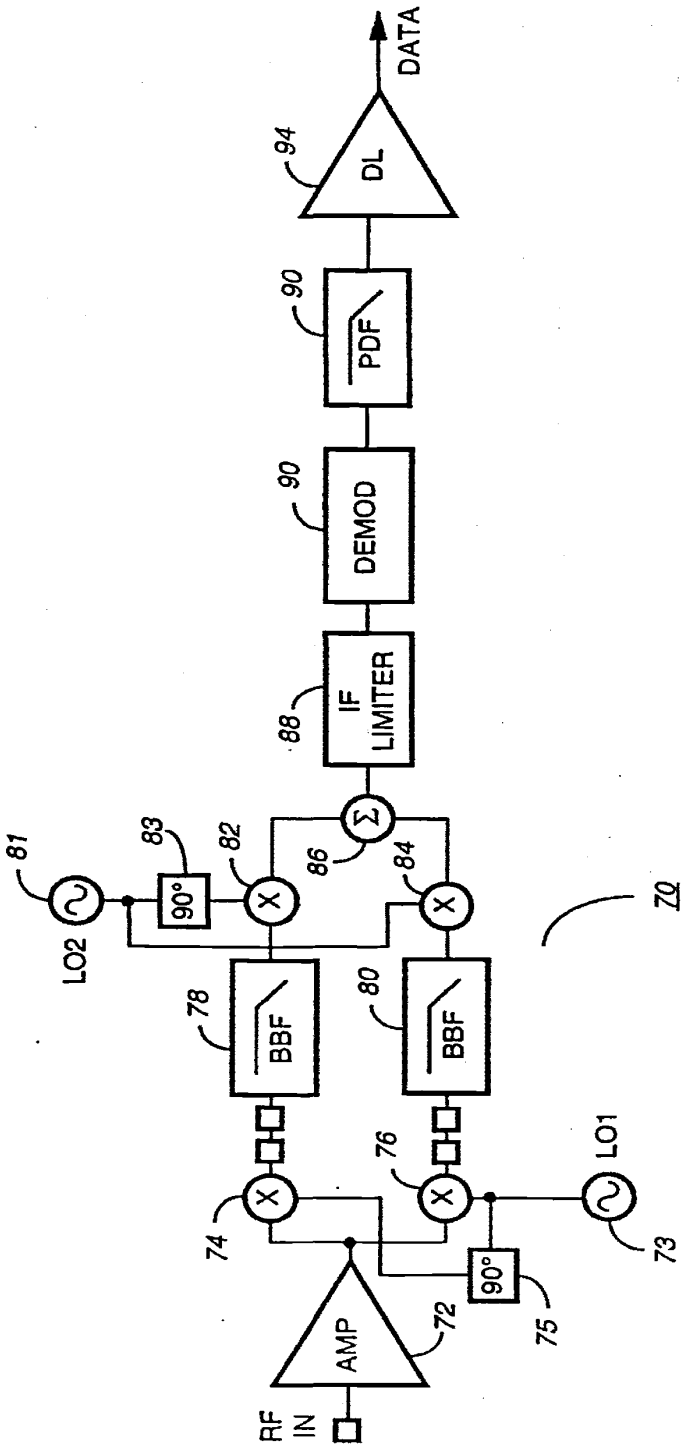



FIG.6



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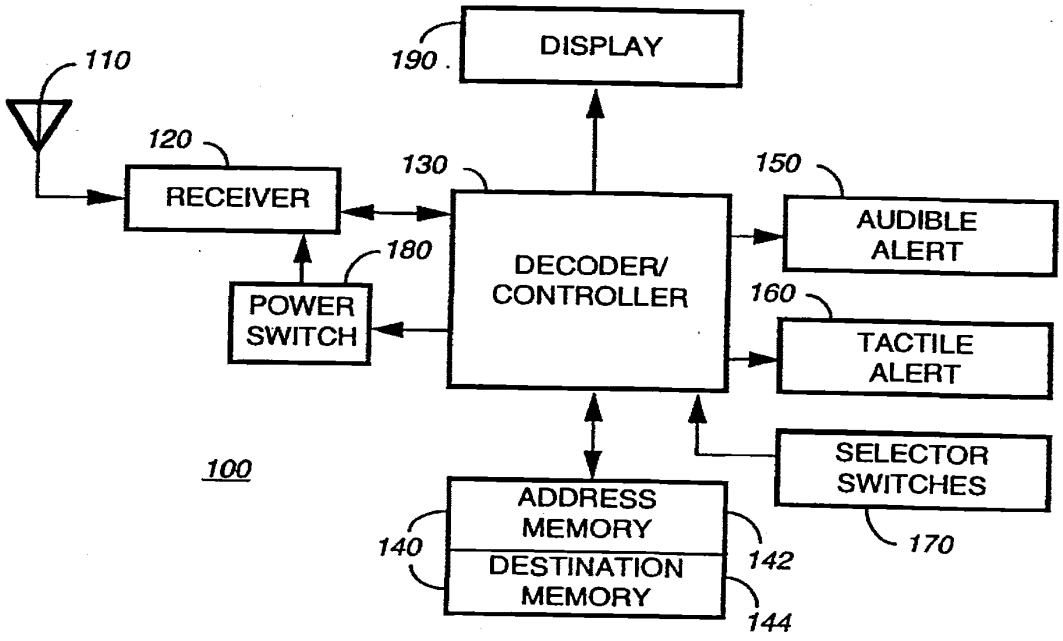



*FIG. 7*



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# DOUBLE BALANCED MIXER CIRCUIT WITH ACTIVE FILTER LOAD FOR A PORTABLE COMUNICATION RECEIVER

## FIELD OF THE INVENTION

This invention relates in general to the field of a portable communication receiver, and more particularly to a mixer circuit for minimizing the current drain of the receiver.

## BACKGROUND OF THE INVENTION

A portable communication receiver includes receiver circuitry for demodulating a received radio frequency signal. One type of receiver circuitry is called a "ZERO-IF" circuit, which is a low cost radio receiver. Most implementations of a ZERO-IF circuit include double balanced mixers followed by integrated low pass channel filters. Noise and dynamic range limitations typically force high current drain in the mixer and in the initial stages of a baseband channel filter. In addition, the second order input stage of each baseband filter consumes considerable current.

It is desirable to minimize current drain in these stages without compromising noise figure or selectivity.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an electrical schematic diagram of a prior art double balanced mixer stage having coupled at its output an active low pass filter stage.

FIG. 2 is an electrical schematic diagram of a conventional transconductance amplifier as used in the circuit shown in FIG. 1.

FIG. 3 is a frequency plot diagram showing the frequency response of the circuit shown in FIG. 1.

FIG. 4 is an electrical schematic diagram of a double balanced mixer with active load according to the present invention.

FIG. 5 is a frequency response plot of the circuit shown in FIG. 4.

FIG. 6 is an electrical block diagram of a zero-intermediate frequency receiver circuit according to the present invention.

FIG. 7 is an electrical block diagram a selective call receiver according to the present invention.

## DETAILED DESCRIPTION OF THE DRAWINGS

FIG. 1 illustrates a prior art double balanced mixer circuit 8 which comprises a multiplication circuit 10 followed by an active low pass filter stage 20. The multiplication circuit 10 comprises a differential amplifier formed by transistors Q1 and Q2. A direct current (DC) current source I1 is coupled to the emitters of the transistors Q1 and Q2 and sets the operating point bias for the circuit. The bases of transistors Q1 and Q2 are the differential inputs of the mixer 8 and receive the differential radio frequency (RF) input signal (RF+/RF−) to be mixed by the mixer circuit 8. The current source I1 is 200 μA in this example.

Transistors Q3, Q4, Q5 and Q6 form a common base switching network driven by a differential local oscillator signal (LO+/LO−). The bases of transistors Q3, Q4, Q5 and Q6 are the differential local oscillator signal inputs such that LO+ is coupled to transistors Q3 and Q6 and LO− is coupled to transistors Q4 and Q5. The emitters of transistors Q3 and Q4 are coupled together and the emitters of transistors Q5 and Q6 are coupled together. The collectors of transistors Q3 and Q5 are coupled to a voltage supply B+ via resistor R1.



The collectors of transistors Q4 and Q6 are coupled to the voltage supply B+ via resistor R2. The collector of transistor Q1 is coupled to the emitters of transistors Q3 and Q4 and the collector of transistor Q2 is coupled to the emitters of transistors Q5 and Q6.

The common base switching network steers the collector currents of transistors Q1 and Q2 to achieve a desired multiplication function associated with all mixers. Resistors R1 and R2 serve as a resistive load which converts the output current into a voltage suitable for driving the next stage.

The active filter circuit 20 comprises transconductance amplifiers 22, 24, 26 and 28 with respective gains of g1, g2, g3 and g4. The transconductance amplifiers 22, 24, 26 and 28 each have a inverting (−) and non-inverting (+) input. The collectors of transistors Q3 and Q5 are coupled to the non-inverting input of transconductance amplifier 26 and the collectors of transistors Q4 and Q6 are coupled to the non-inverting input of transconductance amplifier 22. Capacitors C1 and C2 are coupled between the amplifiers as shown and form a differential version of the well known Sallen and Key second order low pass filter. The output of the prior art double balanced mixer circuit 8 is generated as a differential output (Vo+,Vo−) consisting of the output of the transconductance amplifier 24 and the transconductance amplifier 28.

An example of a transconductance amplifier 22, 24, 26 or 28 is shown in FIG. 2. Current source I2 is a DC current source that directly biases and tunes the transconductance of the amplifier. Transistors Q1 and Q2 form a differential amplifier driven by the input signal. PNP transistors Q3 and Q4 form a current mirror load referenced to the voltage supply B+. The output of the transconductance amplifier is the difference in the collector currents of transistors Q2 and Q4. The transconductance, G, of this amplifier design is determined by the expression I1/(2*Vt), where Vt=K*T/Q, and K is Boltzman's constant, T is the absolute temperature, and Q is the charge on an electron. In this example, a current drain of 33 μA is required for each of the four transconductance amplifiers. Accordingly, at least an additional 130 μA is needed to bias the four transconductance amplifiers.

Thus, this example of the entire mixer circuit 8 consumes 200 μA in the multiplication circuit and an additional 130 μA in the following active filter circuit. Moreover, the linear dynamic range of the transconductance amplifier used in the low pass filter is a limiting factor in the large signal handling capability of the design.

FIG. 3 illustrates the frequency response of the circuit shown in FIG. 1, with the output taken at Vo+,Vo− and the input at RF+,RF−. The plot shows that there is approximately 10.5 dB of rejection at the 25 kHz adjacent channel frequency.

FIG. 4 illustrates the double balanced mixer circuit 50 according to the present invention. The multiplication circuit 10 comprising current source I1 and transistors Q1–Q6 is the same as that shown in FIG. 1. A differential output current that is the product of the RF and LO input signals is generated by the multiplication circuit 10 and is provided at the first and second differential outputs 52 and 54, respectively. The collectors of transistors of transistors Q3 and Q5 are coupled to the first differential output 52 and the collectors of transistors Q4 and Q6 are coupled to the second differential output 54.

The active filter circuit 30 comprises a common-base differential amplifier 32 that provides a low impedance load. The common-base differential amplifier 32 comprises tran-



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sistors Q7 and Q8 A voltage bias source Vbias is coupled to the bases of transistors Q7 and Q8. The emitter of transistor Q7 is coupled to the collectors of transistors Q3 and Q5 and the emitter of transistor Q8 is coupled to the collectors of transistors Q4 and Q6. The amplifier 32 functions as a unity gain current controlled current source which generates a differential current output at the collectors of transistors Q7 and Q8, respectively in response to the differential output current of the multiplication circuit 10.

A differential second order current-mode Sallen and Key based, low pass active filter 34 is formed by resistors R1–R4 and capacitors C1–C3 coupled to the collectors and emitters of transistors Q7 and Q8. Resistors R1 and R2 are connected in series and resistor R2 is coupled to the collector of transistor Q7. Resistor R1 is connected to a bias voltage B+. Capacitor C1 is coupled between the emitter of transistor Q7 and a node between resistors R1 and R2. Resistors R3 and R4 are connected in series and resistor R4 is coupled to the collector of transistor Q8. Resistor R3 is connected to bias voltage B+. Capacitor C2 is coupled between the emitter of transistor Q8 and a node between resistors R3 and R4.

In operation, the local oscillator signal (LO+,LO–) is coupled to the bases of transistors Q3,Q6 and Q4,Q5, and the RF signal to be mixed (RF+,RF–) is coupled to the bases of transistors Q1 and Q2. The output of the double balanced mixer circuit 50 is taken at opposite ends of capacitor C3 as shown in FIG. 4 by MIXER OUTPUT (+) and MIXER OUTPUT (–). The differential second order low pass active filter filters the differential current output of the common-base differential amplifier 32 and generates a filtered differential mixer output signal.

The entire double balanced mixer circuit 50 comprising the multiplication circuit 10 and the active filter circuit 30 consumes only 200 μA. The active filter circuit 30 is driven by the same current source I1 as the multiplication circuit 10, thereby enabling large signal handling capability of the circuit. Thus, whereas the prior art circuit of FIG. 1 includes an active filter circuit 20 which requires a current source I2 for each transconductance amplifier in the active filter circuit 20 (FIG. 2), the mixer circuit 50 according to the present invention uses a single current source for both the multiplication circuit 10 and the active filter circuit 30.

FIG. 5 illustrates the frequency response of the circuit 50 according to the present invention, with component values optimized to provide more gain and an improved response shape at the alternate node outputs. Specifically, the values used in the low pass active filter 34 to achieve the results shown in FIG. 5 are:

| | | | |
|---|---|---|---|
| R1, R3 | 1.5K | C1, C2 | 28 nF |
| R2, R4 | 500 | C3 | 5 nF |

Approximately 17.5 dB of attenuation in the adjacent channel frequency is obtained, which is 7 dB improvement over the prior art circuit, and as shown in FIG. 5, the double balanced mixer circuit 50 according to the present invention has a good passband shape. The dotted trace in FIG. 5 represents the response when the output is taken at the mixer outputs noted FIG. 4. The solid trace in FIG. 5 corresponds to the response of the circuit when the output is taken at the node between resistors R1 and R2, and the node between resistors R3 and R4, called ALTERNATE MIXER OUTPUT (+) and ALTERNATE MIXER OUTPUT(–). Taking the output of the mixer circuit 50 from the ALTERNATE MIXER OUTPUTs achieves better rejection as FIG. 5 illustrates.

It is appreciated by those with ordinary skill in the art that although the foregoing description is made in connection with a fully differential circuit configuration, the present invention has utility in a non-differential mode. Referring again to FIG. 4, the negative or minus (–) nodes of the local oscillator signal input (LO–). RF signal input (RF–) are optionally tied a DC bias source or ground, as appropriate. Nevertheless, the output of the multiplication circuit 10 may still be differential (for better performance). Indeed, the entire circuit can be implemented in a non-differential mode such that the output 52 is the only output of the multiplication circuit. Thus, the entire right half of the circuit is effectively absent in a non-differential mode, the common-base amplifier 32 would comprise transistor Q7 and active filter circuit 34 would comprise resistors R1 and R2, and capacitors C1 and C3. The output of the mixer circuit 50 is only MIXER OUTPUT (+) and MIXER OUTPUT (–) is optionally grounded, thus grounding that node of the capacitor C3.

FIG. 6 illustrates a zero-intermediate frequency ("zero-IF") circuit 70 featuring the double balanced mixer circuit 50 of the present invention. The zero-IF circuit 70 is an example of a receiver circuit utilizing the double balanced mixer circuit 50 according to the present invention. The double balanced mixer circuit 50 has utility in other receiver circuits as well.

The zero-IF circuit 70 comprises a radio frequency (RF) amplifier 72 which receives as input an RF signal detected by an antenna (not shown) and amplifies the detected RF signal to generate an amplified RF signal. The amplified RF signal is divided into two channels for processing, one representing an in-phase or "I" channel and one representing a quadrature phase or "Q" channel. A local oscillator LO1 provides a first local oscillator signal which is phase shifted by the 90 degree phase shifter 75 and coupled to mixers 74 and 76. Mixers 74 and 76 preferably comprise the double balanced mixer circuit 50 according to the present invention.

The output of the mixers 74 and 76 are coupled to base band filters (BBF's) 78 and 80, respectively, which are in turn coupled to mixers 82 and 84. A second local oscillator LO2 and a second phase shifter 83 drive the mixers 82 and 84.

A summing circuit 86 adds the outputs of the mixers 82 and 84 to generate a sum signal which is passed through an IF limiter 88. The output of the IF limiter 88 is processed by a demodulator 90. The output of the demodulator is coupled to a post detection filter (PDF) 92 which generates a recovered audio signal at its output. Ultimately, the recovered audio signal is passed through a data limiter 94 to generate data contained in the received RF signal.

Referring to FIG. 7, a selective call receiver 100 is shown. The selective call receiver 100 comprises an antenna 110, a receiver 120, a decoder/controller 130, and a code plug memory 140 including an address memory 142 and a destination memory 144. The code plug memory 140 is programmable by a remote programming device, as is well known in the art. In addition, various alert devices are provided, such as the tactile alert 160 and the audible alert 150. A power switch 180 is also provided to activate and de-activate certain components of the selective call receiver 100 under control of the decoder/controller 130. The receiver 120 includes, for example, the zero-IF receiver circuit 70 or another receiver circuit, including the double balanced mixer circuit 50 according to the present invention.

User input into the selective call receiver is by way of selector switches 170. A menu of various user program-



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mable features is accessed via the switches, through the use of menu information displayed on the display **190**. The selector switches **170** allow, for example, "up" or "down" adjustment of user programmable features.

What is claimed is:

1. A mixer circuit comprising:

a multiplication circuit having a first input suitable for connection to an oscillator signal and a second input suitable for connection to a radio frequency (RF) signal to be mixed with the oscillator signal, the multiplication circuit generating at an output an output current which is a multiplication of the oscillator signal and the RF signal;

a direct-current (DC) current source coupled to the multiplication circuit for supplying DC current for operation of the multiplication circuit;

an active filter circuit coupled to the multiplication circuit, the active filter circuit being biased for operation by DC current that is coupled to it through the output of the multiplication circuit from the DC current source, the active filter circuit comprising:

a common-base amplifier coupled to the output of the multiplication circuit and generating a current output in response to the output current of the multiplication circuit, wherein the common-base amplifier comprises a voltage bias, a first transistor comprising an emitter, base and collector, the emitter of the first transistor coupled to the output of the multiplication circuit, the DC current being coupled to the active filter circuit through the emitter of the first transistor, and the base of the first transistor coupled to the voltage bias; and

a low pass active filter coupled to the common-base amplifier for filtering the current output of the common-base amplifier and generating at an output a filtered mixer output signal.

2. The mixer circuit of claim 1, wherein the low pass active filter is a second order Sallen and Key filter which comprises:

first and second resistors connected in series and coupled between the collector of the first transistor of the common-base amplifier and a voltage supply;

a first capacitor coupled between the emitter of the first transistor of the common-base amplifier and a node between the first and second resistors; and

a second capacitor coupled to the collector of the first transistor of the common-base amplifier.

3. A receiver circuit comprising the mixer circuit of claim 1.

4. A selective call receiver comprising the receiver circuit of claim 3.

5. A mixer circuit comprising:

a multiplication circuit having a first input suitable for connection to an oscillator signal and a second input suitable for connection to a radio frequency (RF) signal to be mixed with the oscillator signal, the multiplication circuit generating at first and second differential outputs an output current which is a multiplication of the oscillator signal and the RF signal;

a direct-current (DC) current source coupled to the multiplication circuit for supplying DC current for operation of the multiplication circuit;

an active filter circuit coupled to the multiplication circuit, the active filter circuit being biased for operation by DC current that is coupled to it through the output of the multiplication circuit from the DC current source, the active filter circuit comprising:

a common-base amplifier coupled to the output of the multiplication circuit and generating a current output in response to the output current of the multiplication circuit, the common-base amplifier being a differential common-base amplifier comprising:

a voltage bias; and

first and second transistors each comprising an emitter, base and collector, the emitter of the first transistor coupled to the first differential output of the multiplication circuit and the emitter of the second transistor coupled to the second differential output of the multiplication circuit, the DC current being coupled to the active filter circuit through the emitters of the first and second transistors, and the bases of the first and second transistors being coupled to the voltage bias; and

a low pass active filter coupled to the common-base amplifier for filtering the current output of the common-base amplifier and generating at an output a filtered mixer output signal.

6. The mixer circuit of claim 5, wherein the low pass active filter is a differential second order Sallen and Key filter which comprises:

a voltage supply;

first and second resistors connected in series and coupled between the collector of the first transistor of the common-base amplifier and the voltage supply;

third and fourth resistors connected in series and coupled between the collector of the second transistor of the common-base amplifier and the voltage supply;

a first capacitor coupled between the emitter of the first transistor of the common-base differential amplifier and a node between the first and second resistors;

a second capacitor coupled between the emitter of the second transistor of the common-base amplifier and a node between the third and fourth resistors; and

a third capacitor coupled between the collectors of the first and second transistors.

7. The mixer circuit of claim 6, wherein the filtered mixer output signal at the output of the low pass active filter comprises a differential voltage at opposite ends of the third capacitor.

8. The mixer circuit of claim 6, wherein the filtered mixer output signal at the output of the low pass active filter comprises a differential voltage at the node between the first and second resistors, and the node between the third and fourth resistors, respectively.

9. A receiver circuit suitable for connection to an antenna for receiving a radio frequency (RF) signal detected by the antenna, the receiver circuit comprising:

an amplifier for amplifying the RF signal detected by the antenna and generating an amplified RF signal;

at least one local oscillator for generating a local oscillator signal;

at least one mixer coupled to the at least one local oscillator and to an output of the amplifier, the at least one mixer comprising:

a multiplication circuit having a first input coupled to the local oscillator signal and a second input coupled to the amplified RF signal, the multiplication circuit generating at an output an output current which is a multiplication of the local oscillator signal and the amplified RF signal;

a direct-current (DC) current source coupled to the multiplication circuit for supplying DC current for operation of the multiplication circuit;



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an active filter circuit coupled to the multiplication circuit, the active filter circuit being biased for operation by DC current that is coupled to it through the output of the multiplication circuit from the DC current source, the active filter circuit comprising:

a common-base amplifier coupled to the output of the multiplication circuit and generating a current output in response to the output current of the multiplication circuit, wherein the common-base amplifier comprises a voltage bias, a first transistor comprising an emitter, base and collector, the emitter of the first transistor coupled to the output of the multiplication circuit, the DC current being coupled to the active filter circuit through the emitter of the first transistor, and the base of the first transistor coupled to the voltage bias;

a low pass active filter coupled to the common-base amplifier for filtering the current output of the common-base amplifier and generating at an output a filtered mixer output signal; and

a demodulator coupled to an output of the at least one mixer for demodulating the filtered mixer output signal to generate a recovered audio signal.

10. A selective call receiver comprising the receiver circuit of claim 9, and further comprising:

a data limiter coupled to the demodulator for receiving the recovered audio signal and for generating a digital signal representative of a selective call signal;

a code plug memory for storing an address of the selective call receiver; and

a decoder/controller connected to the data limiter and the code plug memory and responsive to the digital signal to generate an alert based on the digital signal and the address stored in the code plug memory.

11. The receiver circuit of claim 9, wherein the low pass active filter is a second order Sallen and Key filter which comprises:

first and second resistors connected in series and coupled between the collector of the first transistor of the common-base amplifier and a voltage supply;

a first capacitor coupled between the emitter of the first transistor of the common-base amplifier and a node between the first and second resistors; and

a second capacitor coupled to the collector of the first transistor of the common-base amplifier.

12. A receiver circuit suitable for connection to an antenna for receiving a radio frequency (RF) signal detected by the antenna, the receiver circuit comprising:

an amplifier for amplifying the RF signal detected by the antenna and generating an amplified RF signal;

at least one local oscillator for generating a local oscillator signal;

at least one mixer coupled to the at least one local oscillator and to an output of the amplifier, the at least one mixer comprising:

a multiplication circuit having a first input coupled to the local oscillator signal and a second input coupled to the amplified RF signal, the multiplication circuit generating at first and second differential outputs an output current which is a multiplication of the local oscillator signal and the amplified RF signal;

a direct-current (DC) current source coupled to the multiplication circuit for supplying DC current for operation of the multiplication circuit;

an active filter circuit coupled to the multiplication circuit, the active filter circuit being biased for operation by DC current that is coupled to it through the output of the multiplication circuit from the DC current source, the active filter circuit comprising:

a common-base amplifier coupled to the output of the multiplication circuit and generating a current output in response to the output current of the multiplication circuit, the common-base amplifier being a differential common-base amplifier comprising:

a voltage bias; and

first and second transistors each comprising an emitter, base and collector, the emitter of the first transistor coupled to the first differential output of the multiplication circuit and the emitter of the second transistor coupled to the second differential output of the multiplication circuit, the DC current being coupled to the active filter circuit through the emitters of the first and second transistors, and the bases of the first and second transistors being coupled to the voltage bias;

a low pass active filter coupled to the common-base amplifier for filtering the current output of the common-base amplifier and generating at an output a filtered mixer output signal; and

a demodulator coupled to an output of the at least one mixer for demodulating the filtered mixer output signal to generate a recovered audio signal.

13. The receiver circuit of claim 12, wherein the low pass active filter is a differential second order Sallen and Key filter which comprises:

a voltage supply;

first and second resistors connected in series and coupled between the collector of the first transistor of the common-base amplifier and the voltage supply;

third and fourth resistors connected in series and coupled between the collector of the second transistor of the common-base amplifier and the voltage supply;

a first capacitor coupled between the emitter of the first transistor of the common-base differential amplifier and a node between the first and second resistors;

a second capacitor coupled between the emitter of the second transistor of the common-base amplifier and a node between the third and fourth resistors; and

a third capacitor coupled between the collectors of the first and second transistors.

14. The receiver circuit of claim 13, wherein the filtered mixer output signal at the output of the low pass active filter comprises a differential voltage at opposite ends of the third capacitor.

15. The receiver circuit of claim 13, wherein the filtered mixer output signal at the output of the low pass active filter comprises a differential voltage at the node between the first and second resistors, and the node between the third and fourth resistors, respectively.

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US005390345A

# United States Patent [19]

Wada et al.

[11] Patent Number: 5,390,345

[45] Date of Patent: Feb. 14, 1995

[54] METHOD FOR PREVENTING DESENSITIZATION AND RADIO INTERFERENCE OF RADIO RECEIVERS

[75] Inventors: Masahiro Wada, Tokyo; Kazuo Tominaga, Kanagawa, both of Japan

[73] Assignees: Nippon Telegraph and Telephone Corporation; Toyo Communication Equipment Co., Ltd., both of Japan

[21] Appl. No.: 829,034

[22] PCT Filed: May 31, 1991

[86] PCT No.: PCT/JP91/00731

§ 371 Date: Mar. 30, 1992

§ 102(e) Date: Mar. 30, 1992

[87] PCT Pub. No.: WO91/19356

PCT Pub. Date: Dec. 12, 1991

[30] Foreign Application Priority Data

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[51] Int. Cl.[6] ..... H04B 1/10

[52] U.S. Cl. ..... 455/234.1; 455/249.1; 455/254; 455/295; 455/296

[58] Field of Search ..... 455/234.1, 239.1, 245.1, 455/249.1, 250.1, 254, 295, 296, 308, 311

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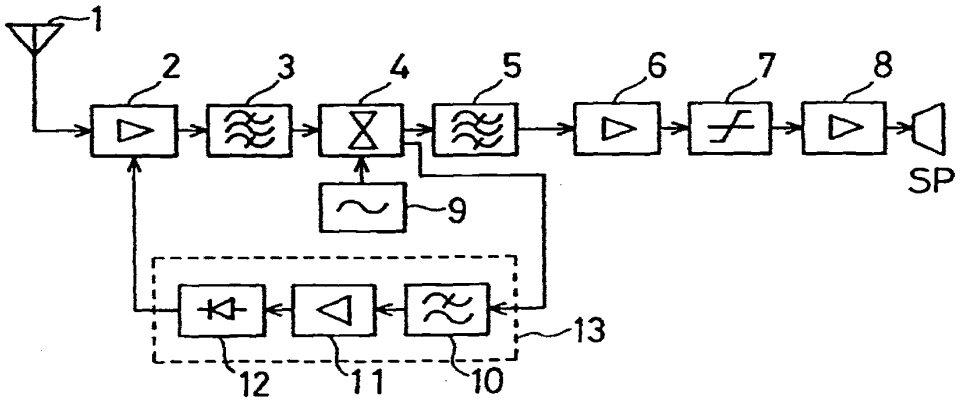
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| 0171239 | 8/1986 | Japan | 455/234.1 |
| 0125715 | 6/1987 | Japan | 455/295 |
| 328114 | 12/1987 | Japan . | |
| 202019 | 8/1988 | Japan . | |
| 0170121 | 7/1989 | Japan | 455/296 |

*Primary Examiner*—Curtis Kuntz
*Assistant Examiner*—Chi Pham
*Attorney, Agent, or Firm*—Graham & James

[57] ABSTRACT

A signal which results from cross modulation of two or more nearby received waves contained in the output of a high-frequency amplifier or mixer of a radio receiver, for example, a low-frequency signal corresponding to a channel separation frequency is extracted. The gain of the high-frequency amplifier or attenuation of a variable attenuator provided in the preceding stage of the amplifier is controlled in accordance with the level of the low-frequency signal. Alternatively, the gain of the high-frequency amplifier or attenuation of the variable attenuator is controlled in accordance with the level of the low-frequency signal when it is equal to or larger than a predetermined value. This permits normal reception of a desired wave, even if the signal receiving level is high.

3 Claims, 3 Drawing Sheets






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FIG. 1

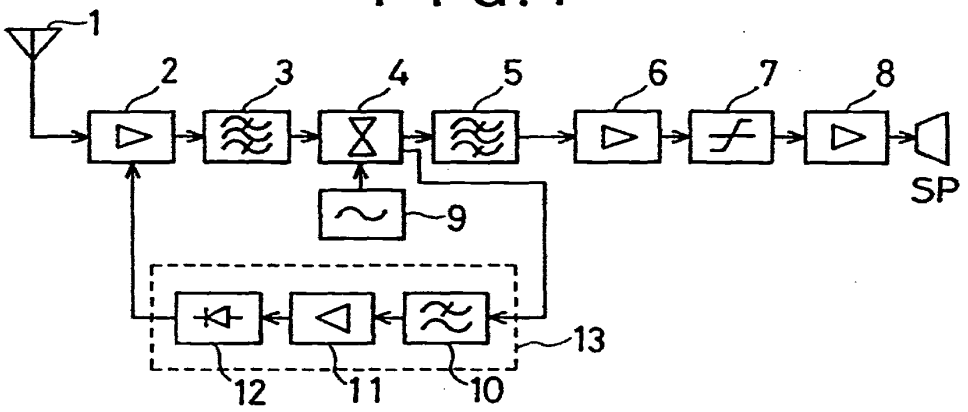



FIG. 2(a)

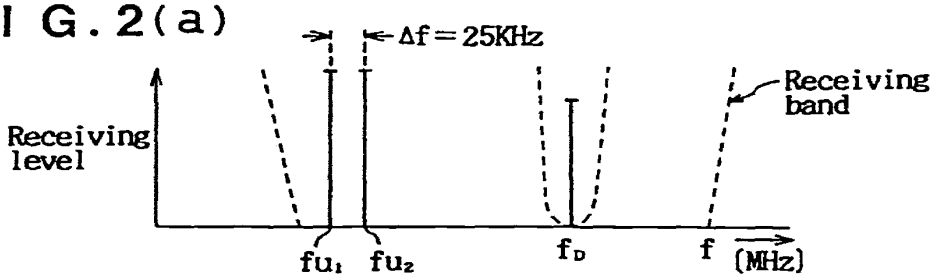



FIG. 2(b)

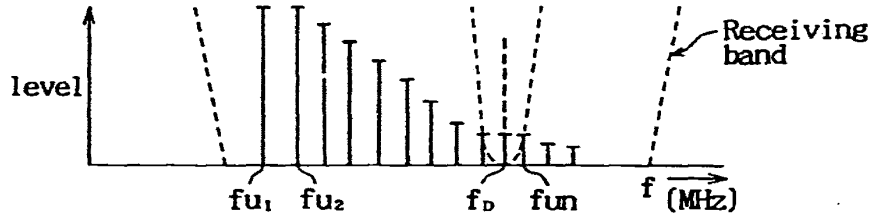
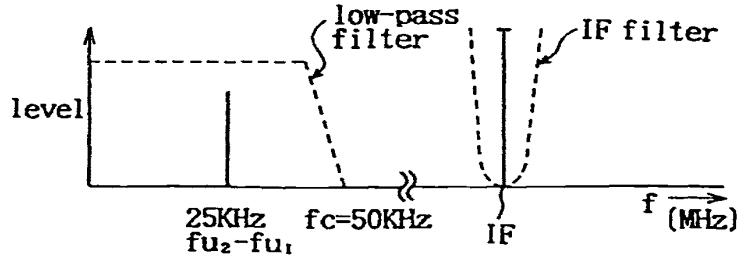



FIG. 2(c)






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FIG. 3

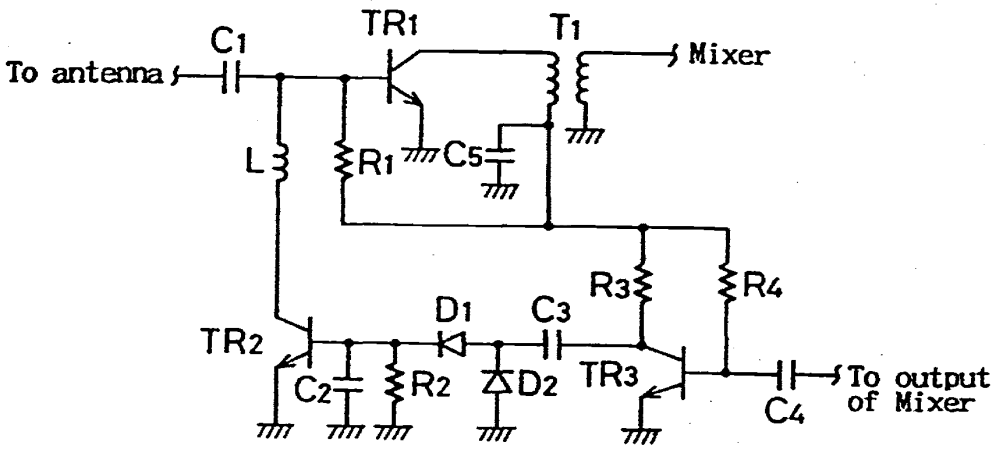
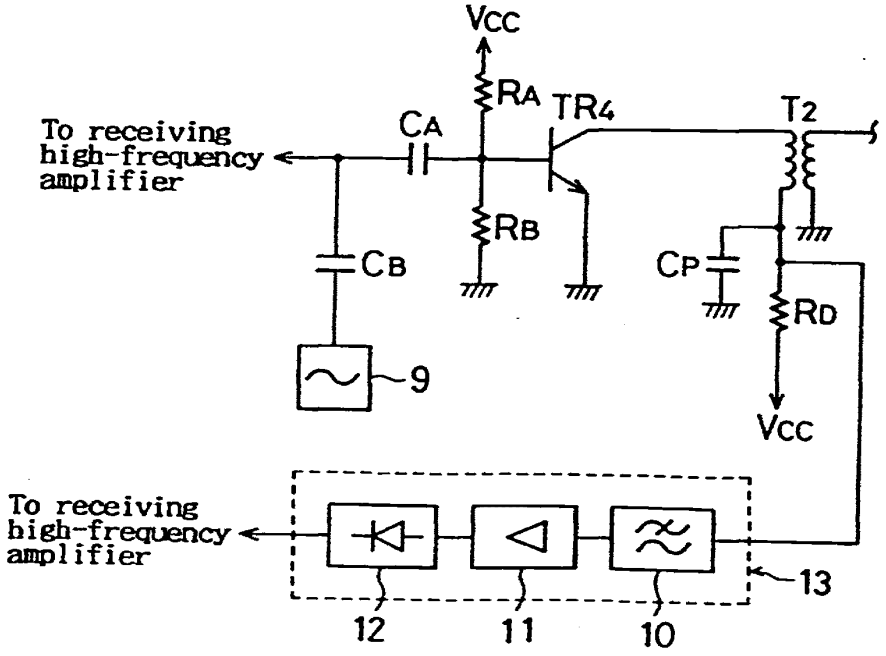


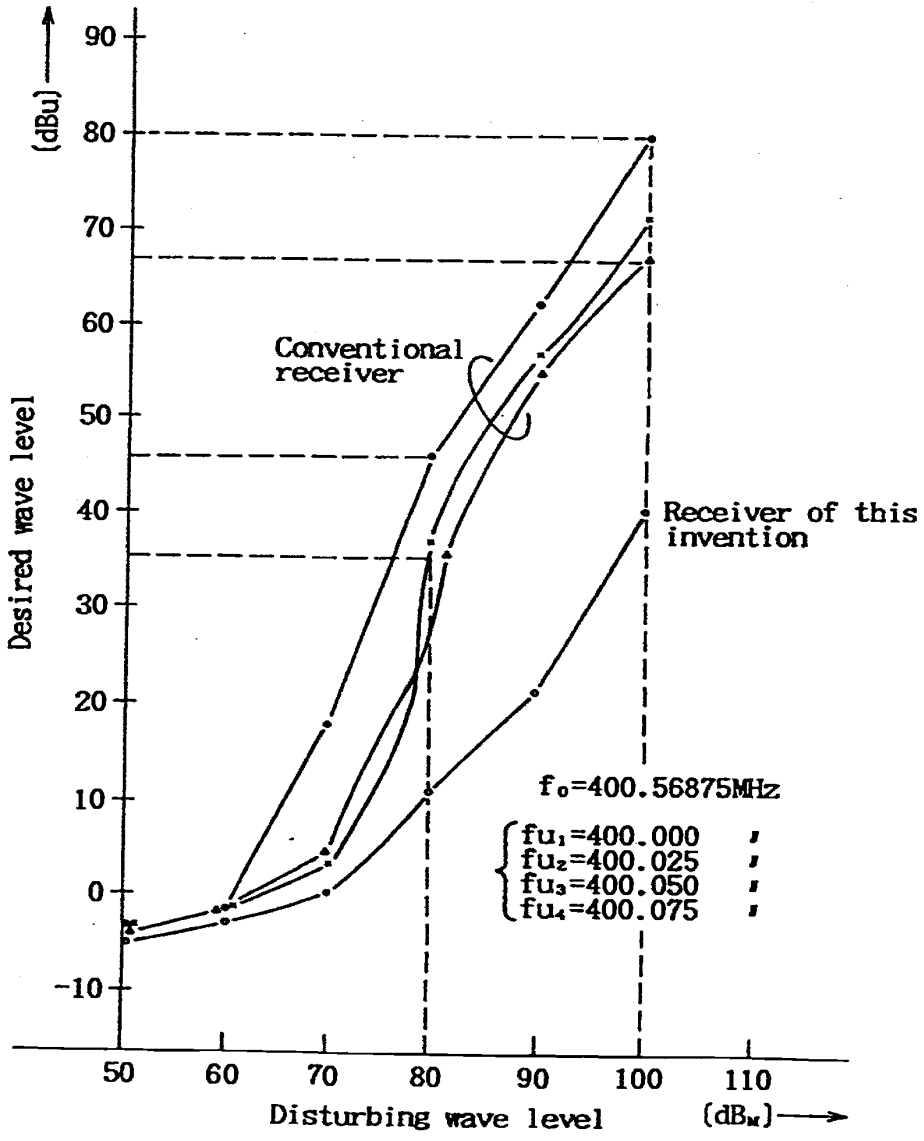

FIG. 4






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FIG. 5




Disturbing wave-sensitivity characteristic



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# METHOD FOR PREVENTING DESENSITIZATION AND RADIO INTERFERENCE OF RADIO RECEIVERS

## TECHNICAL FIELD

The present invention relates to a method for preventing desensitization or radio interference of radio receivers and, more particularly, to a method for preventing a decrease in the receiving sensitivity by high-level reception of both of a desired wave and a near-by disturbing wave, or for preventing interference with the receiving channel by a mixed component of a plurality of near-by disturbing waves without containing a desired wave.

## BACKGROUND ART

Important functions of the radio receiver are such as near-by channel selectivity for eliminating near-by channels to demodulate only a desired wave, a function of preventing the radio receiver from operating as if a desired wave is received as a result of the generation of the same frequency component as that of desired wave by mixing of a plurality of disturbing waves, and a function of preventing interference by receiving channels of the same frequency with each other.

These functions are influenced by characteristics of various filters of a receiving high-frequency circuit and an intermediate-frequency amplifying circuit and the nonlinearity of respective circuits, and the degree of interference or disturbance differs with the correlation of receiving frequencies and the received signal level.

To make these functions satisfactory for practical use, efforts have been concentrated on the improvement of characteristics at the device level, such as enhancement of the linearity of the receiving high-frequency circuit and the intermediate-frequency amplifying circuit or maximization of the steepness of the filter characteristic at each stage.

Radio receivers, however, even if made sure to have such required functions through conventional measurement, are not always capable of good reception under the recent radio wave environment.

According to a prior art method for measuring the near-by channel selectivity of the radio receiver, the signal level of a near-by channel is raised in a state in which a signal is received at a level higher than a desired wave receiving sensitivity level of the receiving channel (that is, a state in which a desired wave whose SN ratio is, for example, 6 dB higher than a desired wave signal of a 20 dB is applied to the receiver) and a difference between the signal level of the nearby channel and the desired wave receiving level of the receiving channel is obtained when the above-said SN ratio drops by a predetermined value, and the value thus obtained is regarded as an indication of the near-by channel selectivity of the receiver.

Similar measurements may sometimes be made wherein two nearby waves or two waves bearing a predetermined frequency relationship are applied, as disturbing waves, to the receiver at the same level.

At any rate, conventional measurements of receiver functions all utilize the desired wave signal of the sensitivity level at the basis of measurement, as typified by the above method; hence, the absolute value of the level of the disturbing wave is inevitably very low in the evaluation of the functions.



However, there are cases where radio receivers, even if found by the above-mentioned measurement to possess the prescribed functions, are incapable of normal reception of signals of extremely high levels, even if the level difference between the desired wave and the disturbing wave is less than a prescribed value.

For example, in the vicinity of a base station where a multifrequency transmitting antenna is provided, the desired wave and the disturbing wave are both received at an extremely high level, but even if the disturbing wave is slightly higher in level than the desired wave, that is, even if the level difference between them is only 10 dB or so, the level of the desired wave in the receiver is suppressed owing to the nonlinearity of the receiving high-frequency circuit—this markedly decreases the receiving sensitivity, hindering the normal reception.

Under such conditions, not only the near-by channel selectivity but also the interference eliminating function are impaired; for example, frequency components nearby the desired wave receiving channel, which are generated by harmonic waves of two or more disturbing waves present anywhere in the same receiving frequency band or a mixture thereof, cause interference and hence pose the same problem as mentioned above.

Such a problem is encountered more frequently with the recent increase in the numbers of radio channels and base stations or repeater stations; namely, radio service zones are formed everywhere in the center of a city, in particular, where many radio stations are established—this constitutes a serious obstacle to mobile communications.

## DISCLOSURE OF THE INVENTION

It is therefore an object of the present invention to provide a method for preventing desensitization and radio interference of radio receivers to permit normal reception even if radio waves are received at high levels.

To attain the above objective, according to the present invention, a signal, which results from cross modulation of two or more near-by received waves contained in the high-frequency amplifier output or mixer output of the radio receiver, for example, a low-frequency signal corresponding to a channel separation frequency, is extracted, and the gain of the high-frequency amplifier or attenuation of a variable attenuator provided in the preceding stage of the high-frequency amplifier is controlled in accordance with the level of the extracted signal when it is higher than a predetermined value.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram illustrating an example of a radio receiver embodying the present invention;

FIGS. 2*a*, *b* and *c* are spectrum diagrams for explaining the operation of the embodiment of the present invention;

FIG. 3 is circuit diagram showing an example of a receiving high-frequency amplifier for use in the present invention;

FIG. 4 is a circuit diagram showing an example of cross-modulated signal extracting means; and

FIG. 5 is a graph showing a desensitization characteristic of the receiver according to the present invention, for evaluation of its performance, together with similar characteristics of conventional receivers.



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## BEST MODE FOR CARRYING OUT THE INVENTION

The present invention will hereinafter be described in detail with reference to the accompanying drawings.

FIG. 1 illustrates in block form an example of an FM receiver embodying the present invention.

In FIG. 1, reference numeral 1 indicates an antenna, which is connected to a receiving circuit which is made up of a cascade connection of a variable gain type high-frequency amplifier 2, a high-frequency filter 3, a mixer 4, an intermediate-frequency filter 5, an intermediate-frequency amplifier 6, a demodulator 7 and a low-frequency amplifier 8 and a local oscillator 9 connected to the mixer 4. In this embodiment the output of the mixer 4 is applied to an interference detector 13 which includes a low-pass filter 10 having a cut-off frequency of, for example 50 kHz or so, a cross-modulated signal amplifier 11 and a rectifier 12, and a DC signal obtained with the rectifier 12 is fed back to a gain control terminal of the above-mentioned variable gain high-frequency amplifier 2.

With such a circuit arrangement, the operation of the receiver portion composed of the antenna 1, the high-frequency amplifier 2, the band-pass filter 3, the mixer 4, the intermediate-frequency filter 5, the intermediate-frequency amplifier 6, the demodulator 7, the low-frequency amplifier 8 and the local oscillator 9 is the same as in the prior art, and hence no detailed description will be given of the operation, but the receiver of this embodiment differs from the conventional receivers in that the gain of the high-frequency amplifier 2 is variable with the above-noted DC signal.

Further, the interference detector 13 in this example detects the presence of disturbing waves of high levels and controls the gain of the high-frequency amplifier 2 as described below.

FIGS. 2*a*, *b* and *c* are spectrum diagrams for explaining the operation of the interference detector 13.

Now, let it be assumed that two disturbing waves $f_{U1}$ and $f_{U2}$ spaced, for example, 25 kHz (which is a channel separation) apart are received at a higher level than a desired wave $f_D$ in the same receiving band, as shown in FIG. 2*a*. In the prior art harmonic waves are generated owing to the nonlinearity of the receiving high-frequency amplifier 2 or mixer 4 in such an instance, and as shown in FIG. 2*b*, the level of the desired wave $f_D$ is drastically reduced, while at the same time disturbing signal components $f_{Un}$ are generated in or near the desired wave receiving channel—this leads to interference or serious deterioration of the SN ratio, hampering normal reception of the desired wave $f_D$.

In this case, the output of the mixer 4 contains the difference frequency 25 kHz between the two disturbing waves and a signal component equal to an integral multiple of the difference frequency as depicted in FIG. 2*c*.

In this embodiment the above-mentioned phenomenon is noted. A low-frequency signal contained in the output of the mixer 4, i.e. a portion of a cross-modulated component, is extracted by the low-pass filter 10 which has a cut-off frequency of, for example, 50 kHz, and it is amplified by the low-frequency amplifier 11 to a required level, thereafter being converted by the rectifier 12 to a DC signal. The gain of the high-frequency amplifier 2 is controlled in accordance with the level of the DC signal. According to the method described above, since no frequency component is extracted by the low-pass filter 10 in case two or more disturbing waves do not exist in the receiving band, the gain of the high-frequency amplifier 2 is not reduced at all but becomes maximum. On the other hand, when a disturbing wave is present as mentioned above, the gain of the high-frequency amplifier 2 is decreased in accordance with the level of the disturbing wave.. Consequently, the degree of distortion in the amplifier 2 substantially lowers and the degree of reduction of the level of the desired wave also decreases or the generation of a disturbing signal component which gets mixed into the intermediate-frequency band is prevented, thus, normal reception of the desired wave is possible.

In other words, the method described above is an attenuation method in which a variable attenuator is provided between the antenna 1 and the high-frequency amplifier 2, and the variable attenuator reduces the signal to the high-frequency amplifier when a level of two or more disturbing waves are very high. In the present invention the operation therefor is automatically performed by extracting the low-frequency signal that results from two or more disturbing waves.

No simple-structured means has been proposed so far for directly extracting the two or more high-frequency disturbing wave which cause cross modulation in the desired wave receiving frequency band, and conventionally it would be necessary therefor to employ a complicated and expensive device which is provided with receivers corresponding to disturbing wave frequencies and rectify amplified intermediated frequencies, just like what is called a frequency selective amplifier.

In contrast thereto, according to the above-described method of the present invention, the presence of disturbing waves can be detected with much ease by extracting a signal which results from inevitable mixing of two or more disturbing waves and the desired wave. In addition, the above signal is a low-frequency signal of about the afore-mentioned channel separation frequency, and hence is easy of selection and amplification. Hence, the method of the present invention can be implemented at low cost.

FIG. 3 is a circuit diagram illustrating principal parts of a specific operative example of the variable gain type high-frequency amplifier 2.

In FIG. 3, reference character $TR_1$ denotes a common-emitter type high-frequency amplifying transistor, which is supplied at its collector with power via a primary coil of a tuning transformer $T_1$. A bias current supply resistor $R_1$ is connected between the base of the transistor $TR_1$ and a power supply line and the collector of a second transistor $TR_1$ is connected between the base and the ground via a choke coil L. The transistor $TR_1$ has its emitter grounded. A received signal from the antenna is applied via a DC blocking capacitor $C_1$ to the base of the transistor $TR_1$.

A capacitor $C_2$ and a resistor $R_2$ are connected in parallel between the base of the second transistor $TR_2$ and the ground, and the base of the transistor $TR_2$ is connected to the collector of a third transistor $TR_3$ via rectifying diodes $D_1$ and $D_2$ and a capacitor $C_3$.

The collector and the base of the third transistor $TR_3$ are supplied with the power source voltage via resistors $R_3$ and $R_4$, respectively, and a cross-modulated signal based on the above-said disturbing waves, derived by the low-pass filter 10 from the mixer 4, is applied via a capacitor $C_4$ to the base of the transistor $TR_3$. The tran-



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sistor $TR_3$ is used as a low-frequency amplifier for amplifying the above-mentioned cross-modulated signal.

With such a circuit arrangement, the collector-emitter resistance of the transistor $TR_2$ varies with the level of the signal input to the base of the transistor $TR_3$, accordingly the base bias of the transistor $TR_1$ of the high-frequency amplifier 2 varies, permitting control of its gain. In this sense the second transistor $TR_2$ serves as a grounding side bias resistor of the transistor $TR_1$.

The above-mentioned choke coil L is to block a high-frequency signal but need not always be provided when the collector-emitter impedance of the second transistor $TR_2$ is high.

With this method, it is considered that a decrease in the base current of the high-frequency amplifier 2 causes a decrease of its dynamic range, resulting in increased signal distortion. It is therefore effective in increasing or decreasing only the high-frequency signal without changing the base bias of the amplifier 2 to insert a capacitor between the collector of the transistor $TR_2$ and the base of the transistor $TR_1$ for isolating them DC-wise.

With such an arrangement, it is possible to attenuate only the input signal to the transistor $TR_1$ without changing its base bias and hence obviate the above-mentioned defect.

FIG. 4 illustrates an example of the circuit connection for extracting the afore-mentioned mixed frequency signal from the mixer output, that is, for extracting from the normal intermediate-frequency signal component a low-frequency signal component resulting from distortion of the disturbing waves. Conventionally, in many cases a decoupling resistor $R_D$ is connected in series to the primary coil of a tuning transformer $T_2$ of the mixer output portion and a by-pass capacitor $C_P$ for grounding the hot side of the resistor $R_D$ high-frequency-wise is also connected to the primary coil, and only the low-frequency signal voltage by the disturbing waves appears in the mixer output portion. Accordingly, such a connection as shown in FIG. 4 allows ease in extracting the cross-modulated signal for use in the present invention.

In this instance, the afore-mentioned low-pass filter 10 need not always be provided if the intermediate-frequency signal, the received high-frequency signal, a local oscillation signal and their mixed output are sufficiently removed by this method to extract only the low-frequency signal based on the disturbing waves.

FIG. 5 is a graph showing measured results of the performance of a receiver embodying the present invention. For better understanding of the effect of the invention, results of performance tests of conventional receivers are also shown.

In the performance test the desired wave $f_D$ of 400.56875 MHz and four disturbing wave signals $f_{U1}$ through $f_{U4}$ which are 493.75 kHz lower than the desired wave $f_D$ (the disturbing wave signals being sequentially spaced 25 kHz apart) are simultaneously applied to the high-frequency input end of the receiver via a required coupling circuit. In FIG. 5, the abscissa represents the disturbing wave level (all the levels of the disturbing wave signals being the same) and the ordinate represents the level of the desired wave signal corresponding to a predetermined SN ratio (20 dB, for instance) reached when the respective disturbing wave signals were input.

In the measurements the frequency of the desired wave signal was 400.56875 MHz as mentioned above and frequencies of the four disturbing wave signals were 400.000, 400.025, 400.050 and 400.075 MHz, and three conventional receivers fabricated on the basis of different designs were employed.

As is evident from FIG. 5, in the conventional receivers the desired wave receiving sensitivity stays at a predetermined value of about $-5$ dBμ until the disturbing wave level reaches approximately 60 dBμ, but as the disturbing wave level further increases, the desired wave receiving sensitivity rapidly deteriorates, and when the disturbing wave level is 100 dBμ, the desired wave signal cannot normally be received unless its level is in the range of 65 to 80 dBμ.

This means that the desired wave signal cannot be received or the SN ratio is seriously impaired when the level of the disturbing wave signal goes very high, for example, when the level is only 20 to 35 dB or so higher than the level of the desired wave.

On the other hand, the receiver according to the present invention is able to receive the desired wave at a level of 45 dBμ even when the level of the disturbing wave is as high as 100 dBμ, and the level of the desired wave receivable by the receiver is about 10 dBμ when the disturbing wave is at an intermediate level, for instance, 80 dBμ, whereas in the conventional receivers the level of the desired wave needs to be in the range of between 35 and 45 dBμ in such a case. The difference of 25 to 35 dBμ is the difference in sensitivity between the receiver according to the present invention and conventional receivers. This demonstrates that the effect of improvement by the present invention is very marked.

In the above-mentioned measurements the channel separation of the receiving frequency band is 25 kHz and the cut-off frequency of the low-pass filter 10 for extracting the cross-modulated signal must be set to a value equal to or higher than at least 25 kHz but lover than the intermediate frequency; however, when the channel separation is 12.5 kHz, the low-pass filter 10 needs only to extract a frequency component of at least 12.5 kHz.

Although the above embodiment has been described to derive the cross-modulated signal from the mixer 4, it is evident that the invention is not limited specifically thereto but that the signal can also be derived from, for example, the output of the high-frequency amplifier or similar element.

The variable gain type high-frequency amplifier 2 need not be limited specifically to that exemplified in FIG. 3 but may also be modified into various forms.

While in the above embodiment the gain of the high-frequency amplifier 2 is increased or decreased by controlling the base bias of the transistor $TR_1$ forming the amplifier 2, it is also possible to connect a variable attenuator between the antenna 1 and the high-frequency amplifier 2 and control its attenuation. When the attenuator is excellent in linearity, the characteristic shown in FIG. 5 can be further improved.

That is, in the above embodiment the linearity of the high-frequency amplifier 2 is likely to deteriorate, because its gain is reduced by decreasing the base bias current of the transistor $TR_1$, but the use of an attenuator of excellent linearity affords reduction of the level of the signal input to the high-frequency amplifier 2 without degrading its characteristic; hence, the desired wave receiving level selecting characteristic can be maintained theoretically within the attenuation variable range of the attenuator.

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For example, in the case where the desired wave receiving level selecting characteristic is 80 dBμ, the desired wave can be received when its level is 20 dBμ, even if the level of the disturbing wave is 100 dBμ.

As the variable attenuator of excellent linearity for use in the present invention, it is possible to employ a variable attenuator for high-frequency signal use which has an arrangement in which its attenuation is controlled by electrically switching, from the outside, electronic switches connected to a plurality of terminals of a resistance network or ladder-type resistance network.

If such a variable attenuator is allowed to be somewhat nonlinear, then the attenuator can be implemented by voltage or current control of a transistor, FER, diode, or similar semiconductor device.

For controlling the variable gain type high-frequency amplifier or variable attenuator a comparator or logarithmic amplifier may also be employed in the aforementioned interference detecting portion, by which the gain of the amplifier or attenuation of the attenuator are controlled for only disturbing waves of levels above a certain value, or the gain is reduced or attenuation is varied greatly as the disturbing wave level increases.

in recent years there has been studied, for a novel receiving system, a practical application of a method in which a received signal and a local oscillation signal of the same frequency are mixed together and the mixed signal is used to directly demodulate a signal superimposed on a carrier. It will be appreciated that the present invention is also applicable to such a method.

As described above, according to the present invention, it is possible to prevent, by a simple method, radio interference or desensitization of a radio receiver which occurs when two or more disturbing signal levels are high. Thus, the present invention produces a remarkable effect in improving the functions and performance of radio receivers.

We claim:

1. A radio receiver capable of preventing radio interference caused by cross modulation of two or more disturbing waves, comprising:

a high-frequency amplifier for amplifying a received signal, a gain of said high-frequency amplifier being controlled by a direct current signal;

a local oscillator;

a mixer for outputting an intermediate frequency signal caused by mixing an output signal of said local oscillator and an output signal of said high-frequency amplifier; and

interference detector means for detecting a cross modulated product within said intermediate frequency signal, comprising a filter which separates said cross modulated product from said intermediate frequency signal, said cross modulated product having a low frequency which is at least equal to the channel separation frequency of said two or more disturbing waves, and a rectifier for generating said direct current signal from said cross modulated product for controlling said gain of said high-frequency amplifier.

2. A radio receiver capable of preventing radio interference caused by cross modulation of two or more disturbing waves, comprising:

an attenuator which controls an attenuation level of a signal by application of a direct current signal;

a high-frequency amplifier for amplifying an output signal of said attenuator;

a local oscillator;

a mixer for outputting an intermediate frequency signal generated by mixing an .output signal of said local oscillator and an output signal of said high-frequency amplifier;

interference detector means for detecting a cross modulated product within said intermediate frequency signal, comprising a filter which separates said cross modulated product from said intermediate frequency signal, said cross modulated product having a low frequency which is at least equal to the channel separation frequency of said two or more disturbing waves, and a rectifier for generating said direct current signal from said cross modulated product for controlling said attenuation level.

3. A radio receiver according to claim 1, wherein:

said high-frequency amplifier is comprised of at least two transistors, a base of the first transistor receiving a signal from an antenna of said radio receiver, said base being connected to a capacitor, said base of said first transistor also being connected to a ground via a choke coil and a collector and an emitter of the second transistor, said choke coil being capable of obstructing passage of high-frequency signals, a collector of said first transistor being connected to a power supply via a primary coil of a tuning transformer, a base of said second transistor being connected to a rectifier, said rectifier being connected to said interference detector means to receive said direct current signal.

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Receipt

**Practitioner's Docket No. 297-008576-US(PAR)** ***PATENT***

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re application of: MURTOJARVI et al.
Serial No.: 09/292,301 Group No.: 2811
Filed: 04/15/99 Examiner:
For: METHOD FOR ATTENUATING SPURIOUS SIGNALS AND RECEIVER

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| | *Error in* | *Correct data* |
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Title: METHOD FOR **ATTENUATING** SPURIOUS SIGNALS AND RECEIVER

*3.* *(complete the following applicable item)*

A. x The correction(s) is/are not due to any error by applicant and no fee is due.

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Reg. No.: 24,622

Clarence A. Green
*(type or print name of practitioner)*

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| APPLICATION NUMBER | FILING DATE | GRP ART UNIT | FIL FEE REC'D | ATTORNEY DOCKET NO. | DRWGS | TOT CL | IND CL |
|---|---|---|---|---|---|---|---|
| 09/292,301 | 04/15/99 | 2811 | $760.00 | 297-008576-U | 6 | 12 | 2 |

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Applicant(s)

SIMO MURTOJARVI, SALO, FINLAND; ANTTI RAUHALA, MUURLA, FINLAND; HARRI KIMPPA, SALO, FINLAND.

FOREIGN APPLICATIONS- FINLAND 980858 04/17/98

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METHOD FOR ATTENUATNG SPURIOUS SIGNALS AND RECEIVER
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DATA ENTRY BY: SASFAI, DAVID J. TEAM: 03 DATE: 05/05/99

(see reverse)



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**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

**In re Application of: MURTOJARVI et al.**
**SERIAL NO.: 09/292,301** **EXAMINER:**
**FILING DATE: 4/15/99** **ART UNIT:**
**TITLE: METHOD FOR ATTENUATING SPURIOUS SIGNALS AND RECEIVER**
**ATTORNEY DOCKET NO.: 297-008576-US(PAR)**

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**SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT**

**Dear Sir:**

**The following information is being disclosed to the Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.**

**This Supplemental Information Disclosure Statement is being filed before receipt of a first Office Action on the above-identified patent application. Thus, a certification under 37 CFR 1.97 (e) or fee under 37 CFR 1.17 (p) is not required for the information herein to be considered.**

**The above-identified patent application has a corresponding European Patent Application No. EP 99 66 0061. Applicants' attorney encloses a copy of a European Search Report issued on the corresponding European Patent Application No. EP 99 66 0061. The European Search Report cited US Patent No. US 5,584,066; Patent Abstracts of Japan JP 08056121; PCT International Publication Nos. WO 97/07596, WO 95/30275 and "A 170 MHz RF Front-End**



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**for ERMES Pager Applications" Piazza et al., IEEE Journal of Solid-State Circuits, vol. 30, no. 12, pp. 1430-1437.**

**Copies of the European Search Report and the cited references are enclosed together with PTO-Form 1449.**

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**Respectfully submitted,**

14 Oct 99

**Clarence A. Green, Reg. No. 24,622** **Date**

**Perman & Green, LLP**
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**203-259-1800**

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**CERTIFICATE OF MAILING**

**I hereby certify that the attached Supplemental Information Disclosure Statement, European Search Report, PTO-Form 1449 and references are being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner of Patents and Trademarks, Washington, D. C. 20231.**

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#6



| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No.: 297-008576-US(PAR) | Serial No.: 09/292,301 |
|---|---|---|
| | Applicant(s): MURTOJARVI et al. | |
| | Filing Date: 4/15/99 | Group: 2681 |

**U.S. PATENTS**

| Initials | Patent Number | Issue Date | Name | Class | Sub-class | Filing date |
|---|---|---|---|---|---|---|
| ZL | 5,584,066 | 12/10/96 | Okanobu | 455 | 302 | 10/7/94 |

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**FOREIGN PATENT DOCUMENTS**

| Initials | Document Number | Date | Country | Name | Translation? Yes/No/n/a |
|---|---|---|---|---|---|
| ZL | WO 97/07596 | 2/27/97 | PCT | Philips Electronics N.V. | N/A |
| ZL | WO 95/30275 | 11/9/95 | PCT | Qualcomm Incorporated | N/A |

**OTHER DOCUMENTS (Title, Author, Date, Pages, Etc., if known)**

| | |
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Examiner's Signature: [signature] Date Considered: 1-16-2001

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# United States Patent [19]

Okanobu

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[54] **CORRECTING CIRCUIT FOR MIXING CIRCUIT RECEIVER USING SAME AND FREQUENCY SPECTRUM INVERTING CIRCUIT USING SAME**

[75] Inventor: **Taiwa Okanobu**, Tokyo, Japan

[73] Assignee: **Sony Corporation**, Tokyo, Japan

[21] Appl. No.: **320,040**

[22] Filed: **Oct. 7, 1994**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] ..... **H04B 1/04**; H04B 1/10

[52] **U.S. Cl.** ..... **455/302**; 455/114; 455/118; 455/310; 332/123

[58] **Field of Search** ..... 455/232.1, 234.1, 455/234.2, 250.1, 296, 307, 310, 311, 302, 313, 317, 114, 118, 314, 324, 226.2, 303, 319, 326, 50.1, 63; 375/296; 331/10–12; 332/103, 123, 126, 127; 329/318, 319, 320, 325, 304

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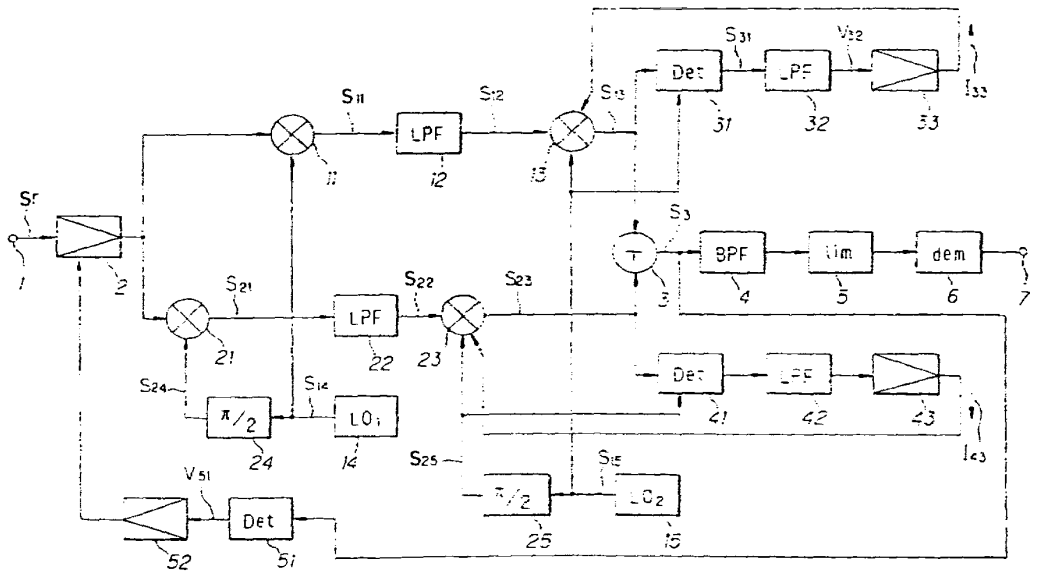
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*Primary Examiner*—Reinhard J. Eisenzopf
*Assistant Examiner*—Nguyen Vo
*Attorney, Agent, or Firm*—Lisa A. Rode, Esq.; Jerry A. Miller

[57] **ABSTRACT**

A double superheterodyne receiver comprising a pair of first mixer circuits, a pair of second mixer circuits, a demodulator circuit, and a pair of detector circuits. The first mixer circuits are connected in an orthogonal relation to each other and acts to convert a received RF signal into a pair of first intermediate-frequency (IF) signals in the baseband. The second mixer circuits are connected in an orthogonal relation to each other and acts to convert the first IF signals into a pair of second IF signals of a given center frequency. The demodulator circuit arithmetically combines the second IF signals so as to create a third IF signal, and demodulates the original signal from the third IF signal. The output signals from the second mixer circuits are supplied to the detector circuits, which in turn detect the carrier component contained in the output signals. The output signals from the detector circuits are fed to the second mixer circuits. The DC balance between the second mixer circuits is so corrected that the leaking carrier components are reduced.

**14 Claims, 8 Drawing Sheets**






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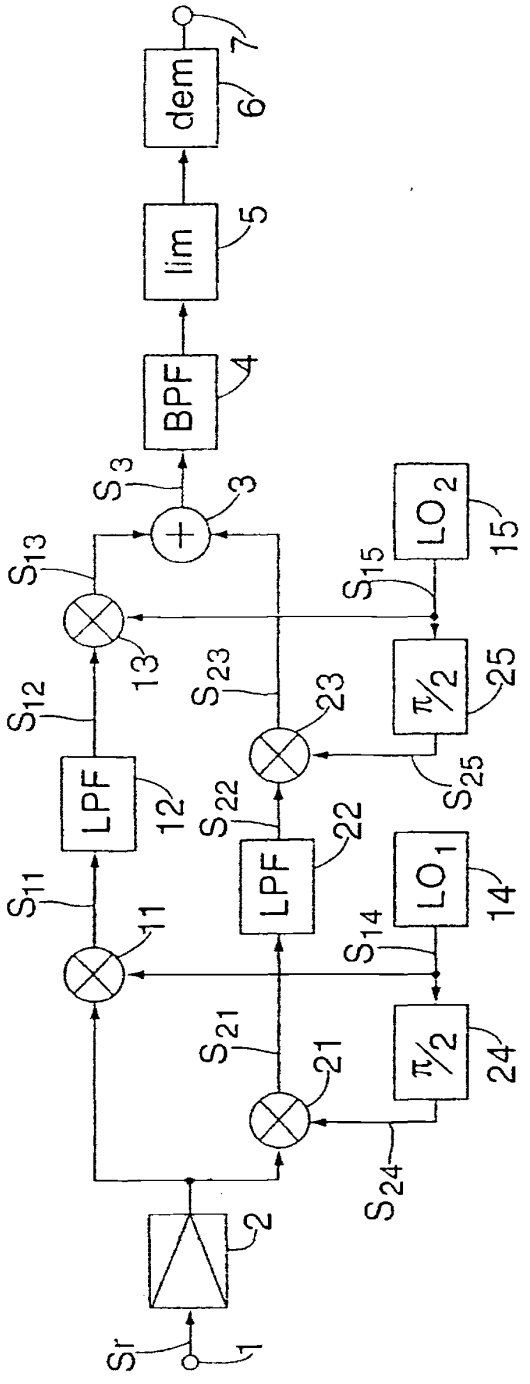



FIG. 1
(PRIOR ART)

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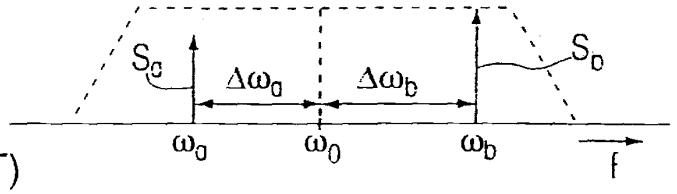



FIG. 2A
(PRIOR ART)

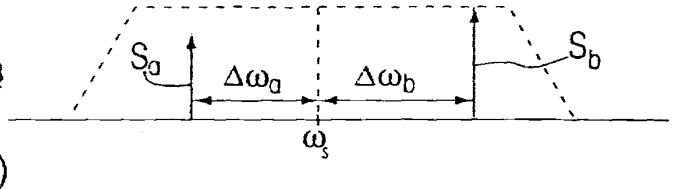



FIG. 2B
(PRIOR ART)

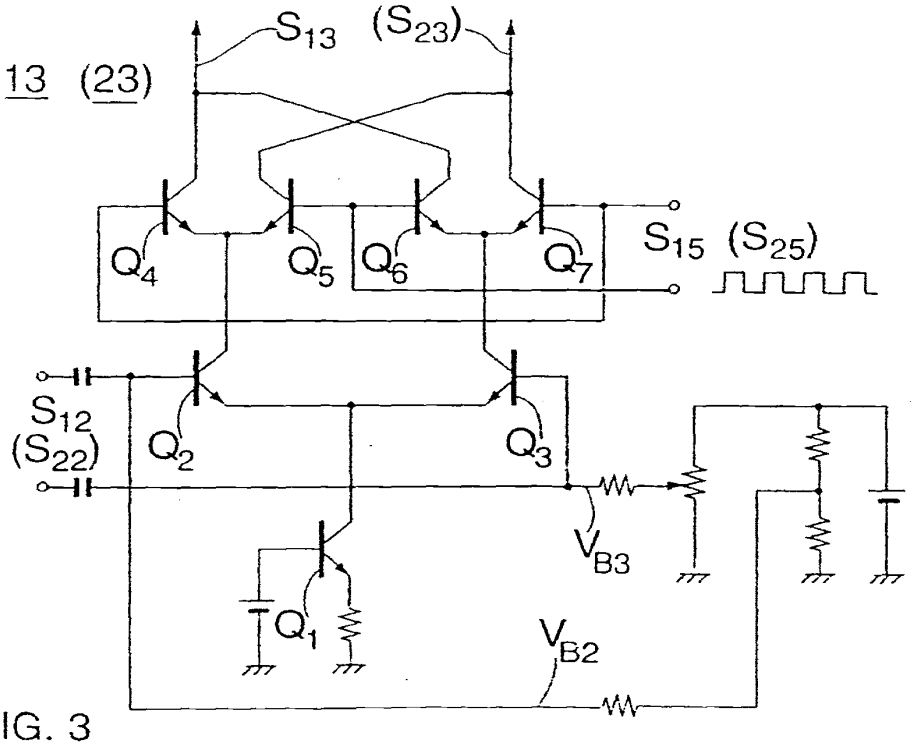



FIG. 3
(PRIOR ART)



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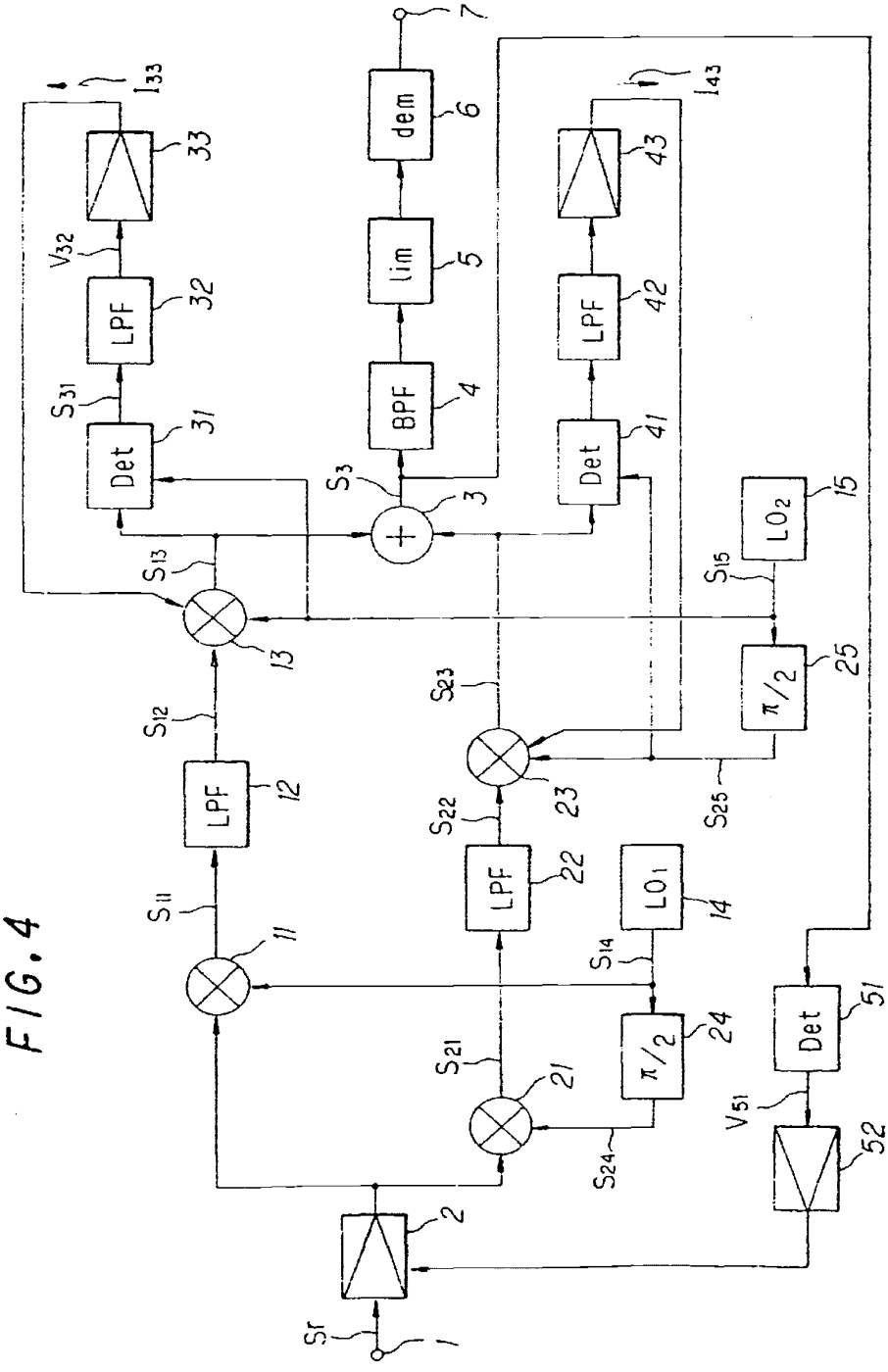



FIG. 4

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FIG. 5

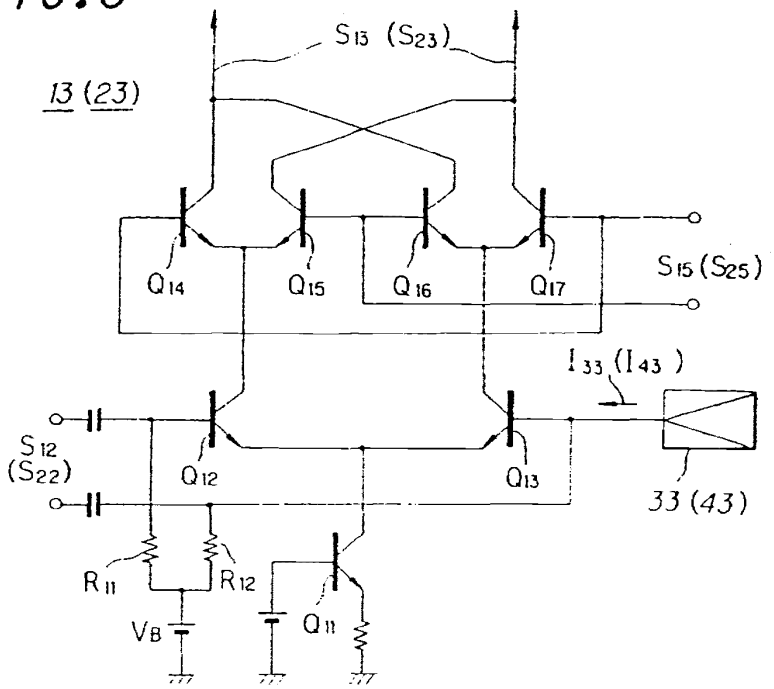



FIG. 6A

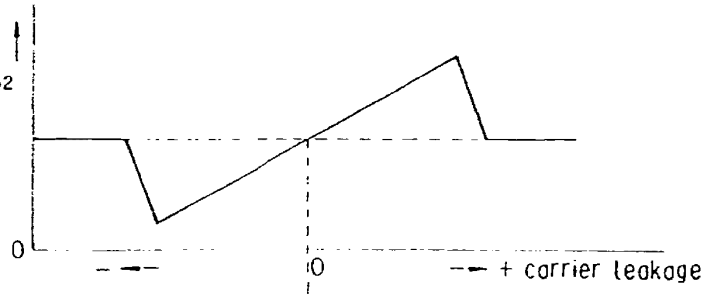
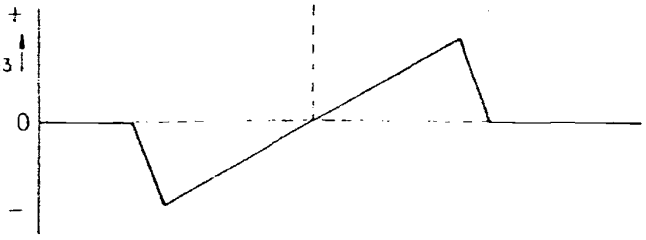


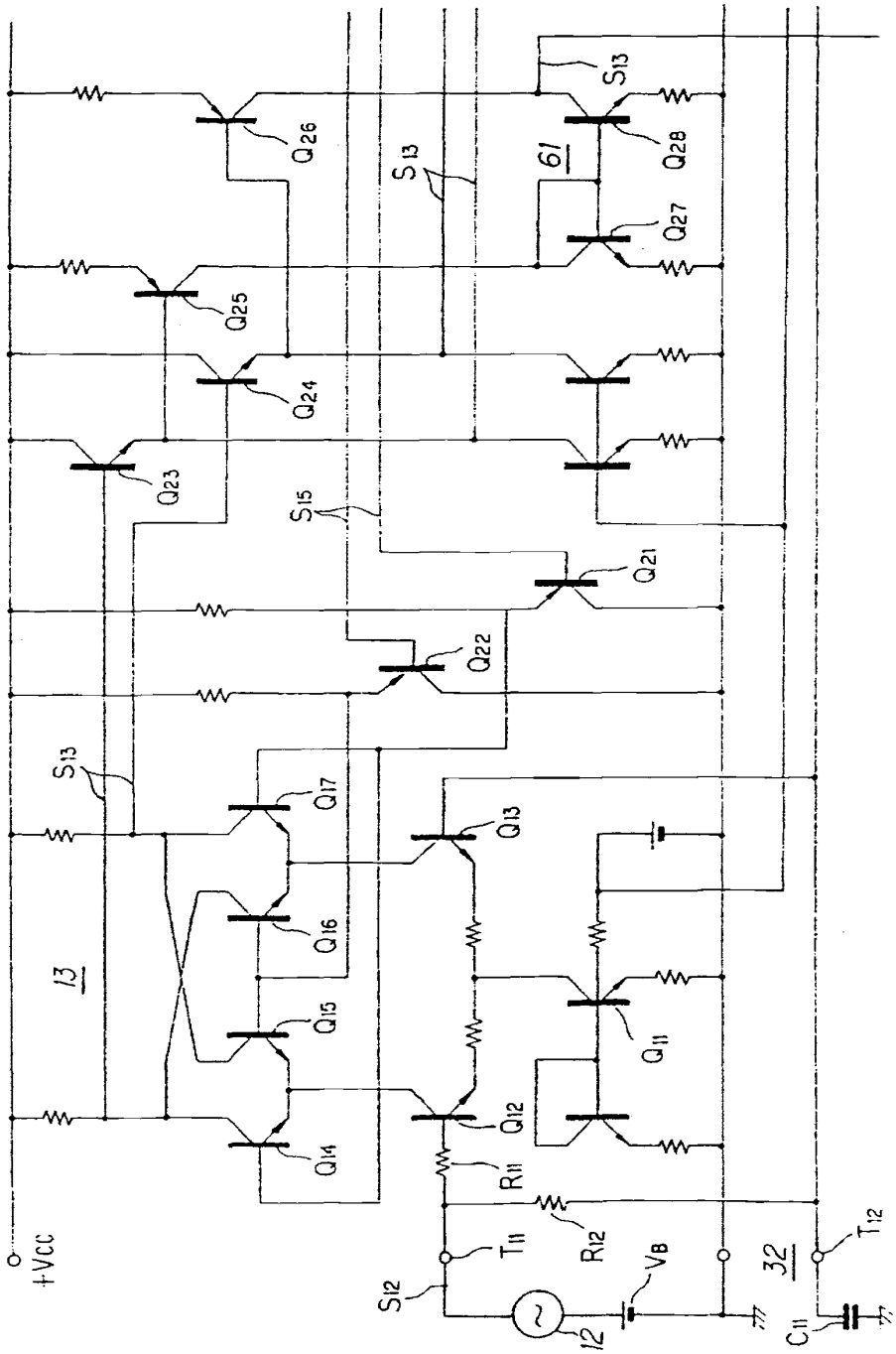

FIG. 6B




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FIG. 7




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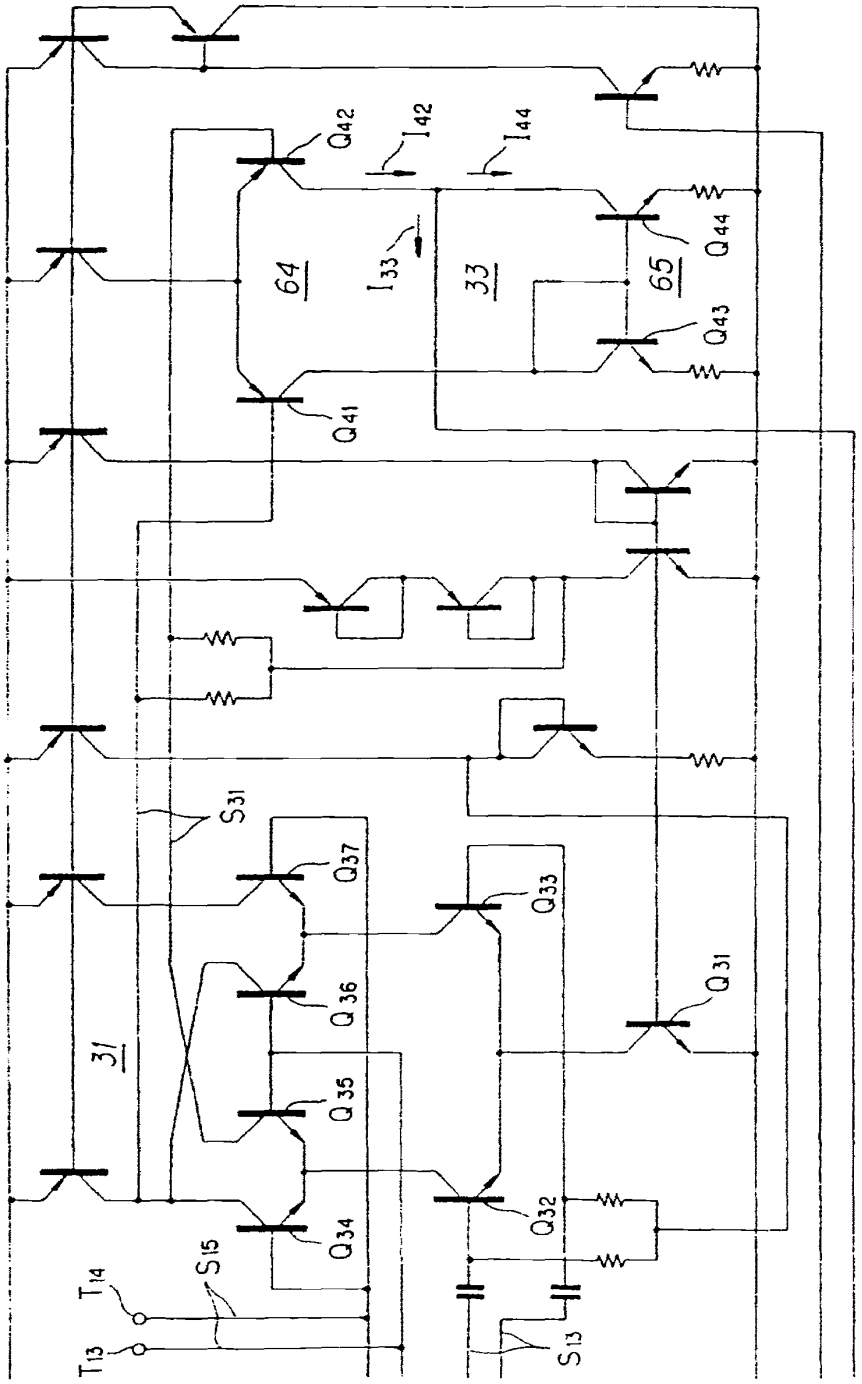
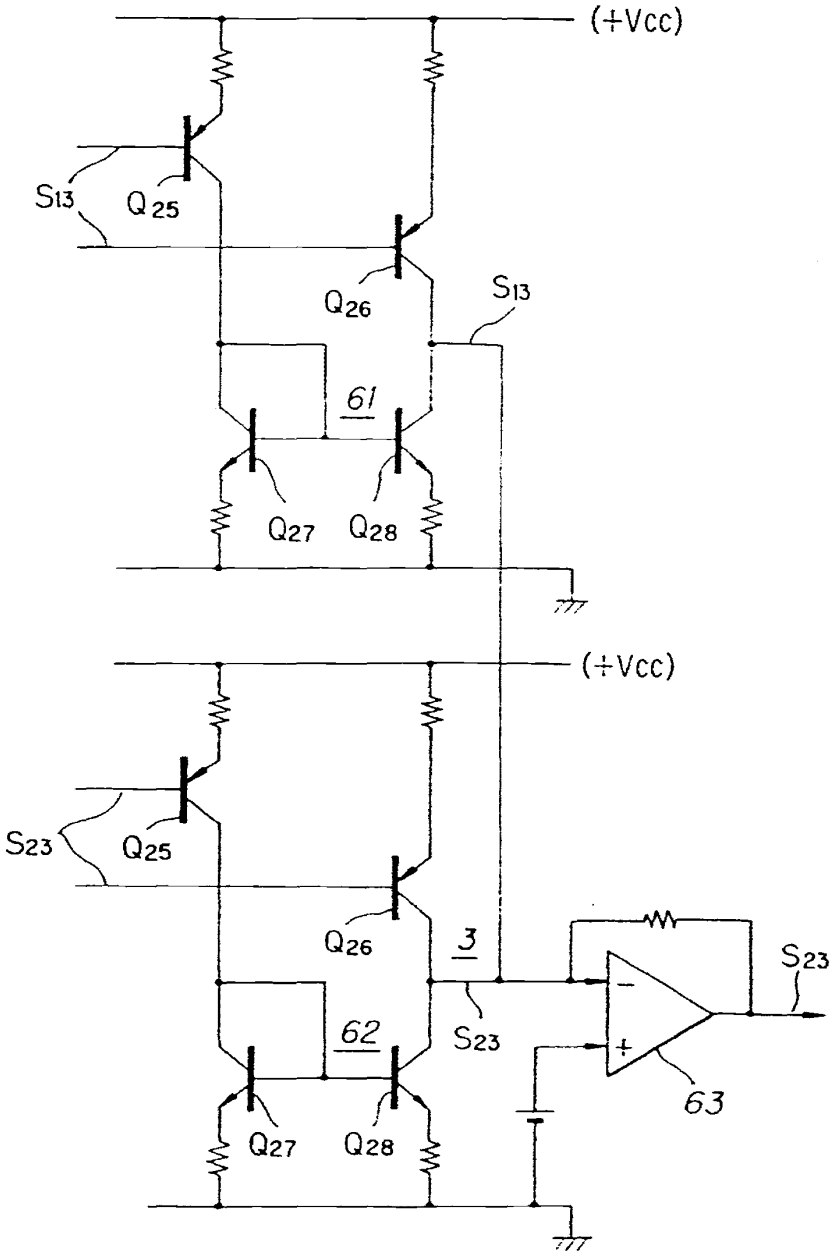



FIG. 8



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FIG. 9

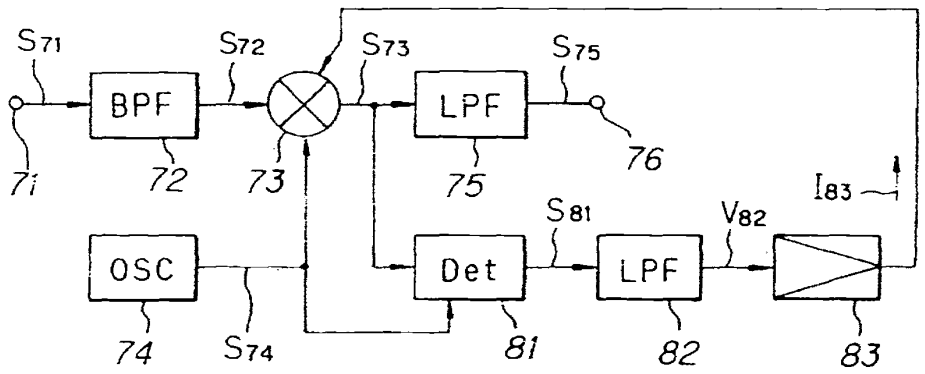



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FIG. 10




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# CORRECTING CIRCUIT FOR MIXING CIRCUIT RECEIVER USING SAME AND FREQUENCY SPECTRUM INVERTING CIRCUIT USING SAME

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a correcting circuit for a mixer circuit, to a receiver using such a correcting circuit, and to a frequency spectrum-inverting circuit using such a correcting circuit. More particularly, the invention relates to a correcting circuit which is for use with a mixing circuit and acts to reduce carrier leakage, to a receiver and a frequency spectrum-inverting circuit using such a correcting circuit.

2. Background of the Invention

One known superheterodyne receiver is a double superheterodyne, direct-conversion type receiver as shown in FIG. 1. This receiver performs its first and second frequency conversions, utilizing orthogonal conversion, to improve the image rejection characteristics. This receiver operates as follows.

The receiver shown in FIG. 1 constitutes the receiver portion of a cordless telephone set, and receives an FM signal. The FM signal, Sr, to be received is applied to its input terminal 1 and fed to first mixer circuits 11 and 21, for I-axis and Q-axis, respectively, for orthogonal conversion via an RF amplifier 2.

A first local oscillator circuit 14 produces a first local oscillator signal $S_{14}$ having the same frequency as the carrier frequency of the received signal Sr. This signal $S_{14}$ is applied to the mixer circuit 11 and also to a phase-shift circuit 24, where the signal is shifted in phase by $\pi/2$, resulting in a phase-shifted signal $S_{24}$. This signal $S_{24}$ is supplied as the first local oscillator signal to the mixer circuit 21.

For simplicity, it is assumed that the received signal Sr has a signal component Sa within its lower sideband and a signal component Sb within its upper sideband, as shown in FIG. 2A, where $\omega_0$ is the carrier frequency (angular frequency) of the received signal Sr, $\omega_a$, is the angular frequency ($\omega_a<\omega_0$) of the signal component Sa, Ea is the amplitude of the signal component Sa, $\omega_b$ is the angular frequency ($\omega_a>\omega_0$) of the signal component Sb, $E_b$ is the amplitude of the signal component $S_b$, $\Delta\omega_a=\omega_0-\omega_a$, and $\Delta\omega_b=\omega_b-\omega_0$. We can have the relations

$$Sr=Sa+Sb$$

$$Sa=Ea\cdot\sin\omega_a t$$

$$Sb=Eb\cdot\sin\omega_b t$$

Assuming that $E_1$ is the amplitude of the first local oscillator signals $S_{14}$ and $S_{24}$, we have the relationships

$$S_{14}=E_1\cdot\sin\omega_0 t$$

$$S_{24}=E_1\cdot\cos\omega_0 t$$

Let $S_{11}$ and $S_{12}$ be the output signals from the mixer circuits 11 and 21, respectively. These output signals can be expressed in the manner described below.



$$\begin{aligned}S_{11} &= Sr\cdot S_{14}\\ &= (Ea\cdot\sin\omega_a t - Eb\cdot\sin\omega_b t)\times E_1\cdot\sin\omega_0 t\\ &= \alpha a\{-\cos(\omega_a+\omega_0)t+\cos(\omega_a-\omega_0)t\}+\\ &\quad \alpha b\{-\cos(\omega_b+\omega_0)t+\cos(\omega_b-\omega_0)t\}\\ &= \alpha a\{-\cos(\omega_a+\omega_0)t+\cos\Delta\omega_a t\}+\\ &\quad \alpha b\{-\cos(\omega_b+\omega_0)t+\cos\Delta\omega_b t\}\end{aligned}$$

$$\begin{aligned}S_{21} &= Sr\cdot S_{24}\\ &= (Ea\cdot\sin\omega_a t - Eb\cdot\sin\omega_b t)\times E_1\cdot\cos\omega_0 t\\ &= \alpha a\{\sin(\omega_a+\omega_0)t-\sin(\omega_0-\omega_a)t\}-\\ &\quad \alpha b\{\sin(\omega_b+\omega_0)t+\sin(\omega_b-\omega_0)t\}\\ &= \alpha a\{\sin(\omega_a+\omega_0)t-\sin\Delta\omega_a t\}+\\ &\quad \alpha b\{\sin(\omega_b+\omega_0)t+\sin\Delta\omega_b t\}\end{aligned}$$

$$\alpha a = Ea\cdot E_1/2$$
$$\alpha b = Eb\cdot E_1/2$$

Of the above formulas, the signal components of the angular frequencies $\Delta\omega_a$ and $\Delta\omega_b$ are desired intermediate frequencies and so these signals $S_{11}$ and $S_{21}$ are supplied to low-pass filters 12 and 22, respectively. The signal components of the angular frequencies $\Delta\omega_a$ and $\Delta\omega_b$ are taken out as first intermediate-frequency signals $S_{12}$ and $S_{22}$, respectively. Thus, we have

$$S_{12}=\alpha a\cdot\cos\Delta\omega_a t+\alpha b\cdot\cos\Delta\omega_b t$$

$$S_{22}=-\alpha a\cdot\sin\Delta\omega_a t+\alpha b\cdot\sin\Delta\omega_b t$$

In this case, as can be seen from FIG. 2A, the signals $S_{12}$ and $S_{22}$ are signals in the baseband.

These signals $S_{12}$ and $S_{22}$ are supplied to second mixer circuits 13 and 23, respectively, for I-axis and Q-axis, respectively, for orthogonal conversion. A comparatively low-frequency, second local oscillator signal $S_{15}$ is taken from a second local oscillator circuit 15. This signal $S_{15}$ is fed to the mixer circuit 13 and also to a phase-shift circuit 25, where the signal is shifted in phase by $\pi/2$. The phase-shifted signal is supplied as the second local oscillator signal to the mixer circuit 23. Accordingly, we have

$$S_{15}=E_2\cdot\sin\omega_s t$$

$$S_{25}=E_2\cdot\cos\omega_s t$$

where $E_2$, is the amplitude of the second local oscillator signals $S_{15}$ and $S_{25}$ and $\omega_s=2\pi f_s$. For example, $f_s$ is 55 kHz. Let $S_{13}$ and $S_{14}$ be the output signals from the mixer circuits 13 and 23, respectively. Thus,

$$\begin{aligned}S_{13} &= S_{12}\cdot S_{15}\\ &= (\alpha a\cdot\cos\Delta\omega_a t+\alpha b\cdot\cos\Delta\omega_b t)\times E_2\cdot\sin\omega_s t\\ &= \beta a\{\sin(\Delta\omega_a+\omega_s)t-\sin(\Delta\omega_a-\omega_s)t\}+\\ &\quad \beta b\{\sin(\Delta\omega_b+\omega_s)t-\sin(\Delta\omega_b-\omega_s)t\}\end{aligned}$$

$$\begin{aligned}S_{23} &= S_{22}\cdot S_{25}\\ &= (-\alpha a\cdot\sin\Delta\omega_a t+\alpha b\cdot\sin\Delta\omega_b t)\times E_2\cdot\cos\omega_s t\\ &= -\beta a\{\sin(\Delta\omega_a+\omega_s)t-\sin(\Delta\omega_a-\omega_s)t\}+\\ &\quad \beta b\{\sin(\Delta\omega_b+\omega_s)t-\sin(\Delta\omega_b-\omega_s)t\}\end{aligned}$$

$$\beta a = \alpha a\cdot E_2/2$$
$$\beta b = \alpha b\cdot E_2/2$$

By modifying these signals $S_{13}$ and $S_{23}$ in such a way that any frequency difference does not assume a negative value, we have

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$$S_{13} = \beta a \{\sin(\Delta\omega_a - \omega_s)t + \sin(\omega_s - \Delta\omega_a)t\} + \beta b \{\sin(\Delta\omega_b - \omega_s)t + \sin(\omega_s - \Delta\omega_b)t\}$$
$$= \beta a \cdot \sin(\omega_s + \Delta\omega_a)t - \beta a \cdot \sin(\omega_s - \Delta\omega_a)t\} - \beta b \cdot \sin(\omega_s - \Delta\omega_b)t - \beta b \cdot \sin(\omega_s - \Delta\omega_b)t\}$$

$$S_{23} = -\beta a \{\sin(\Delta\omega_a + \omega_s)t - \sin(\omega_s - \Delta\omega_a)t\} + \beta b \{\sin(\Delta\omega_b + \omega_s)t - \sin(\omega_s - \Delta\omega_b)t\}$$
$$= -\beta a \cdot \sin(\omega_s + \Delta\omega_a)t + \beta a \cdot \sin(\omega_s - \Delta\omega_a)t\} - \beta b \cdot \sin(\omega_s + \Delta\omega_b)t - \beta b \cdot \sin(\omega_s - \Delta\omega_b)t\}$$

These signals $S_{13}$ and $S_{23}$ are supplied to an adder circuit **3**, where they are summed up. The adder circuit **3** produces a sum signal given by

$$S_3 = S_{13} - S_{23}$$
$$= 2\beta a \cdot \sin(\omega_s - \Delta\omega_a)t + 2\beta b \cdot \sin(\omega_s + \Delta\omega_b)t$$

This sum signal $S_3$ is illustrated in FIG. 2B. This signal $S_3$ is obtained by converting the original signal Sr into a signal of the carrier frequency, or the angular frequency $\omega_s$. That is, the signal $S_3$ is a second intermediate-frequency signal of intermediate frequency $f_s$.

This second intermediate-frequency signal $S_3$ is supplied via an IF bandpass filter **4** and via a limiter amplifier **5** to an FM demodulator circuit **6**, where the original signal is demodulated. This audio signal appears at an output terminal **7**.

If the adder circuit **3** does not produce the sum of the signals $S_{13}$ and $S_{23}$ but performs a subtraction, then

$$Simg = S_{13} - S_{23}$$
$$= 2\beta a \cdot \sin(\omega_s - \Delta\omega_a)t + 2\beta b \cdot \sin(\omega_s + \Delta\omega_b)t$$

This signal Simg is a signal having a distribution that is an inversion of the frequency spectrum of the above-described original second intermediate-frequency signal $S_3$ in the frequency band occupied by this signal $S_3$, i.e., the signal Simg is an image interference signal.

In an ordinary FM receiver, this intermediate frequency is set to 10.7 MHz. Therefore, the intermediate-frequency filter is inevitably made of a ceramic filter. This makes it impossible to fabricate the circuit as an IC. In the above-described receiver, however, the first intermediate-frequency (IF) signals $S_{12}$ and $S_{22}$ are in the baseband. Consequently, the second IF frequency $f_s$ can be set to a low value, e.g., 55 kHz. Hence, each of the filters **12**, **22**, and **4** can consist of an active filter made up of resistors, capacitors, and an amplifier. Thus, the portions from the terminal **1** to the terminal **7**, including the filters **12**, **22**, and **4**, can be integrated into one monolithic IC chip.

The receiver of the construction described above cannot be put into practical use because it has two great problems. The first one arises because the second mixer circuits **13** and **23** do not operate ideally. In particular, some of the second local oscillator signals $S_{15}$ and $S_{25}$ leak to the adder circuit **3** through the mixer circuits **13** and **23**, thus causing trouble.

More specifically, each of the mixer circuits **13** and **23** is generally made of a double balanced switching circuit, or a balanced modulator circuit, as shown in FIG. **3**. The first IF signal $S_{12}$ or $S_{22}$ is supplied across the bases of lower transistors $Q_2$ and $Q_3$. The rectangular second local oscillator signal $S_{15}$ or $S_{25}$ is supplied across the bases of upper transistors $Q_4$ and $Q_5$ and across the bases of upper transistors $Q_6$ and $Q_7$. The signal $S_{12}$ produced from the collectors of the transistors $Q_2$ and $Q_3$ is chopped by the signal $S_{15}$. The second IF signal $S_{13}$ or $S_{23}$ is taken from the collectors of the transistors $Q_4$–$Q_7$.

In this case, if the characteristics of the transistors $Q_1$–$Q_7$ and their DC biases are completely balanced against each other, then only the desired second IF signal $S_{13}$ is produced from the transistors $Q_4$–$Q_7$. In practice, however, the characteristics of the transistors $Q_1$–$Q_7$ and their DC biases are not matched, in which case the second IF signal $S_{13}$ produced from the transistors $Q_4$–$Q_7$contains a carrier component, or a component of the second local oscillator signal $S_{15}$. That is, carrier leakage occurs.

Accordingly, it is common practice to adjust the bias voltage $V_{B3}$ applied to the base of the transistor $Q_3$ so as to minimize the carrier leakage, based on the voltage $V_{B2}$ applied to the base of the transistor $Q_2$, as shown in FIG. **3**.

In this method, each individual receiver is required to be adjusted. This deteriorates the productivity of receivers. If the ambient temperature around the receiver varies, the optimally adjusted point changes and so temperature compensation is needed. This compensation is not easy to perform.

One effective method of maintaining the accuracy of the balance between the characteristics of the transistors and between the DC biases is to fabricate components as an IC. However, if the mixer circuits **13** and **23** shown in FIG. **3** is fabricated as an IC, carrier can be suppressed to about 40–50 dB at best. If the carrier leakage is suppressed further, external adjustment is yet needed.

If the carrier signal leaks from the mixer circuits **13** and **23** in this way, the carrier frequency is $f_2$ and equal to the second intermediate frequency $f_2$ in the case of the receiver shown in FIG. **1**. Therefore, it is very difficult to separate the second IF signal $S_3$ from the leaking carrier component. As a result, if automatic gain control (AGC) is provided, the level of the received electric field is displayed, and tuning is indicated, then malfunctions will occur. Furthermore, the leaking carrier component beats with the second IF signal $S_3$, thus deteriorating the reception characteristics.

The second problem arises from the fact that the first IF signals $S_{12}$ and $S_{22}$ are in the baseband. That is, if the received signal Sr has a large level, then it cannot be treated. More specifically, in the receiver shown in FIG. **1**, in the signal intervals between the first mixer circuits **11**, **21** and the second mixer circuits **13**, **23**, respectively, the following relation holds:

$$\text{first intermediate frequency} \leq \text{frequencies of signal components}$$

Therefore, even where the received signal Sr is an FM signal, if the first IF signals $S_{12}$ and $S_{22}$ are clipped, information is lost during this interval. It follows that the signals $S_{12}$ and $S_{22}$ are sampled at a frequency lower than the frequencies of these signals. As a result, beating and distortions take place.

## SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to provide a double superheterodyne receiver which is free of the above-mentioned problems.

It is another object of the invention to provide a frequency spectrum-inverting circuit which is free of the above-mentioned problems.

It is a further object of the invention to provide a mixer circuit-correcting circuit which is free of the above-mentioned problems.

According to one aspect of the present invention, there is provided a double superheterodyne receiver comprising a



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pair of first mixer circuits, a pair of second mixer circuits, a demodulator circuit, and a pair of detector circuits. The first mixer circuits are connected in an orthogonal relation to each other, and convert a received RF signal into a pair of first IF signals in the baseband. The second mixer circuits are connected in an orthogonal relation to each other, and convert the first IF signals into a pair of second IF signals of a given center frequency. The demodulator circuit arithmetically combines the second IF signals so as to create a third IF signal and demodulates the original signal from the third IF signal. The output signals from the second mixer circuits are supplied to the detector circuits, which in turn detect a leaking carrier component contained in the output signals. The output signals from the detector circuits are fed to the second mixer circuits. The DC balance between the second mixer circuits is so corrected that the leaking carrier component is reduced.

According to another aspect of the present invention, there is provided a double superheterodyne receiver comprising a pair of first mixer circuits, a pair of second mixer circuits, a demodulator circuit, a pair of detector circuits, and a microprocessor. The first mixer circuits are connected in an orthogonal relation to each other, and convert a received RF signal into a pair of first IF signals in the baseband. The second mixer circuits are connected in an orthogonal relation to each other, and convert the first IF signals into second IF signals of a given center frequency. The demodulator circuit arithmetically combines the second IF signals so as to create a third IF signal and demodulates the original signal from the third IF signal. The output signals from the second mixer circuits are supplied to the detector circuits, which in turn detect a carrier component contained in the output signals. The DC balance between the second mixer circuits is so corrected that a leaking carrier component is reduced. Circuit components from the first mixer circuits to the demodulator circuit are formed by the microprocessor.

According to still another aspect of the present invention, there is provided a frequency spectrum-inverting circuit comprising a carrier signal-generating circuit, a balanced modulator circuit, and a detector circuit. The carrier signal-generating circuit produces a carrier signal. The balanced modulator circuit receives the carrier signal from the carrier signal-generating circuit and a modulating audio signal whose bandwidth is limited. The detector circuit receives the output signal from the balanced modulator circuit and detects the leaking carrier component contained in the output signal. The output signal from the detector circuit is supplied to the balanced modulator circuit. The DC balance in the balanced modulator circuit is so corrected that the leaking carrier component decreases.

According to yet another aspect of present invention, there is provided a mixer circuit-correcting circuit comprising a double balanced modulator circuit and a detector circuit. The double balanced modulator circuit receives a carrier signal, converts the frequency of the input signal into a second frequency, and delivers an output signal of this second frequency. The detector circuit receives the output signal from the double balanced modulator circuit and detects a leaking carrier component contained in the output signal. The output signal from the detector circuit is supplied to the double balanced modulator circuit. The DC balance in the balanced modulator circuit is so corrected that the leaking carrier component decreases.

In the present invention, leakage of the carrier signal from the mixer circuits is reduced greatly. Consequently, various troubles which would normally be caused by the carrier leakage can be prevented.

Other objects and features of the invention will appear in the course of the description thereof, which follows.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be more readily understood with reference to the accompanying drawings, wherein:

FIG. **1** is a block diagram of a conventional double superheterodyne receiver;

FIG. **2A** is a frequency spectrum of a signal received by the receiver shown in FIG. **1**;

FIG. **2B** is a frequency spectrum of an output signal from an adder included in the receiver shown in FIG. **1**;

FIG. **3** is a circuit diagram of mixer circuits included in the receiver shown in FIG. **1**;

FIG. **4** is a block diagram of a double superheterodyne receiver according to the present invention;

FIG. **5** is a circuit diagram of mixer circuits included in the receiver shown in FIG. **4**;

FIG. **6A** is a waveform diagram illustrating a DC voltage $V_{32}$ produced from one low-pass filter included in the receiver shown in FIG. **4**;

FIG. **6B** is a waveform diagram illustrating an electrical current $I_{33}$ produced from one amplifier included in the receiver shown in FIG. **4**;

FIGS. **7–9** are circuit diagrams of carrier leakage-reducing circuit portions included in the receiver shown in FIG. **4**; and

FIG. **10** is a block diagram of a frequency spectrum-inverting circuit according to the invention.

## DETAILED DESCRIPTION OF THE INVENTION

The structures of receivers according to the present invention are hereinafter described by referring to the accompanying drawings. It is to be noted that like components are indicated by like reference numerals in various figures and that those components which have been already described in connection with FIG. **1** will not described in detail below. Referring to FIG. **4**, there is shown a receiver embodying the concept of the present invention. This receiver has a reception portion for receiving a signal Sr. The reception portion starting with an input terminal **1** and ending with an output terminal **7** is similar to the reception portion of the receiver shown in FIG. **1**. Second mixer circuits **13** and **23** are each composed of a double balanced switching circuit consisting of transistors $Q_{11}$–$Q_{17}$ as shown in FIG. **5**, in the similar way as the mixer circuit shown in FIG. **3**. The transistors $Q_{12}$ and $Q_{13}$ to which first IF signal $S_{12}$ or $S_{22}$ is supplied receive equal base bias voltage $V_B$ via resistors $R_{11}$ and $R_{12}$, respectively.

In accordance with the present invention a synchronous detector circuit **31** is provided as a circuit for detecting a carrier component leaking from the mixer circuit **13**. The output signal $S_{13}$ from the mixer circuit **13** is supplied as a detected input signal to the synchronous detector circuit **31**. The second local oscillator signal $S_{15}$ from a local oscillator circuit **15** is fed as a reference signal to the synchronous detector circuit **31**. The output signal from the synchronous detector circuit **31** is supplied to a low-pass filter **32**.

The output voltage $V_{32}$ from the low-pass filter **32** is fed to a regulated-current circuit or an amplifier **33** having a large output resistance, so that the voltage $V_{32}$ is converted into an electrical current $I_{33}$. This current $I_{33}$ is furnished to



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the base of the transistor $Q_{13}$, for example, of the second mixer circuit **13** shown in FIG. **5**. It will be understood, however, that output voltage $V_{32}$ may also be used to control the DC balance in the second mixer circuit **13**.

Similarly, a synchronous detector circuit **41** is provided as a circuit for detecting a carrier component leaking from the mixer circuit **23**. The output signal $S_{23}$ from the mixer circuit **23** is supplied as a detected input signal to the synchronous detector circuit **41**. A phase-shifted signal $S_{25}$ from a phase-shift circuit **25** is supplied as a reference signal to the synchronous detector circuit **41**. The output signal from the synchronous detector circuit **41** is fed to a low-pass filter **42**, which in turn produces a given DC voltage. This DC voltage is fed to a regulated current circuit or to an amplifier **43** having a large output resistance, whereby the DC voltage is converted into an electrical current $I_{43}$. This current $I_{43}$ is supplied to the base of one transistor $Q_{13}$ of the second mixer circuit **23**.

The second IF signal $S_3$ from the adder circuit **3** is fed to a level detector circuit **51**, which in turn produces a delayed AGC voltage $V_{51}$. This delayed AGC voltage $V_{51}$ is supplied to an amplifier **2** via an amplifier **52** to control the gain of the amplifier **2**.

In this structure, if a carrier component leaks from the mixer circuit **13**, the synchronous detector circuit **31** detects the leaking carrier component synchronously with the second local oscillator signal $S_{15}$ of the same frequency as the leaking carrier component. As a result, the low-pass filter **32** produces the DC voltage $V_{32}$ whose level varies depending on the phase, i.e., on whether the leaking carrier component is in phase or 180°-out of phase, and in response to the magnitude, as shown in FIG. **6**A.

This DC voltage $V_{32}$ is converted into the electrical current $I_{33}$ changing as shown in FIG. **6**B by the amplifier **33**. This current $I_{33}$ is fed to the base of the transistor $Q_{13}$. Therefore, if the leaking carrier component is in phase, the current $I_{33}$ increases the base current of the transistor $Q_{13}$. Conversely, if the leaking carrier component is 180° -out of phase, the current $I_{33}$ reduces the base current for the transistor $Q_{13}$. At this time, the amount by which the base current increases or decreases corresponds to the magnitude of the current $I_{33}$. Accordingly, the DC balance between the transistors $Q_{12}$ and $Q_{13}$ is corrected by the current $I_{33}$ in the same way as the voltage $V_{B3}$ shown in FIG. **3**. This greatly reduces the carrier component leaking from the mixer circuit **13**.

Likewise, the output current $I_{43}$ from the amplifier **43** corrects the DC balance between the transistors $Q_{12}$ and $Q_{13}$ of the mixer circuit **23**. In consequence, the carrier component leaking from the mixer circuit **23** is reduced greatly.

In this case, the circuit for reducing the leaking carrier component forms a negative loop. Let $G_{NF}$ be the gain of this loop. The amplitude of the leaking carrier component is reduced by a factor of $G_{NF}$ compared with the amplitude of the leaking carrier component produced where no negative loop is formed as shown in FIG. **1**. For example, let the loop gain $G_{NF}$ be 100. The magnitude of the leaking carrier component is reduced by a factor of 100. Thus, an improvement of 40 dB is accomplished.

The first problem, i.e., generation of a carrier component leaking from the mixer circuits **13** and **23**, is reduced greatly. As a result, various troubles which would normally arise from the carrier leakage can be prevented. Where AGC is provided, the level of the received electric field is displayed, and tuning is indicated, these functions can be performed correctly. Furthermore, the leaking carrier component does not beat with the second IF signal $S_3$; thus preventing the deterioration of the reception characteristics.

The first IF signals $S_{12}$ and $S_{22}$ have the above-described relations with the second IF signal $S_3$ and so the level of the signal $S_3$ corresponds to the levels of the signals $S_{12}$ and $S_{22}$. Since the leakage of the carrier component from the mixer circuits **13** and **23** can be neglected as mentioned previously, the AGC using the AGC voltage $V_{51}$ can be properly performed.

Accordingly, the level of the received signal Sr is controlled under the AGC so that the level of the second IF signal $S_3$ is kept constant. The levels of the first IF signals $S_{12}$ and $S_{22}$ are also maintained constant. As a result, even if the level of the received signal Sr applied to the input terminal **1** is large, the first IF signals $S_{12}$ and $S_{22}$ are not clipped. Hence, neither beating nor distortions are produced. In this way, the second-mentioned problem can be solved. The signal Sr which is received at a high level can be received with good characteristics.

FIGS. **7**–**9** show an example of an IC forming the aforementioned circuit for reducing the leaking carrier component. This example is divided into several parts in these figures. Some parts are shown in both FIGS. **7** and **9**.

A first IF signal $S_{12}$ and a DC bias voltage $V_B$ are supplied from a terminal $T_{11}$ to the base of the transistor $Q_{12}$ of the second mixer circuit **13** through a resistor $R_{11}$. The terminal $T_{11}$ is connected with the base of the transistor $Q_{13}$ via a resistor $R_{12}$. An external capacitor $C_{11}$ is connected between this base of the transistor $Q_{13}$ and ground via a terminal $T_{12}$. This capacitor $C_{11}$ forms a bypass line from the base of the transistor $Q_{13}$ in terms of AC signals as viewed from the first IF signal $S_{12}$. Furthermore, the capacitor $C_{11}$ forms a part of the low-pass filter **32**.

A balanced second local oscillator signal $S_{15}$ is supplied between the bases of the transistors $Q_{14}$ and $Q_{17}$ and the bases of the transistors $Q_{15}$ and $Q_{16}$ through transistors $Q_{21}$ and $Q_{22}$ of an emitter follower from the terminals $T_{13}$ and $T_{14}$. A balanced second IF signal $S_{13}$ is taken from between the collectors of transistors $Q_{14}$ and $Q_{16}$ and the collectors of the transistors $Q_{15}$ and $Q_{17}$.

This signal $S_{13}$ is supplied to transistors $Q_{27}$ and $Q_{28}$ of a current mirror circuit **61** via the emitter-grounded transistors $Q_{25}$ and $Q_{26}$ and via the transistors $Q_{23}$ and $Q_{24}$ of the emitter follower. In this way, the signal $S_{13}$ is converted into an unbalanced signal $S_{13}$. The second IF signal $S_{23}$ is processed similarly and converted into an unbalanced signal $S_{23}$ by a current mirror circuit **62**.

The output terminals of the current mirror circuits **61** and **62** are tied together to form the adder circuit **3** and to produce the second IF signal $S_3$. This signal $S_3$ is supplied to the following stage (not shown) via a buffer amplifier **63**.

Transistors $Q_{31}$–$Q_{37}$ together form the double balanced synchronous detector circuit **31**. The output signal $S_{13}$, or the second IF signal, from the second mixer circuit **13** is supplied to the bases of the transistors $Q_{33}$ and $Q_{32}$ via the transistors $Q_{23}$ and $Q_{24}$. The second local oscillator signal $S_{15}$ is fed between the bases of the transistors $Q_{34}$ and $Q_{37}$ and the bases of the transistors $Q_{35}$ and $Q_{36}$ from the terminals $T_{13}$ and $T_{14}$. In this manner, a balanced synchronously detected signal $S_{31}$ is taken from the collectors of the transistors $Q_{34}$ and $Q_{36}$ and from the collectors of the transistors $Q_{35}$ and $Q_{37}$.

This synchronously detected signal $S_{31}$ is supplied to the bases of transistors $Q_{41}$ and $Q_{42}$ which together form a differential amplifier **64**. Transistors $Q_{43}$ and $Q_{44}$ which together form a current mirror circuit **65** are connected to the



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collector of the amplifier **64**. The differential amplifier **64** and the current mirror circuit **65** together form the amplifier **33**. In the amplifier **33**, the following relation holds:

$$I_{33}=I_{42}-I_{44}$$

where $I_{42}$ and $I_{44}$ are the collector currents for the transistors $Q_{42}$ and $Q_{44}$, respectively.

The output terminal of the amplifier **33** is connected to the base of the transistor $Q_{13}$. In this case, the output impedance of the amplifier **33** and a capacitor $C_1$ together form the low-pass filter **32**.

Therefore, if the carrier component does not leak from the second mixer circuit **13**, then $S_{31}=0$. Thus,

$$I_{42}=I_{44}$$

This leads to

$$I_{33}=0$$

That is, if no carrier component leaks from the second mixer circuit **13**, an equal base current is supplied to the transistors $Q_{12}$ and $Q_{13}$.

However, if carrier leakage from the second mixer circuit **13** takes place, either the relationship $S_{31}>0$ or the relationship $S_{31}<0$ holds. Hence,

$$I_{42}>I_{44} \text{ or } I_{42}<I_{44}$$

Thus, we have

$$I_{33}>0 \text{ or } I_{33}<0$$

At this time, the magnitude, or the absolute value, of the current $I_{33}$ corresponds to the magnitude of the leaking carrier component.

Accordingly, if carrier leakage from the second mixer circuit **13** occurs, the base current for the transistor $Q_{12}$ does not vary but the base current for the transistor $Q_{13}$ increases or decreases, depending on the phase of the leaking carrier component. The amount of the increase or decrease corresponds to the magnitude of the leaking carrier component. That is, the DC balance in the second mixer circuit **13** is corrected by the current $I_{33}$ and, therefore, the generated carrier leakage is reduced greatly. Carrier leakage from the second mixer circuit **23** is similarly reduced greatly in a manner not illustrated.

In the foregoing case, carrier leakage from the second mixer circuits **13** and **23** of the receiver of a cordless telephone set is reduced. In cordless telephones, in order to prevent eavesdropping, the frequency spectrum of the transmitted and received audio signal is inverted. The above-described technique for reducing carrier leakage is also suited for inversion of the frequency spectrum of the audio signal.

FIG. **10** shows an example in which the frequency spectrum is inverted. An audio signal $S_{71}$ is supplied from a terminal **71** to a bandpass filter **72**, which in turn produces a signal $S_{72}$ of frequency components of 300 Hz to 3 kHz, for example. This signal $S_{72}$ is supplied as a modulating input signal to a balanced modulator circuit **73**. A carrier signal generator circuit **74** produces a carrier signal $S_{74}$ of a frequency of 3.5 kHz, for example, and is fed to the modulator circuit **73**. Thus, the modulator circuit **73** produces a DSB signal $S_{73}$ balance-modulated by the signal $S_{72}$.

This signal $S_{73}$ is fed to a low-pass filter **75**, so that of the signal $S_{73}$, the lower sideband signal, i.e., signal $S_{75}$ obtained by inverting the frequency spectrum of the signal $S_{72}$, is taken from a terminal **76**.

In this case, if the balanced modulator circuit **73** is an ideal circuit, then the carrier signal $S_{74}$ does not leak into the output signal $S_{73}$ from the modulator circuit **73**. In practice, however, the carrier signal $S_{74}$ leaks because of imbalance between devices and imbalance between DC biases. That is, the output signal $S_{73}$ contains a leaking carrier component. In order to remove this leaking carrier component, the cutoff characteristic curve of the low-pass filter **75** must be steep. In consequence, the low-pass filter **75** is required to have very high orders.

The signal $S_{73}$ from the balanced modulator circuit **73** is supplied as a detected input signal to a synchronous detector circuit **81**. The carrier signal $S_{74}$ is supplied as a reference signal to the detector circuit **81**. The signal $S_{73}$ is detected in synchronism with the signal $S_{74}$. The output signal $S_{81}$ from the synchronous detector circuit **81** is fed to a low-pass filter **82**, so that the signal $S_{81}$ is converted into a DC voltage corresponding to the phase and the amplitude of the leaking carrier component. This voltage $V_{82}$ is supplied to an amplifier **83**, where the input voltage $V_{82}$ is converted into a DC current $I_{33}$. Then, this DC current $I_{33}$ is fed back to the balanced modulator circuit **73** as a signal for controlling the DC balance.

Therefore, the output signal $S_{73}$ from the balanced modulator circuit **73** ceases to contain the leaking carrier component. This makes it unnecessary that the cutoff characteristic curve of the low-pass filter **75** be very steep. Consequently, it is only necessary that the filter **75** have low orders. This permits miniaturization of the telephone set. Furthermore, the cost can be curtailed.

In the examples described in connection with FIGS. **7–9**, the output signal $S_{31}$ from the synchronous detector circuit **31** is supplied to the amplifier **33** having the differential amplifier **64** and the current mirror circuit **65** to create the electrical current $I_{33}$. Alternatively, a current mirror circuit may be connected as a load to the synchronous detector circuit **31** to obtain the current $I_{33}$.

In the above-described example, the voltage $V_{32}$ is converted into the current $I_{33}$, which is in turn used to control the DC balance in the second mixer circuit **13**. It is also possible to control the balance according to the voltage $V_{32}$.

It is to be understood that the present invention is not limited to the foregoing structures and that various changes and modifications are possible within the scope of the invention which is delineated by the following claims.

What is claimed is:

**1**. A double superheterodyne receiver comprising:

a pair of first mixer circuits connected in an orthogonal relation to each other and acting to convert a received RF signal into first intermediate-frequency signals in a baseband;

a pair of second mixer circuits connected in an orthogonal relation to each other and acting to convert said first intermediate-frequency signals into second intermediate-frequency signals of a desired center frequency;

a demodulator circuit for arithmetically combining said second intermediate-frequency signals so as to create a third intermediate-frequency signal and for a demodulating an original signal from said third intermediate-frequency signal; and,

a pair of detector circuits receiving output signals from said pair of second mixer circuits and acting to detect a leaking carrier component contained in said output signals from said pair of second mixer circuits, said detector circuits producing output signals having the same phase as said leaking carrier component, wherein said output signals from said detector circuits are



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provided to said pair of second mixer circuits to correct DC balance between said pair of second mixer circuits so that said leaking carrier component is reduced.

2. The double superheterodyne receiver of claim 1, wherein each of said detector circuits includes a synchronous detector circuit, said output signals from said pair of said second mixer circuits being fed as detected input signals to said synchronous detector circuits, and wherein a local oscillator signal supplied to said second mixer circuits is supplied as a reference signal to said synchronous detector circuits.

3. The double superheterodyne receiver of claim 1, further comprising a level control portion for detecting a level of said third intermediate-frequency signal and for controlling a level of said received RF signal according to the detected level.

4. The double superheterodyne receiver of claim 1, further comprising filters for passing said first and second intermediate frequency signals.

5. A double superheterodyne receiver comprising:

a pair of first mixer circuits connected in an orthogonal relation to each other and acting to convert a received RF signal into a pair of first intermediate-frequency signals in a baseband;

a pair of second mixer circuits connected in an orthogonal relation to each other and acting to convert said first intermediate-frequency signals into second intermediate-frequency signals of a desired center frequency;

a demodulator circuit for arithmetically combining said second intermediate-frequency signals so as to create a third intermediate-frequency signal and for demodulating an original signal from said third intermediate-frequency signal, wherein at least said first mixer circuits and said demodulator circuit are formed on an integrated circuit; and,

a pair of detector circuits receiving output signals from said second mixer circuits and acting to detect a leaking carrier component contained in said output signals from said second mixer circuits, said detector circuits producing output signals having the same phase as said leaking carrier component, wherein said output signals from said detector circuits are provided to said second mixer circuits to correct DC balance between said second mixer circuits in such a way that said leaking carrier component is reduced.

6. The double superheterodyne receiver of claim 5, further comprising a level control portion for detecting a level of said third intermediate-frequency signal and for controlling a level of said received RF signal according to the detected level.

7. The double superheterodyne receiver of claim 5, further comprising filters for passing said first and second intermediate-frequency signals, and wherein each of said filters consists of an active filter.

8. A circuit for inverting a frequency spectrum, comprising:

a carrier signal-generating circuit for producing a carrier signal;

a balanced modulator circuit receiving said carrier signal from said carrier signal-generating circuit and an audio signal as a modulating input signal, said audio signal having a limited bandwidth; and,

a detector circuit receiving an output signal from said balanced modulator circuit and acting to detect a leaking carrier component contained in said output signal from said balanced modulator circuit, said detector circuit producing an output signal having the same phase as said leaking carrier component, wherein said output signal from said detector circuit is provided to said balanced modulator circuit to correct DC balance in said balanced modulator circuit in such a way that said leaking carrier component decreases.

9. A circuit for inverting a frequency spectrum as set forth in claim 8, wherein said detector circuit comprises a synchronous detector circuit receiving said output signal from said balanced modulator circuit, and wherein said carrier signal from said carrier signal-generating circuit is supplied as a reference signal to said synchronous detector circuit.

10. A circuit for inverting a frequency spectrum as set forth in claim 9, wherein said detector circuit further comprises a low-pass filter for receiving an output signal from said synchronous detector circuit.

11. A circuit for inverting a frequency spectrum as set forth in claim 10, wherein said output signal from said synchronous detector circuit is supplied to said balanced modulator circuit via said low-pass filter.

12. A correcting circuit for a mixer circuit, comprising:

a double balanced modulator circuit receiving a carrier signal and acting to convert a frequency of an input signal into a second frequency and to produce a first output signal of said second frequency; and,

a detector circuit receiving said output signal from said double balanced modulator circuit and acting to detect a leaking carrier component contained in said output signal, said detector circuit producing an output signal having the same phase as said leaking carrier component, wherein said output signal from said detector circuit is provided to said double balanced modulator circuit to correct DC balance in said double balanced modulator circuit in such a way that said leaking carrier component decreases.

13. A correcting circuit for a mixer circuit as set forth in claim 12, further comprising a carrier signal-generating circuit, wherein said detector circuit is equipped with a synchronous detector circuit receiving said output signal from said double balanced modulator circuit, and wherein said carrier signal from said carrier signal-generating circuit is supplied as a reference signal to said synchronous detector circuit.

14. A correcting circuit for a mixer circuit as set forth in claim 13, wherein said detector circuit is equipped with a low-pass filter receiving an output signal from said synchronous detector circuit, and wherein said output signal from said synchronous detector circuit is supplied to said double balanced modulator circuit via said low-pass filter.

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(71) Applicant : PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, N-5621 BA Eindhoven (NL).

(71) Applicant *(for SE ONLY)* : PHILIPS NORDEN AB (SE/SE); Kottbygatan 7, Kista S-164 85 Stockholm (SE).

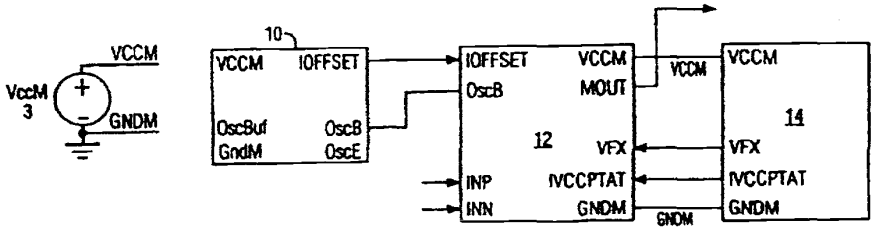
(72) Inventors: NAVID, Nasrollah, Saeed, Navid; 13692 Quito Road, Saratoga, CA 95070 (US). FOTOWAT-AHMADY, Ali; 1014 West Olvie #1, Sunnyvale, CA 94086 (US). BEHBAJANI, Farbod, Behbahani; 141 West Fairview Boulevard, Inglewood, CA 90302 (US).

(74) Agent: VEERMAN, Jan, W.; Internationaal Octrooibureau B.V., P.O. Box 220, NL-5600 AE Eindhoven (NL).

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(54) Title: A LOW VOLTAGE TEMPERATURE AND VCC COMPENSATED RADIO FREQUENCY MIXER




(57) Abstract

A radio frequency mixer (12) utilizing frequency and bias compensation for improved performance characteristics. The radio frequency mixer (12) receives bias signals that are dependent on the power supply voltage (VCCM) levels to internally balance the local oscillation (10) received and mix the perfectly bias balanced internally generated oscillation signal with the radio frequency input.

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(71) Applicants: PHILIPS ELECTRONICS N.V. [NL/NL]; Groenewoudseweg 1, N-5621 BA Eindhoven (NL). PHILIPS NORDEN AB [SE/SE]; Kottbygatan 7, Kista, S-164 85 Stockholm (SE).

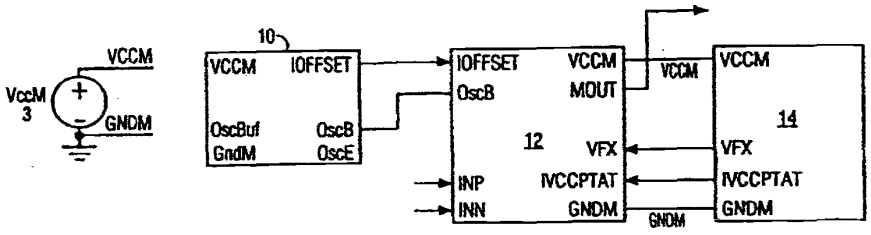
(72) Inventors: NAVID, Nasrollah, Saeed, Navid; 13692 Quito Road, Saratoga, CA 95070 (US). FOTOWAT-AHMADY, Ali; 1014 West Olvie #1, Sunnyvale, CA 94086 (US). BEHBAJANI, Farbod, Behbahani; 141 West Fairview Boulevard, Inglewood, CA 90302 (US).

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A low voltage temperature and VCC compensated radio frequency mixer.

Background of the invention

Field of the invention

The present invention relates to radio frequency mixers. More particularly, it relates to a more linearized radio frequency mixer utilizing frequency and bias compensation for improved performance.

The prior art

Presently, a standard Gilbert cell is used for mixer designs in radio frequency circuits. A Gilbert cell generally consists of a single or double differential pair of transistors in the lower tree of the mixer. Such mixer is shown in the United States Patent No. 4,344,188. Under low voltage conditions, second order effects such as the intermediate frequency output riding on the large local oscillator feed-through, will cause clipping of the intermediate frequency signal and result in intermodulation products. In addition, small base-emitter voltages changes caused by temperature or second order bias dependencies will cause current and gain variations that limit the performance of the circuit. It is therefore desirable to have a radio frequency mixer that operates independent of temperature changes and variations in the power supply voltage level.

Summary of the invention

The present invention provides a radio frequency mixer that uses frequency and bias compensation to improve performance.

According to the invention, an oscillator circuit provides the required local oscillator signal and an offset current signal to the mixer circuit. A bias network circuit generates a bias voltage signal and a bias current signal which are fed into the mixer circuit. The offset current signal and the bias current signal balance the internally generated local oscillator signal applied to the upper tree of the mixer. The bias current signal is dependent on power supply voltage values and thereby compensated the mixer for changes in the power



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supply voltage level. The bias voltage signal biases the lower tree of the mixer circuit to prevent any changes in the temperature and power supply voltage levels from effecting the mixing of the local oscillator and radio frequency inputs.

It is therefore an object of the present invention to provide a radio frequency mixer that compensates for changes in temperature and power supply voltage levels.

It is another object of the invention to provide a radio frequency mixer that utilizes bias signals dependent on the power supply voltage levels to optimize the signal swing headroom at all temperature and power supply voltage conditions.

It is yet another object of the invention to provide a radio frequency mixer that uses an offset current signal to internally generate a perfectly balanced local oscillator differential pair to the external local oscillator signal for mixing with the radio frequency input.

Another object of the invention is to provide a radio frequency mixer that overcomes the shortfalls of the prior art.

It is a further object of the invention to provide a radio frequency mixer that operates efficiently and reliably.

Brief description of the drawings

Other objects and features of the present invention will become apparent from the following detailed description considered in connection with the accompanying drawings which disclose an embodiment of the present invention. It should be understood, however, that the drawings are designed for the purpose of illustration only and not as a definition of the limits of the invention.

In the drawings, wherein similar reference characters denote similar elements throughout the several views:

Figure 1 is a block diagram of the circuit according to the invention;

Figure 2 is a schematic diagram of the oscillator/buffer of Figure 1 according to the invention;

Figure 3 is a schematic diagram of the mixer circuit of Figure 1 according to the invention; and

Figure 4 is a partial schematic diagram of the biasing circuit of Figure 1 according to the invention.



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Detailed description of preferred embodiments

Turning now in detail to the drawings, Figure 1 is a block diagram of the radio frequency mixer showing the interconnections of the oscillator 10, mixer 12 and bias network 14 according to the invention. The voltage VCCM is the power supply for all blocks, and the GndM is the ground for all blocks.

Mixer 12 has a positive input INP and a negative input INN for receiving a radio frequency input signal. Oscillator 10 generates the requisite local oscillator signal OscB needed for the mixer, and also provides an offset current signal IOFFSET to aid in the balancing of the mixer operation.

Figure 2 is a schematic circuit diagram of oscillator 10 according to the invention. A transistor Q01 performs the oscillator function. A resonating element can be connected to the base OscB of transistor Q01, and to the emitter OscE of transistor Q01. By connecting a resonator in various well-known conditions (e.g., Colpitts, Butler, etc.) transistor Q01 will sustain an oscillation and thereby serves as an "on chip" oscillator. The frequency of the oscillation is dependent upon the resonator element used.

Transistor Q05 is a 10x device and provides the biasing of transistor Q01. A 10x device indicates that there are actually ten transistors connected in parallel so that all of the bases, collectors and emitters respectively are connected to each other.

Transistor Q02 is connected in parallel with Q01 and serves as an on chip oscillator buffer. As result of this parallel connection, transistor Q02 will have the same signal at its base and emitter as that of transistor Q01. The oscillation signal OscBuf is taken from the emitter of transistor Q02. The signal OscBuf is taken from transistor Q02 and not from transistor Q01 because taking the output from the emitter of transistor Q01 would impact and alter the characteristics of the external resonator element, also connected to the emitter of transistor Q01. The object is to keep transistor Q01 undisturbed from any loading that results when you take the old transistor Q02 by taking the signal from its emitter to drive another circuit, that load will not effect the operation of transistor Q01. Transistor Q06 is a 10x device and provides the biasing of Q02.

Diode D01 acts as a protection device to transistor Q01. Diode D02 is also a protection device for transistor Q02. These protection devices D01, D02 prevent the accidental overload of the emitter of transistor Q01, or the connection OscE with a high voltage signal. In this instance, diode D01 will prevent the emitter voltage from exceeding the base voltage of transistor Q01. Thus, since diode D01 is arranged in opposite polarity


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with transistor Q01, if the emitter voltage is brought higher than the base, diode D01 will clamp the base-emitter junction of transistor Q01. Diode D02 will operate the same as diode D01.

Transistor Q03 and transistor Q04 are biasing devices where the collector of transistor Q03 and the base of transistor Q04 are connected to a reference current source PTATIR4. The collector current of Q04 is designated as the signal IOFFSET which will be discussed further with the mixer.

Figure 3 is a schematic diagram of the complete mixer circuit. The core of the mixer is composed of a lower tree 22 and an upper tree 24. Lower tree 22 includes a triple differential amplifier made up of transistors QM1, QM2, QM11, QM12, QM3 and QM4. The use of a triple differential amplifier improves linearity and third order intermodulation products. The resistors XREE1, XREE2 and XREE6 provide the requisite biasing of the lower tree transistors. The upper tree 24 is made up of transistors QM5, QM6, QM7 and QM8.

Any offset or unbalanced situation will cause leakage from the local oscillator into the output of the mixer. Thus, in order for the mixer to operate most efficiently, it is desirable to balance the upper tree of the mixer as equally as possible.

The oscillator 10 provides the signal OscB to the mixer at the input OscB. Transistor QM21 is the buffer transistor of the mixer and receives the signal from the local oscillator at its base. Transistor QM21 is biased at its emitter by transistor QM33 and at its base by transistor QM30. Capacitor CM10 and resistor XRM14A are filter components for increasing the signal level at high frequencies from the incoming signal OscB.

A replicating stage 20 performs the same as buffer transistor QM21, except that it does not have the oscillating signal at its input transistor QM20. Replicating stage 20 provides a bias voltage to the base of transistors QM8 and QM6 in the upper tree 24 equal to the voltage signals received by transistor QM5 and transistor QM7 through transistor QM21. Thus, transistor QM20 and resistor XRM32 is replicating the oscillator/buffer circuit on the other side of the mixer formed by transistor QM21 and resistor XRM31 to achieve an internally balanced local oscillator bias signal. This balances the mixer's upper tree at both sides and is required for a double balanced mixer.

Mixer 12 is a four terminal device having two inputs INP and INN for receiving the positive and negative radio frequency inputs and two local oscillator inputs which are generated internally by transistor QM21 on one side and by transistor QM20 of the



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replicating stage 22 on the other. Replicating stage 20 is primarily for balancing the local oscillator signal bias within mixer 12.

Transistors QM44 and QM45 and resistors XRM54, XRM55 are bias generators which generate all the bias currents going to the different transistors of the circuit. A reference current PTATIRS is used for the bias generators. PTAT stands for proportional to absolute temperature, and IR stands for implant resistor. Thus, this is a PTAT current source which is generated using an implant resistor. In order to make the circuit perform independently of temperature, the same kind of resistors must be used throughout the circuit, so that when you are determining the ratios, their temperature coefficients cancel each other. The circuitry for generating PTAT current sources is considered prior art and is not shown for brevity. A bias current IVCCPTAT is generated by the bias network 14. The bias current IVCCPTAT is a PTAT current source that is dependent on the power supply voltage VCCM. The input source VFX is a direct current reference source or bias voltage generated by the bias network 14. Mixer 12 has an output MOUT2.

Referring to Figures 2 and 3 together, the base currents for transistors Q05, Q06 and Q03 (with Q05 and Q06 being 10x devices) are all provided through transistor Q04. Thus, the current IOFFSET is actually equal to the sum of the base currents of transistors Q03, Q05 and Q06. The current IOFFSET is then fed into the mixer circuit at the base of transistor QM20 in replicating stage 20. The addition of the current IOFFSET to the replicating stage 20 compensates for different base currents that transistor QM21 is seeing. Transistor QM21 is connected to the terminal OscB of the oscillator 10. The terminal OscB of the oscillator 10 is connected to the bases of transistors Q01 and Q02, so the currents of transistors Q01 and Q02 actually affect the bias of transistor QM21. Since terminal OscB is connected to the base of transistors Q01 and Q02 which are connected to the base of transistor QM21, all of the base currents for these three transistors Q01, Q02, QM21 are provided via resistor XRM31 from the power supply voltage VCCM.

If there is no current IOFFSET fed into the replicating stage 20, then the current through resistor XRM32 is only the base current of transistor QM20, which is less than the base current of transistor QM21. In order for the base voltage of transistor QM20 and QM21 to be exactly the same, the same amount of current must be flowing through resistors XRM32 and XRM31.

The current IOFFSET is generated by taking the collector current of transistor Q04 and adding it to the base of transistor QM20 so that now the current which is going



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through resistor XRM32 is also the same as the current going through resistor XRM31, and therefore we have the same base voltage for transistors QM20 and QM21, and therefore the same base voltage for transistors QM8 and QM5, respectively. The upper tree 24 of the mixer is now perfectly balanced and remains this way over temperature and power supply voltage VCCM variations. In other words, the current IOFFSET generated as the collector current of transistor Q04, tracks the base current of transistors Q01, Q02 and QM21 to guarantee symmetric operation or a perfectly balanced local oscillation signal.

Capacitor C01 of oscillator 10 is a filter capacitor to filter out any noise which might be coming in on the base of the transistors Q05 and Q06. The emitters of transistors Q01 and Q02 are the output terminals OscE, OscBuf or access points of this oscillator. The large junction capacitance of transistors Q05 and Q06 (10x devices), will cause the large oscillator signals at output terminals OscE and OscBuf to couple and come to the base of transistors Q05 and Q06. By inserting capacitor C01, we filter out or eliminate that potential problem. Capacitor C01 acts like a low pass filter in this instance.

With limiting voltage headroom under lower power supply voltage VCCM conditions, second order effects like clipping of the small intermediate frequency output riding on the large local oscillator feed-through, will reduce the mixer gain as well as produce unwanted spurious products. The use of capacitor CC1 on the output MOUT2 reduces the leaked local oscillator and radio frequency levels in the output, thereby preventing signal clipping. Another second order effect is the local oscillator leakage from the emitter of transistor QM5 to the base of transistor QM1. This leaked signal behaves like a radio frequency signal and re-enters the mixer. This in effect, is like the local oscillator signal mixing with itself which results in a negative direct current shift on the collector of transistor QM5. The collector of transistor QM5 is tied to the power supply voltage VCCM and the intermediate frequency signal is picked from the collector of transistor QM7, thereby preventing premature limiting.

Figure 4 is a simplified example of the biasing circuit 14 according to the invention. The biasing circuit 14 generates the bias signals VFX and IVCCPTAT for the mixer circuit. To generate these signals VFX, IVCCPTAT, a standard on-chip generated band gap voltage BG1 is applied to the circuit. The band gap voltage does not change with the temperature and is fixed for silicon at 1.23 volts to the first order.

The signal VFX is generated on the left hand side of the circuit. The signal VFX is generated from the band gap voltage BG1, but has a different absolute value which is



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more appropriate for the mixer. Band gap voltage BG1 is applied to the base of transistor QV3. Transistors QV1, QV3, QV28, QV13 and QV4 and resistors XRV11 and XRV10 and the biasing transistor QV32 together form a non-inverting operational amplifier with a gain ratio of the resistors XRV10 and XRV11. The voltage signal VFX is then proportional to the band gap voltage BG1 with a resistor ratio of the resistors XRV10 and XRV11. The reference current source PTAT CUR 3 is used to bias transistor QV32.

The bias signal IVCCPTAT is generated on the right hand of the circuit. The signal IVCCPTAT is also generated from the same band gap voltage BG1 going over transistors QB9 and QB10. The current IVCCPTAT is generated by the voltage difference converted over resistor XRB7. The signal IVCCPTAT is dependent on the power supply voltage VCC because as the power supply voltage VCC changes, the voltage at the base of transistor QB9 changes. In addition, the resistor ratio of resistors XRB6 and XRB7 changes as the power supply voltage VCC changes. This difference is then translated over resistor XRB7 and turned into the desired bias signal IVCCPTAT. The remaining current sources PTAT CUR1 and PTAT CUR2 are just reference current sources for the circuit.

The voltage on resistor XRM31 in Figure 3 is used to control the voltage on the emitter of transistor QM5 for optimized signal swing headroom at all power supply voltage VCC and temperature conditions. The bias current IVCCPTAT has a power supply voltage VCC dependent value for this purpose. The use of the bias voltage VFX on the lower tree 22 of the mixer, which is also weakly dependent on the power supply voltage VCC results in optimized headroom, linearity and gain in all power supply voltage VCC levels.

While one embodiment of the present invention has been shown and described, it is to be understood that many changes and modifications may be made hereunto without departing from the spirit and scope of the invention as defined in the appended claims.


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CLAIMS

1. A mixer characterized in that it comprises:

an oscillator circuit (10) for externally producing a local oscillator signal (OscB) and an offset current signal (IOFFSET);

a bias network (14) for producing a bias voltage signal (VFX) and a bias current signal (IVCCPTAT); and

a mixer circuit (12) connected to said oscillator circuit (10) and said bias network (14), said mixer circuit (12) having inputs (INP, INN) for receiving an input signal and said local oscillator (10), offset currents (IOFFSET), bias voltage and bias current signals, and producing at its output (MOUT) an intermediate frequency signal representative of the input signals.

2. The mixer (12) according to Claim 1, wherein said mixer circuit (12) further comprises:

internal oscillating means (10) for receiving the local oscillator signal and generating an internal local oscillator signal;

a replicating stage (20) for receiving the offset current signal (IOFFSET) and balancing the internally generated local oscillator bias signal within the mixer (12), said internal oscillating means (10) and said replicating stage (20) receiving the bias current signal;

an upper tree circuit (24) for receiving the internally balanced local oscillator signal; and

a lower tree circuit (22) for receiving the input and said bias voltage signal, said upper tree circuit (24) and said lower tree circuit (22) being connected to mix the input and the internally balanced local oscillator signal to produce said intermediate frequency output (MOUT2).

3. The mixer (12) according to Claim 2, wherein said lower tree circuit (22) of said mixer (12) comprises a triple differential amplifier (QM1, QM2, QM11, QM12, QM3, QM4).

4. The mixer (12) according to Claim 2, wherein said upper tree circuit (24)



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comprises a first and second pair of transistor (QM5, QM6, QM7, QM8).

5. The mixer (12) according to Claim 2, wherein said internal oscillating means (10) comprises an oscillating transistor Q01.

6. The mixer (12) according to Claim 2, wherein said replicating stage (20) comprises a transistor (QM20) and a resistor (XRM32) connected to the base of said transistor (QM20) at one end, and to a power supply terminal (VCCM) at the opposite end.

7. The mixer (12) according to Claim 6, wherein replicating stage (20) generates identical bias signals to the bias signals generated at said internal oscillating means (10) in response to said offset signal (IOFFSET).

8. The mixer (12) according to Claim 2, wherein said bias current signal is dependent on the value of the power supply voltage (VCCM) and biases said internal oscillating means (10) and said replicating stage (20) to provide optimized signal swing headroom at all power supply voltage (VCCM) and temperature levels.

9. The mixer (12) according to Claim 2, wherein said bias voltage signal biases said lower tree circuit (22) of said mixer (12) to optimize headroom, linearity and gain in all power supply voltage levels (VCCM).



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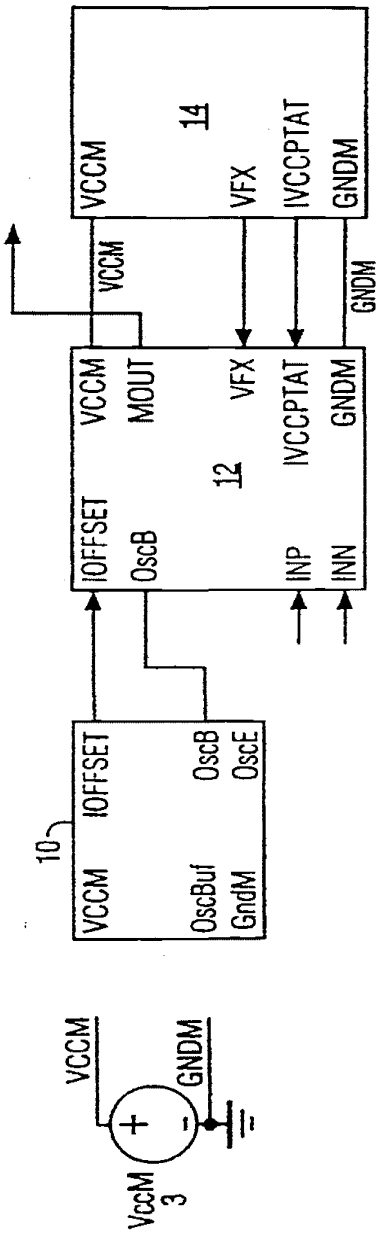



FIG. 1



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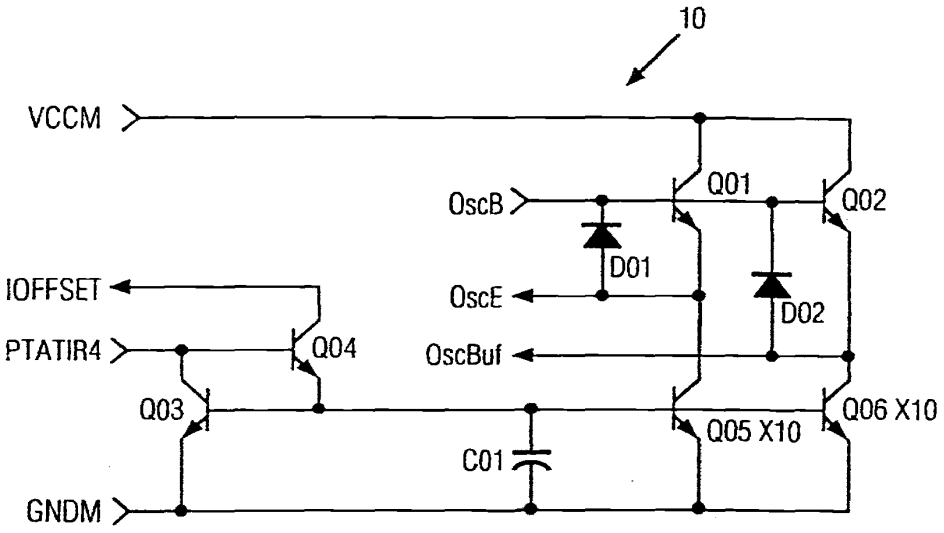



FIG. 2



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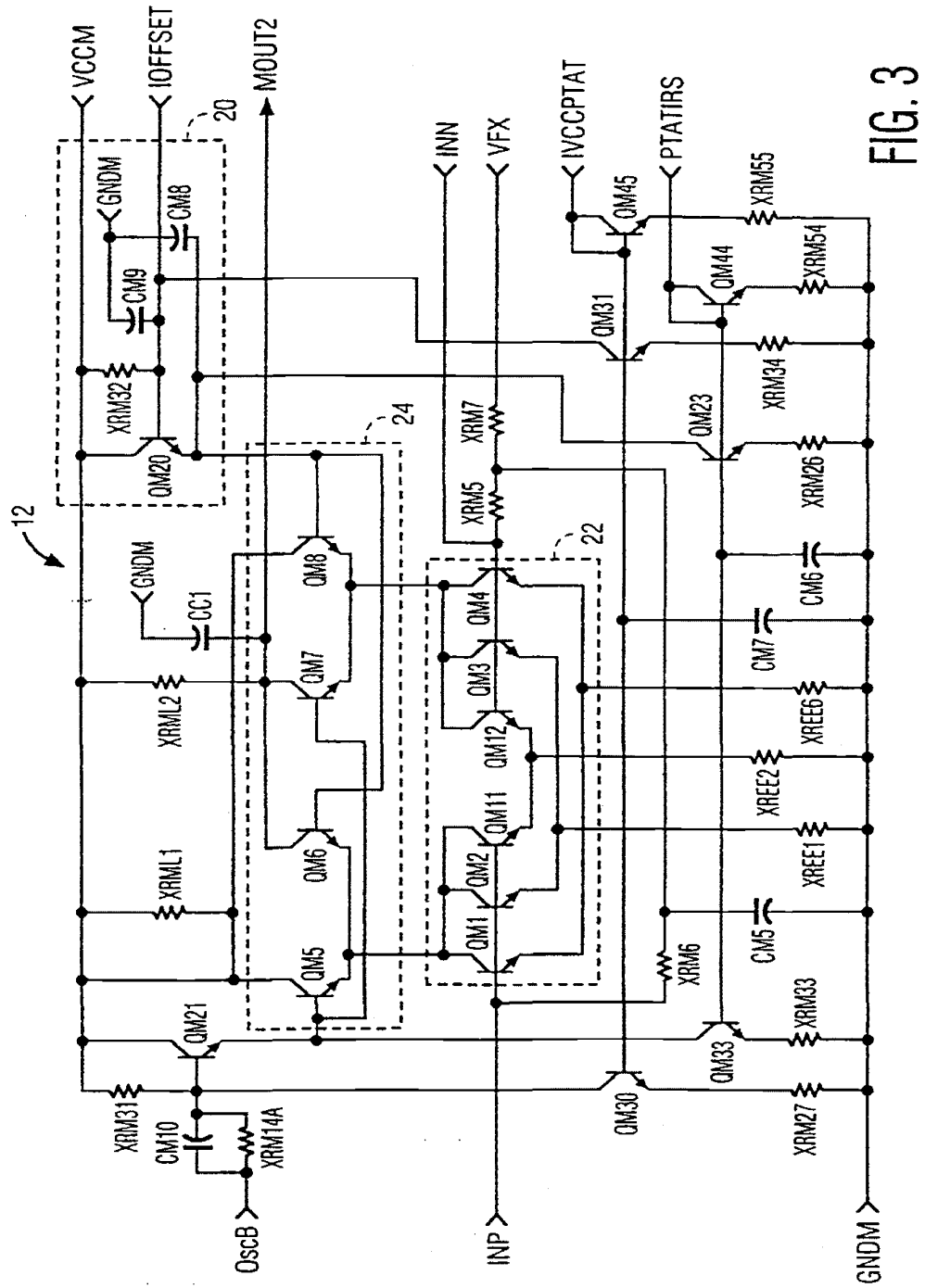



FIG. 3





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# INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 96/00815

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H04B 1/00, H03D 7/14
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)

IPC6: H04B, H03D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| X | EP 0416889 A2 (LSI LOGIC EUROPE PLC), 13 March 1991 (13.03.91), page 2, line 48 - line 52 | 1 |
| P,X | US 5446923 A (G.D. MARTINSON ET AL), 29 August 1995 (29.08.95), column 11, line 9 - line 13, figure 5, abstract | 1 |

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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| 28 January 1997 | 29 -01- 1997 |
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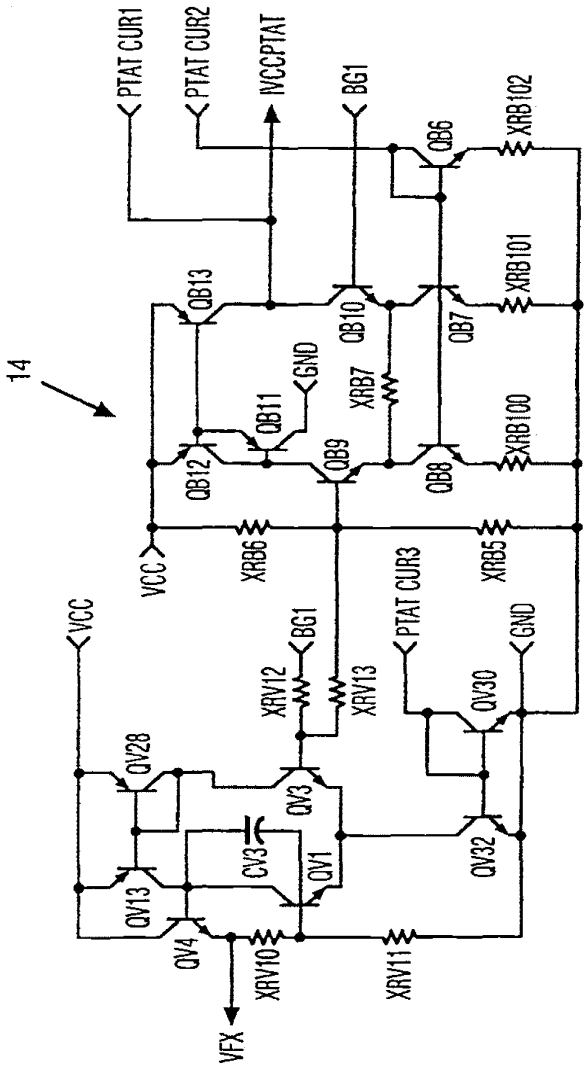



FIG. 4





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## INTERNATIONAL SEARCH REPORT

Information on patent family members

28/10/96

International application No.
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(71) Applicant: QUALCOMM INCORPORATED [US/US]; 6455 Lusk Boulevard, San Diego, CA 92121 (US).

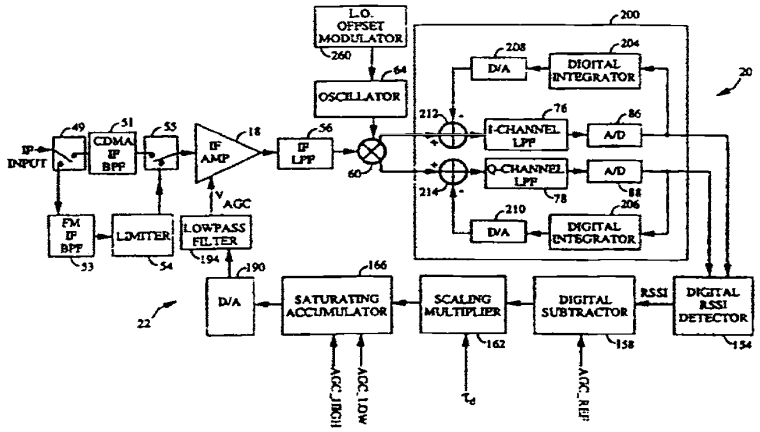
(72) Inventors: WILSON, Nathaniel, B.; 11346-8 Portobelo, San Diego, CA 92124 (US). BLACK, Peter, J.; Apartment #13, 11 Austral Street, St. Lucia, QLD 4067 (US). PETERZELL, Paul, E.; 6146 Calle Mariselda #203, San Diego, CA 92124 (US).

(74) Agent: MILLER, Russell, B.; Qualcomm Incorporated, 6455 Lusk Boulevard, San Diego, CA 92121 (US).

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**Published**
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(54) Title: METHOD AND APPARATUS FOR AUTOMATIC GAIN CONTROL AND DC OFFSET CANCELLATION IN QUADRATURE RECEIVER




(57) Abstract

An automatic gain control (AGC) and D.C. offset correction method and apparatus for controlling signal power of a received RF signal within a dual mode quadrature receiver is disclosed herein. The AGC apparatus includes an adjustable gain amplifier (18). A quadrature downconverter (20) coupled to the amplifier (18) serves to translate the frequency of the output signal to a baseband frequency which is offset by a predetermined margin from D.C. Two high gain active lowpass filters (76 and 78) provide out-of-band signal rejection for the baseband signals. A D.C. feedthrough suppression loop supresses D.C. offsets produced by a downconverter (20) and the lowpass filters (76 and 78). The AGC apparatus also generates a received power signal based on the power of the output signal. A saturating integrator compares the received power signal to a reference signal and produces the gain control signal by integrating or by refraining from integration based on values of the reference, received power signal, and gain control signals.

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# METHOD AND APPARATUS FOR AUTOMATIC GAIN CONTROL AND DC OFFSET CANCELLATION IN QUADRATURE RECEIVER

## BACKGROUND OF THE INVENTION

### I. Field of the Invention

The present invention relates generally to RF receivers using quadrature demodulation. More particularly, the present invention relates to a novel method and apparatus for providing automatic gain control, out-of-band signal rejection, and D.C. offset cancellation within a digital receiver.

### II. Description of the Related Art

In analog receivers, such as are used in narrowband FM cellular communication systems, FM demodulators are employed to extract information encoded in the phase of an incident waveform. Existing FM demodulators often include an analog frequency discriminator preceded by an analog limiter, with the limiter serving to constrain the input signal power to a constant level. In this way maximum signal to noise ratio is maintained at the input to the frequency discriminator over the full dynamic range of the FM input signal. However, such an analog signal processing technique generally involves extensive signal filtering, and frequently is implemented using a large number of discrete components. Moreover, it has been demonstrated that improved performance may be achieved using linear digital waveform demodulation rather than analog demodulation. Unfortunately, conventional demodulation techniques are often not applicable to digital receivers, since clipping of the received signal would result in corruption of the data derived therefrom.

A digital receiver for receiving a digitally modulated information signal will generally include a variable gain amplifier with a gain adjusted by a control signal. The process of adjusting the gain of a received signal using a control signal is called Automatic Gain Control (AGC). Typically in digital receivers, the AGC process involves measurement of an output signal power of the variable gain amplifier. The measured value is compared with a value representing the desired signal power and an control signal for the variable gain amplifier is generated. The error value is then





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used to control amplifier gain so as to adjust the signal strength to coincide with the desired signal power. To effect digital demodulation with an optimal signal to noise ratio, automatic gain control is used to hold the magnitude of the baseband waveforms close to the full dynamic range of the baseband analog to digital converters. This generally requires, however, that automatic gain control be provided over the full dynamic range of the received signal power.

In the cellular environment, a digital receiver may receive a signal which experiences rapid and wide variations in signal power. In digital receivers such as are used in a code division multiple access (CDMA) and Time Division Multiple Access (TDMA) mobile cellular telephone, it is necessary to control the power of the demodulated signal for proper signal processing. However, in digital receivers to be both CDMA or TDMA compatible and conventional FM compatible, i.e., dual-mode digital/FM receivers, it is necessary to provide power control of both wideband CDMA (or TDMA) signals and narrowband FM signals. The control process is complicated by the differing dynamic ranges associated with the received FM and CDMA signal power. That is, the magnitude of received FM signals may vary over a dynamic range greater than 100 dB, whereas CDMA systems typically result in a more limited dynamic range, i.e., approximately 80 dB.

The provision of separate AGC circuitry for each mode increases the hardware complexity and expense of such receivers. Accordingly, it would be desirable to provide AGC circuitry capable of operating both upon narrowband, wide-dynamic range FM signals, as well as upon wideband CDMA signals of more limited dynamic range.

It would also be desirable to provide digital AGC in inexpensive receivers utilizing analog to digital (A/D) converters with limited dynamic range. Again, because FM signals within cellular systems may vary more than 100 dB and relatively inexpensive 8-bit A/D's are limited to a dynamic range of approximately 48 dB, a cost effective AGC implementation should be capable of controlling the gain of the portion of the receiver preceding the A/D converters so as to control the signal's dynamic range at the A/D converter. The alternative is to employ expensive A/D converters having greater dynamic range, thereby increasing the cost of the receiver or to increase the AGC range of the analog portion of the radio which is very difficult and costly.

It is therefore an object of the present invention to provide a novel and improved AGC circuit which incorporates the desirable features



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mentioned above, and which, as is described hereinafter, also realizes certain other advantages relative to conventional AGC techniques.

In standard FM cellular telephones, the AGC function is performed by a circuit called a limiter. When a limiter is used, out-of-band signal rejection can only be done using intermediate frequency (IF) filters. Although the requisite signal rejection capability may be achieved through the use of ceramic IF filters, these tend to be relatively large and expensive. Smaller and less expensive IF filters are generally incapable of being realized so as to possess the desired signal rejection characteristics, and hence are generally not employed in FM cellular telephone receivers.

As is well known, recent advances in integrated circuit (IC) technology have made possible the realization of active baseband filters which are quite small and inexpensive compared to IF filters. It follows that it would be desirable to employ active IC baseband filters to effect significant out-of-band signal suppression, thereby allowing smaller and less expensive IF filters to be used to provide any additional required signal rejection. In an active filter, the higher the gain - the better rejection that is possible. But the higher the gain, the more susceptible the system to unwanted D.C. offsets. Suppression of such D.C. offsets is desirable to maximize the available signal dynamic range, minimize offset induced distortion in the baseband demodulated signal and minimize offset induced errors in baseband signal strength estimates.

In standard digital communications systems such as quadrature phase shift keying (QPSK), used in standard CDMA communication systems (and some TDMA systems), or binary phase shift keying (BPSK), information from the waveform is recovered by downconversion of the signal to baseband frequency centered about D.C. In this case D.C. offsets are easily removed, since for QPSK and BPSK, the carrier is generally suppressed by the transmitter anyway. Hence at baseband, a D.C. notch can be used.

However, for constant amplitude modulations such as FM and continuous phase FSK (which are used in FM cellular telephone systems such as AMPS) and Gaussian Minimum Shift Keying (GMSK) (used in some TDMA systems), the carrier must be preserved in order to demodulate the received signal.

The employment of active baseband IC filters leads to the necessity of providing some mechanism for suppression of undesired D.C. offsets. The IF processing chain of conventional digital cellular telephone receivers typically includes a local oscillator (L.O.) having a frequency selected such that the carrier frequency is downconverted to D.C., and a simple D.C. notch



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filter is used to remove unwanted D.C. offsets. If an FM, FSK, or GMSK signal is processed by such an IF processing chain, then the D.C. offset suppression will not only remove unwanted D.C. components, but also critical phase and amplitude information at the carrier frequency. That is, in FM cellular telephone systems significant amplitude and phase information is present at the carrier frequency, and performance will be adversely affected if such information is destroyed.

However, there are two narrow bands of frequencies in between the carrier frequency $F_c$ and $F_c + F_l$ and between $F_c$ and $F_c - F_l$ (where $F_l$ is the lowest frequency expected in the demodulated spectrum, typically $F_l = 300$ Hz for FM cellular) which can be suppressed without adversely effecting the demodulated signal. Although minimal voice information is carried at intermodulation products at frequencies close to the carrier frequency, such products are uncommon and of relatively short duration. Accordingly, the suppression of only the low-frequency intermodulation products after baseband downconversion does not usually result in the loss of appreciable voice information. Similarly, in FSK and GMSK systems, very little signal power is present below $F_l$ = (symbol rate)/100, so again the frequency band between $F_c$ and $F_c + F_l$ may be suppressed without degradation of the digital data.

It is therefore a further object of the present invention to provide an quadrature receiver in which high-gain/highly selective active baseband filters may be employed without causing the loss of carrier frequency information.

## SUMMARY OF THE INVENTION

The present invention is a novel automatic gain control method and apparatus for controlling signal power of a received RF signal over a wide dynamic range. In a preferred implementation the automatic gain control apparatus may be adjusted to provide a desired control response to various fading characteristics of the received RF signal. In applications where the signal of interest is a suppressed carrier digital format such as BPSK or QPSK (for CDMA Digital Cellular) or a constant envelope continuous-phase format such as GMSK, FSK, or FM (used in AMPS cellular phase system), the apparatus of the present invention is capable of providing the necessary gain control, out-of-band signal rejection, and downconversion to baseband, with no D.C. offset.

In accordance with the present invention an automatic gain control (AGC) apparatus for a dual mode receiver is disclosed. The AGC apparatus



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includes an adjustable gain amplifier having an input port for receiving an input signal, a control port for receiving a gain control signal, and an output port for providing an output signal. A downconverter coupled to the output port serves to translate the frequency of the output signal to a baseband frequency, thereby producing a baseband signal. In a preferred implementation the downconverter is operative to map the carrier frequency of the received signal of the output signal to a baseband frequency offset by a predetermined margin from D.C. A D.C. feedthrough suppression loop, disposed to receive said baseband signal, suppresses D.C. feedthrough signals produced by the downconverter, hence providing a compensated baseband signal.

The AGC apparatus further comprises means for generating a received power signal based on the power of the output signal. A saturating integrator compares the received power signal to a reference signal and produces the gain control signal by integrating or by refraining from integration based on values of the reference, received power signal, and gain control signals.

## BRIEF DESCRIPTION OF THE DRAWINGS

The features, objects, and advantages of the present invention will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify correspondingly throughout and wherein:

Figure 1 illustrates in block diagram form an exemplary application of the automatic gain control apparatus (AGC) of the present invention;

Figure 2 illustratively represents the gain of an AGC amplifier as a function of the gain control voltage;

Figure 3 shows an exemplary embodiment of the automatic gain control apparatus of the invention which includes a control loop implemented in analog form;

Figures 4A and 4B illustratively represent the voltage and power transfer characteristics, respectively, associated with an exemplary implementation of a signal limiter included within the inventive gain control apparatus;

Figure 5 depicts an exemplary implementation of decision logic used to govern operation of an integration control switch;

Figures 6A-6C are timing diagrams illustrative of the operation of the AGC apparatus of the invention;



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Figure 7 shows a preferred embodiment of the AGC apparatus of the invention including a digital realization of the control loop;

Figure 8 depicts an exemplary implementation of a digital saturating accumulator included within the integrator of Figure 7;

Figure 9 shows an alternately preferred embodiment of the AGC loop of invention which includes a D.C. feedthrough suppression loop; and

Figure 10 provides a block diagram representation of an analog D.C. feedthrough suppression loop.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

In a digital receiver, such as used in a code division multiple access (CDMA) portable cellular communications device, it is necessary to set the power of the processed signal to a constant level. In the cellular environment, a receiver may receive a signal which experiences rapid and wide variations in signal power. In order to properly process the digital data contained within the received signal the signal power must be controlled within the receiver. In a dual-mode digital receiver, e.g., a digital receiver capable of processing both CDMA (or TDMA) and standard FM signals, the received signal dynamic range will vary as a function of the selected operative mode. Accordingly, an automatic gain control apparatus for a digital receiver is disclosed which is capable, in each of its operative modes, of compensating for variation in received signal power in either environment.

Figure 1 illustrates in block diagram form an exemplary application of the automatic gain control apparatus of the present invention. In Figure 1, the automatic gain control apparatus is implemented in the transceiver of a CDMA portable cellular telephone 10. Telephone 10 may be a dual mode, i.e. CDMA (or TDMA) and conventional FM compatible. The automatic gain control apparatus of the present invention is capable of providing power control of both wideband CDMA (or TDMA) signals and narrowband FM signals. The compatibility of such circuitry to operate on both wideband and narrowband signals provides cost, component and power savings for the receiver.

Telephone 10 includes antenna 12 for receiving RF signals, including CDMA or FM communication signals, transmitted from a base station. Antenna 12 couples the received signals to duplexer 14 which provides the received signals to the receiver portion of telephone 10. Duplexer 14 also



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receives CDMA or FM communication signals from a transmitter portion of telephone 10 for coupling to antenna 12 and transmission to a base station.

The received signals are output from duplexer 14 to downconverter 16 where the RF signals are converted to a lower frequency range and are provided as corresponding intermediate frequency (IF) signals. The IF signals from downconverter 16 are provided to automatic gain controlled IF amplifier 18. The IF signals are amplified at a gain level determined by an AGC signal ($V_{AGC}$) which is also provided to amplifier 18. Amplifier 18 is capable of providing linear control of gain over a high dynamic range, such as in excess of 80 dB, on the basis of $V_{AGC}$. Amplifier 18 may be of a design described in, for example, U.S. Patent No. 5,099,204, entitled "LINEAR GAIN CONTROL AMPLIFIER", and assigned to the Assignee of the present invention.

In the above-referenced U.S. Patent No. 5,099,204, a compensation circuit is employed to achieve a desired dynamic range of linear control. In particular implementations such control may be provided by the amplification circuit in the absence of assistance from a compensation circuit. Included among such implementations are those, for example, in which several amplification stages are arranged in cascade. Similarly, the availability of a high-voltage power supply may eliminate the need for a compensation circuit.

The gain controlled IF signals are output from amplifier 18 to a second frequency downconverter, downconverter 20, where the IF signals are converted to a lower frequency range and are provided as corresponding in-phase and quadrature-phase baseband signals $I_{BB}$ and $Q_{BB}$. In the embodiment shown in Figure 1, the baseband signals in the CDMA mode of operation are I and Q samples of encoded digital data which are output for further phase demodulation and correlation. In a dual mode receiver, downconverter 20 also frequency downconverts FM signals so as to provide baseband FM in-phase and quadrature-phase signals, which are further phase/frequency demodulated into an audio output signal.

Detector 25 measures the strength of the signals output by downconverter 20 and generates a corresponding received signal strength indication (RSSI) signal. The RSSI signal, along with an AGC reference signal (AGC_REF) supplied by a controller (not shown), are provided to a saturating integrator network 22. The AGC_REF signal corresponds to a desired signal strength level for the baseband signals. The controller also provides AGC limit low (AGC_LOW) and AGC limit high (AGC_HIGH) reference signals to saturating integrator 22. The AGC_HIGH and



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AGC_LOW signals correspond to limits on the magnitude of a gain control signal ($V_{AGC}$) provided to a control port of amplifier 18 by saturating integrator 22.

Figure 2 illustratively represents the gain of amplifier 18 as a function of the gain control voltage. Referring to Figure 2, the gain of amplifier 18 is seen to nonlinearly taper to relatively constant values for control voltages exceeding AGC_HIGH and less than AGC_LOW. In general, it will be desired to constrain the value of $V_{AGC}$ to within the linear range between AGC_HIGH and AGC_LOW in order that the corresponding time constant of the control loop remain within an acceptable range. Deviation of the loop time constant from the acceptable range could result in significant loop control errors. In accordance with the invention, amplifier 18 is constrained to operate within a region of linear gain by saturating integrator 22 in order to prevent the performance degradation introduced by such loop control errors.

As is described below, saturating integrator 22 is operative to integrate the difference between the RSSI and AGC_REF signals when $V_{AGC}$ is between AGC_HIGH and AGC_LOW. When presented with an input which would cause $V_{AGC}$ to exceed AGC_HIGH or fall below AGC_LOW integrator 22 stops integrating and the gain control signal $V_{AGC}$ is held constant at either AGC_HIGH or AGC_LOW, thereby improving control loop response as described above.

Referring again to Figure 1, saturating integrator 22 receives the RSSI signal from detector 25, along with the AGC_REF signal from the controller. In order to provide accurate power control, in general it is necessary for the difference between the RSSI signal and the AGC_REF signal to be minimized. Saturating integrator 22 is used to provide this function in the AGC loop by forcing the difference to zero. For example, if the gain of the signal is too high, the RSSI signal will also be high as compared to AGC_REF. Until these signals are of equivalent magnitude, the integrator output signal $V_{AGC}$ will continue to decrease the gain of amplifier 18.

It should be understood that the RSSI measurement can be made at various points in the processing of the received signal. Although Figure 1 illustrates that the measurement is made after frequency downconversion by downconverter 20, the measurement can be made at any point in the signal processing chain following IF amplifier 18. The RSSI measurement will preferably be made subsequent to completion of signal filtering, thereby minimizing the measured spurious interference power. In using analog



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power control techniques for both the wideband and narrowband signals, the same power control circuitry can be used for both modes of operation.

With respect to a transmitter portion 30 of the portable telephone of Figure 1, transmit power is also controlled. The $V_{AGC}$ signal is again used to provide instantaneous control of transmit power in CDMA mode. The $V_{AGC}$ signal is provided to the transmitter portion 30, along with various other control signals from the controller (not shown).

Referring now to Figure 3, there is shown an exemplary embodiment of the automatic gain control apparatus of the invention which includes a partially analog implementation of saturating integrator 22. In Figure 3, the saturating integrator includes operational amplifier (op amp) integrator 40 having a capacitive feedback network. In particular, integrator 40 receives the AGC_REF signal through resistor 42 at its non-inverting input, to which is also connected capacitor 43. When switch 44 is closed in response to control information provided by integrator decision logic 46, an RSSI signal output by RSSI detector 48 is received by integrator 40 through resistor 50. When switch 44 is held in an open position in response to control information from integrator decision logic 46, a capacitor 52 serves to hold the output ($V_{AGC}$) of integrator 40 constant at either AGC_HIGH or AGC_LOW. This prevents saturation of amplifier 18 when the magnitude of the IF input signal departs from a predefined dynamic range.

Again referring to Figure 3, an embodiment of a switching arrangement is shown using RF switches 49 and 55. RF switches 49 and 55 couple CDMA IF bandpass filter 51 to IF amplifier 18 during CDMA mode as shown by the setting of the switches in Figure 3. In FM mode, the position of RF switches 49 and 55 changes to couple FM IF bandpass filter 53 and limiter 54 to IF amplifier 18. FM IF bandpass filter 53 for rejecting out-of-channel interference defines the bandwidth of the FM signals provided through limiter 54 to amplifier 18. For example, in FM mode operation the FM IF filter 53 is designed to have a passband spanning approximately one cellular channel (e.g., 30 kHz), and a stopband extending significantly beyond (e.g., +/- 60 kHz) the IF center frequency. During CDMA mode operation the CDMA IF filter 51 is designed to reject out-of-channel interference and defines the bandwidth of the CDMA signals provided to amplifier 18. For example during CDMA mode, CDMA IF bandpass filter 51 may provide a passband commensurate with the chip rate of the baseband portion of the receiver (e.g. 1.26 MHz), and provide a predefined rejection bandwidth (e.g. 1.8 MHz). In an alternative embodiment, limiter 54 could be in the common path before IF amplifier 18.



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Limiter 54 attenuates high power RF signals, which are principally received during FM mode operation. FM signals may exceed the maximum power of signals encountered during CDMA mode operation. In a preferred embodiment limiter 54 limits the input power to amplifier 18 to within the dynamic range, e.g., 80 dB, characteristic of CDMA operation. Limiter 54 allows the control range of the automatic gain control (AGC) loop of Figure 3 to be designed on the basis of the expected CDMA dynamic range, thereby eliminating the need to provide separately calibrated AGC control loops for FM and CDMA mode operation.

Figures 4A and 4B illustratively represent the voltage and power transfer characteristics, respectively, associated with an exemplary implementation of limiter 54. Referring to Figures 4A and 4B, limiter 54 does not attenuate signals having voltage magnitudes less than a predefined maximum voltage Vm. The saturated power may be quantified as $P_{SAT} = Vm^2/2R_L$, where $R_L$ denotes the input load impedance of amplifier 18. For input power in excess of $P_{SAT}$, the output signal power produced by limiter 54 is made to remain constant at approximately $P_{SAT}$ by clipping the peak signal voltage to the voltage Vm. The value of $P_{SAT}$ will be selected based on the maximum expected CDMA input power level. Accordingly, for example, high-power sinusoidal IF input signals (Pin> $P_{SAT}$), the output waveform produced by limiter 54 is truncated to a fixed amplitude but has the same fundamental frequency and phase information is not lost. The limiter induced harmonic distortion is removed by lowpass filter 56.

Low-pass filter 56, included within the downconverter 20, is designed to have a cut-off frequency larger than the frequency of the IF signal output by amplifier 18 in either CDMA mode or FM mode. As noted above, low-pass filter 56 is designed to attenuate harmonics of the IF signal output by amplifier 18 prior to downconversion to baseband in-phase (I) and quadrature phase (Q) components. High-power waveforms clipped by limiter 54 create unwanted harmonics. IF lowpass filter 56 removes the unwanted harmonics so that they are not converted to baseband along with the desired IF signal information. In an exemplary embodiment the type, order, and passband edge of filter 56 are selected to attenuate the baseband distortion products arising from the IF harmonics inherent in the amplified IF signal produced by amplifier 18.

The filtered IF signal is provided to a first input of a mixer 60, while the other input of mixer 60 receives a locally generated reference signal from oscillator 64. Mixer 60 mixes the filtered IF signal with the reference signal to produce the I and Q baseband (quadrature) components on output lines 70



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and 72, respectively. The mixer 60 is designed to map a frequency which is offset from the IF center frequency by a predefined margin, e.g. from 3 to 300 Hz, to the baseband D.C. frequency. Such a D.C. offset margin allows the automatic gain control loop of Figure 3 to distinguish between an unmodulated FM signal (i.e., a continuous wave (CW) signal) from an input D.C. offset error. Specifically, mixer 60 will preferably be operative to produce an output frequency of approximately 100 Hz in response to an input CW signal at the mid-band IF frequency. In this way input D.C. offset errors tending to corrupt RSSI power measurements are removed by a D.C. notch filter 66 without attenuating CW signal information.

Referring again to Figure 3, output lines 70 and 72 are respectively connected to baseband I and Q lowpass filter networks 76 and 78. Filter networks 76 and 78 will preferably each be implemented so as to provide lowpass transfer functions exhibiting cutoff frequencies of 13 kHz and 630 kHz, respectively, during FM and CDMA mode operation. In an exemplary embodiment filters 76 and 78 each include a pair of filters, one of which is employed during CDMA mode operation and the other during FM mode operation. The individual filters included within networks 76 and 78 are switched into the baseband I and Q signal paths, respectively, in accordance with the selected mode of operation. In the preferred embodiment the system controller includes means for switching the filters included within the filter networks in accordance with the operative mode selected.

In addition to performing and anti-aliasing function for A/D converters 86 and 88, lowpass filters 76 and 78 also provide out-of-band signal rejection. In the preferred embodiment, filters 76 and 78 have high gain, and high stop-band rejection. As a result, IF bandpass filter 51 and 53 can have less stop-band rejection, and therefore can be less expensive.

After filtering by baseband filter networks 76, 78 and by D.C. notch filter 66, the resulting baseband I and Q signals are provided to RSSI detector 48. RSSI detector 48 provides an output RSSI signal indicative of measured signal power (in dB). The difference between the RSSI signal output by RSSI detector 48 and AGC_REF is integrated within saturating integrator 22 so as to produce the control voltage $V_{AGC}$.

Again referring to Figure 3, the I and Q outputs of the baseband filter networks 76 and 78 are also provided to I and Q analog to digital (A/D) converters 86 and 88, respectively. A/D converters 86 and 88 operate to quantize the baseband I and Q signals for digital demodulation in the selected operative mode, i.e., either CDMA or FM. In the preferred



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embodiment the dynamic range of A/D converters 86 and 88 is selected to be sufficient to accommodate signals that exceed the control range of the AGC apparatus of IF amplifier 18. As was noted above with reference to Figures 2 and 3, decision logic 46 within saturating integrator 22 constrains the control voltage $V_{AGC}$ to within the range AGC_LOW < $V_{AGC}$ < AGC_HIGH. This prevents amplifier 18 from saturating in a nonlinear operating region.

Accordingly, A/D converters 86 and 88 are designed to quantize input signals, without excessive distortion, whether or not integrator 40 is saturated. In the preferred embodiment, each of A/D converters 86 and 88 provides 6 to 8 bits of dynamic range. This dynamic range is sufficient to prevent degradation in the signal to noise ratio of the input to A/D converters 86 and 88 as compared to the signal to noise ratio of the quantized digital output of A/D converters 86 and 88 for any RF input level. For example, when $V_{AGC}$ reaches AGC_LOW, limiter 54 constrains the amplitude of the IF signal. In this way, the signal level at the input of A/D converters 86 and 88 may exceed the level indicated by AGC_REF by only some fixed amount. Therefore, A/D converters 86 and 88 will continue to accurately quantize the baseband signals at the increased level.

Likewise the dynamic range of A/D converters 86 and 88 is sufficient to prevent degradation of the signal to noise ratio at low RF input signal levels. For example when $V_{AGC}$ reaches AGC_HIGH and switch 44 opens, if the input RF signal continues to fall, the baseband signal level at the input of A/D converters 86 and 88 falls below the level indicated by AGC_REF. The decreased level of the signal input to A/D converters 86 and 88 results in less than full utilization of the device, i.e., some of the bits of the output of the A/D converters 86 and 88 are not used. For larger RF input signals, the entire dynamic range of the A/D converters 86 and 88 is utilized during the conversion process. Hence, the AGC apparatus of the invention enables a limited range AGC control loop to be used in demodulating signals spanning a substantially larger dynamic range than the control range of the IF amplifier 18.

Figure 5 depicts an exemplary implementation of decision logic 46 operative to control the position of the switch 44. As shown in Figure 5, the AGC_HIGH and $V_{AGC}$ signals are presented to logical comparator 104. When $V_{AGC}$ exceeds the level of AGC_HIGH, the output of comparator 104 becomes a logic level one (1). The output of comparator 104 is logically AND'ed with the output of flip-flop 110, which is at a logic level 1 due to the closed position of switch 44. The output of flip-flop 110 is delayed through delay element 114 to prevent excessive, spurious toggling of the position of



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switch 44. AND gate 108 and delay element 114 operate to prevent switch 44 from being opened until after a fixed period of time following its closure. The output of AND gate 108 transitions from low to high thus resetting the output of flip-flop 110 to a logic level 0 and producing a logic level 0 at the output of AND gate 130 and opening switch 44. When switch 44 is opened, the RSSI signal and AGC_REF signal are no longer forced by the loop to be equivalent. In the case when AGC_HIGH has been exceeded and the loop is opened, the RSSI signal indicates a smaller signal than AGC_REF and the output of logical comparator 102 becomes a logic level 0. When the RSSI signal exceeds the level of AGC_REF, the output of comparator 102 transitions high and the output of AND gate 106 also transitions high, thus setting the output of flip-flop 110 to logic level 1 and closing switch 44. Delay element 112 and AND gate 106 function similarly to delay 114 and AND gate 108, and prevent closure of switch 44 until it has been open for a predefined time period.

An analogous sequence of logical operations is executed when the level of the RF input signal exceeds the AGC range. When $V_{AGC}$ falls below the level of AGC_LOW, the output of comparator 118 becomes a logic level 1. The output of comparator 118 is logically AND'ed with the output of flip-flop 124, which is at a logic level 1 when switch 44 is closed. The output of AND gate 122 then transitions from low to high, thus resetting the output of flip-flop 124 to a logic level 0. This causes a logic level 0 to appear at the output of AND gate 130, which results in the opening of switch 44. When switch 44 is opened, the RSSI signal is no longer forced by the loop to be equal to AGC_REF. Upon the loop being opened in this manner the RSSI signal will be larger than AGC_REF and the output of logical comparator 116 will be at logical level 0. When the RSSI signal becomes smaller than AGC_REF, the outputs of comparator 116 and AND gate 120 transition high. The transition sets the output of flip-flop 124 to logic level 1 and closes switch 44. Delay elements 126 and 128 and AND gates 120 and 122 function similarly to delay 114 and AND gate 108, and serve to prevent rapid toggling of switch 44 between open and closed positions.

The logical output of AND gate 130 can be considered an integration enable signal and is impressed upon a switch control line 124 connected to switch 44. In the preferred embodiment switch 44 is closed in response to the impression of a logical 1 upon control line 124, and is opened when a logical 0 is impressed thereupon. Integrator decision logic 46 thus controls when the difference between the RSSI and AGC_REF signals is integrated by op amp integrator 40. In this way integrator decision logic 46 and



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integrator 40 cooperate to provide the $V_{AGC}$. The operation of the AGC apparatus of Figure 3 may be described in greater detail with reference to the timing diagrams of Figures 6A-6C. In particular, Figures 6A and 6B respectively depict the time variation in the power of an exemplary RF signal and the corresponding state (open or closed) of switch 44 within saturating integrator 22. Figure 6C shows the corresponding value of the gain control voltage ($V_{AGC}$) generated by op amp integrator 40 in response to the RF input signal of Figure 6A.

As is indicated by Figures 6A and 6C, over a first integration interval ($t_0 < t < t_1$) the power of the RF input signal is confined to the AGC control range of the AGC loop, and accordingly AGC_LOW < $V_{AGC}$ < AGC_HIGH (Figure 6C). At time $t=t_1$, integrator decision logic 46 determines that $V_{AGC}$ has reached AGC_LOW, and consequently opens switch 44. Switch 44 remains open over the time interval $t_1 < t < t_2$, during which time integrator 40 is prevented from integrating the difference between RSSI and AGC_REF. During this time the input of A/D converters 86 and 88 is constrained by limiter 54. At time $t=t_2$ the RF input signal power has again become less than the upper bound of the loop control range, which results in switch 44 being closed by integrator decision logic 46 and $V_{AGC}$ exceeding AGC_LOW. Switch 44 then remains closed over a second integration interval ($t_2 < t < t_3$) until the control voltage $V_{AGC}$ reaches AGC_HIGH, at which time switch 44 is again opened by integrator decision logic 46. During this time the input of A/D converters 86 and 88 varies in response to changes in RF input signal level. In a similar manner switch 44 is closed by integrator decision logic 46 at times $t_4$, $t_6$ and $t_8$ in order to initiate third, fourth and fifth integration intervals.

Referring now to Figure 7, there is shown a preferred embodiment of the AGC loop of the invention in which is included a digital realization of saturating integrator 22. In the embodiment of Figure 7 digital highpass filter 150, rather than analog D.C. notch filter 66, is employed to remove the D.C. offset inherent in the baseband I and Q samples produced by A/D converters 86 and 88. The cutoff frequency of filter 150 is selected to be substantially less than the frequency offset introduced within mixer 60. In an alternate implementation of removal of the D.C. offset may be achieved by:

(i) separately determining averages of the baseband I and Q signal samples, and

(ii) subtracting the resultant D.C. component from each I and Q component prior to further processing.



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Digital RSSI detector 154 will typically include a look-up table containing values of log power indexed as a function of the magnitudes of the baseband I and Q samples. Digital RSSI detector 154 approximates log power, i.e., 10 LOG $(I^2 + Q^2)$, by determining the value of LOG(MAX{ABS(I),ABS(Q)}) and the value of a correction term. The operation MAX{ABS(I),ABS(Q)} produces an output value equivalent to the magnitude of the largest component of a given I/Q sample pair. In a particular implementation this output value serves as an index into a look-up table of log power. The output derived from the look-up table is then added to a correction term approximately equivalent to the difference between LOG $(I^2 + Q^2)$ and LOG(MAX{ABS(I),ABS(Q)}).

The received power estimate, i.e., the RSSI signal, produced by RSSI detector 154 is supplied to digital subtractor 158 along with the AGC_REF signal. The resulting error signal is then scaled in accordance with a desired loop time constant $t_d$ by digital scaling multiplier 162. The loop time constant $t_d$ is chosen in accordance with the expected fading characteristics of the RF input signal. Relatively short loop time constants (faster loop response) will generally be selected to enable tracking of signals exhibiting abrupt fading characteristics while slowing the loop response to a level that does not cause excessive overshoot or ringing given the delays introduced in the loop by filters and other elements.

In a preferred embodiment scaling multiplier 162 may be programmed to multiply the error signal from subtractor 158 by a first loop time constant in response to decaying RSSI signals, and to multiply by a second loop time constant when the value of the RSSI signal is increasing. This allows for further flexibility in tailoring the AGC loop response on the basis of the fading characteristics of the operational environment and minimizes loop overshoot.

Referring again to Figure 7, scaled error signal generated by scaling multiplier 162 is provided to saturating accumulator 166. Saturating accumulator 166 operates to accumulate values of the scaled error signal into an aggregate error signal until the aggregate error signal reaches either AGC_HIGH or AGC_LOW. The value of the aggregate error signal is then held at either AGC_HIGH or AGC_LOW until a scaled error signal is received which, after combination with the existing aggregate error signal, results in an aggregate error signal within the range defined by AGC_HIGH and AGC_LOW.

Figure 8 depicts an exemplary discrete time implementation of saturating accumulator 166. As is indicated by Figure 8, the scaled error



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signal is provided to a first input of a digital adder 170. The scaled error signal is added within digital adder 170 to the aggregate error signal produced in the previous time step by saturating accumulator 166, where the aggregate error signal is stored in register 174. The values of AGC_HIGH and AGC_LOW provided by a system controller (not shown) are stored within second register 178. Minimum and maximum signal clippers 182 and 184, coupled to second register 178, constrain the value of the digital signal provided to first register 174 to within the range defined by AGC_HIGH and AGC_LOW.

The digital implementation of highpass filter 150, RSSI detector 154 and saturating integrator 22 depicted in Figures 7 and 8 offers several advantages relative to corresponding analog realizations. For example, the digital components utilized therein are not susceptible to temperature drift, and allow the integration time constant to be adjusted in accordance with expected signal fading conditions so as to expedite loop signal acquisition. In addition, a filter and integrator implemented in digital form occupy significantly less volume than a corresponding arrangement of discrete resistive and capacitive components.

It is also anticipated that the utilization of a digital RSSI detector and a digital saturating integrator will result in improved accuracy. In particular, during the period when the value of $V_{AGC}$ is required to be maintained at either AGC_HIGH or AGC_LOW, capacitive discharge and the like associated with analog components will generally result in the value of $V_{AGC}$ "drooping" from the desired level over a period of time. The digital implementation of the saturating integrator shown in Figures 7 and 8 does not exhibit the signal "droop" characteristic of analog implementations.

Referring again to Figures 7 and 8, the control signal stored within register 174 of saturating accumulator 166 is provided to digital to analog converter (DAC) 190. In a preferred embodiment the resolution of DAC 190 will be sufficient to provide an output analog AGC step size of less than 1 dB. Alternatively, a pulse width modulated (PWM) or pulse density modulated (PDM) output pulse sequence of 0,1 logic levels is produced in response to the control signal. PDM signaling is explained in U.S. Patent Application No. 08/011,618, entitled "Multibit To Single Bit Digital Signal Converter", and assigned to the Assignee of the present invention. The average value of the output pulse sequence corresponds to the desired analog output voltage.

The analog output provided by DAC 190 is passed through lowpass filter 194 prior to being applied to the gain control port of IF amplifier 18.



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Lowpass filter 194 is designed to attenuate any spurious output produced by DAC 190.

Referring now to Figure 9, there is shown an alternately preferred embodiment of the AGC loop of invention operative to advantageously suppress undesired D.C. offset signal components without simultaneously destroying carrier frequency signal information. The AGC loop of Figure 9 bears substantial similarity to the AGC loop of Figure 7, and hence like reference numerals are used in the representation of like circuit elements. As noted in the Background of the Invention, in receivers for digital modulation such as QPSK or BPSK, it is common for the frequency of the local oscillator (L.O.) within the IF processing chain to be selected such that the received carrier frequency is downconverted (i.e., mapped) to D.C. Again, however, subsequent baseband processing designed to suppress undesired D.C. feedthrough passed by mixer 60 also tends to destroy signal information centered about the received carrier which occurs for modulation schemes such as FM, and continuous-phase FSK.

In accordance with one aspect of the invention, the L.O. frequency of the IF oscillator 64 is selected such that the received carrier is mapped to a baseband frequency offset from D.C. by a predetermined margin. A D.C. feedthrough suppression loop 200 (Figure 9) enables cancellation of undesired D.C. feedthrough while simultaneously preserving signal information at the received carrier frequency. In a preferred implementation the L.O. frequency is chosen to be offset by a small amount (e.g., 100 Hz) from the carrier frequency nominally resulting in downconversion of the received spectrum to baseband. It follows that the I and Q channel signal energy output by the mixer 60 at the predetermined offset frequency (e.g., 100 Hz) corresponds to the information impressed upon the received carrier frequency. The downconverted spectrum, including carrier information, is passed to A/D converters 86 and 88 while undesired D.C. feedthrough from mixer 60 is suppressed. Although this process results in the attenuation of energy at the frequency spaced from the received carrier by the predetermined offset, in many applications (e.g., voice communication) the suppressed low frequency energy carries minimal usable signal information. Accordingly, the D.C. suppression loop 200 advantageously allows cancellation of extraneous D.C. feedthrough without destruction of information present at the received carrier frequency.

As is indicated by Figure 9, the D.C. feedthrough suppression loop 200 includes I and Q channel digital integrators 204 and 206 having input ports operatively coupled to the outputs of LPFs 76 and 78 through A/D



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converters 86 and 88, respectively. In the embodiment of Figure 9 the integrators 204 and 206 are respectively disposed to integrate the digital outputs of A/D converters 86 and 88. The results of each integration are converted to analog signals by I and Q channel digital to analog converters (D/A) 208 and 210, which are seen to be respectively interposed between the integrators 204 and 206 and analog subtractors 212 and 214. The gain constants of digital integrators 204 and 206 may be selected such that integrators 204 and 206 are unresponsive to signal power at frequencies at 100Hz and above. The resultant D.C. cancellation signals produced by integrators 204 and 206 are nominally equal to the undesired D.C. errors introduced in the signal path by mixer 60, LPFs 76 and 78, and A/D converters 86 and 88. In this way it is ensured that the power level provided to A/D converters 86 and 88, and hence also to the RSSI circuit 154, is indicative of the power level actually received by AGC circuit 22. Hence, the D.C. feedthrough suppression loop 200 functions to maintain the integrity of the received power level even during elimination of undesired D.C. feedthrough.

Turning now to Figure 10, there is shown an analog implementation of a D.C. feedthrough suppression loop 230 (which can be substituted in Fig. 9 in place of 200) operative to eliminate undesired D.C. feedthrough while simultaneously preserving the level of signal power supplied to RSSI detector 154. The L.O. frequency of the IF oscillator 64 (Fig. 9) is again selected such that the carrier frequency is mapped to a baseband frequency offset from D.C. by a predetermined margin. The D.C. feedthrough suppression loop 230, in a manner substantially similar to that described above with reference to the suppression loop 200, enables cancellation of undesired D.C. feedthrough while simultaneously preserving signal information at the received carrier frequency. Specifically, by appropriately selecting the gains at integrators 234 and 238, the downconverted carrier information mapped to the offset frequency is passed to A/D converters 86 and 88. As discussed above, undesired D.C. feedthrough from mixer 60 is then suppressed by subtractors 212 and 214.

The D.C. feedthrough suppression loop 230 also operates to ensure that the baseband signal power provided to A/D converters 86 and 88, and hence to RSSI detector 154, is indicative of the signal power actually received, and is uncorrupted by extraneous D.C. signals.

In an exemplary embodiment it may be desired to modify the D.C. feedthrough suppression technique described above in order to accommodate the reception of received FM signals corresponding to



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"multi-tone" analog signals. More particularly, in certain applications the received FM signal may be representative of a "multi-tone" waveform comprised of a set of stationary, i.e., fixed-frequency, FM signal components, where each stationary component corresponds to the magnitude or pitch of a particular analog tone. This may require that the low-frequency intermodulation products created by interaction of the multiple FM signal components be preserved. Accordingly, if a static frequency offset is introduced by the L.O. oscillator 64, it is possible that particular intermodulation products will be mapped by mixer 60 to baseband D.C. (i.e., to the same baseband frequency at which may be present D.C. feedthrough). In this case it may prove difficult to distinguish between undesired D.C. feedthrough and useful signal information mapped by mixer 60 to baseband D.C. Since the D.C. feedthrough suppression loops 200 and 230 will generally be designed to cancel substantially all D.C. signal energy produced by mixer 60, it is conceivable that useful intermodulation information could be eliminated along with the undesired D.C. feedthrough.

Referring again to Figure 9, in accordance with another aspect of the invention this difficulty is addressed by providing an L.O. offset modulator 260 operative to introduce time varying variation into the D.C. offset applied to the nominal L.O. frequency. The term "nominal" L.O. frequency refers to that frequency at which the received center carrier frequency is mapped to baseband D.C. by mixer 60. Because in this case the L.O. offset frequency supplied to mixer 60 is not static, but instead varies over a predefined range, received stationary components will not be continuously mapped to baseband D.C. but will instead be mapped to baseband frequencies based on variation in the L.O. offset. Hence, useful low-frequency intermodulation products may be distinguished from undesired D.C. feedthrough, because D.C. feedthrough remains at baseband D.C. notwithstanding variation in the frequency offset applied to the L.O. oscillator signal. Accordingly, the offset modulator 260 allows the D.C. feedthrough suppression loop to eliminate undesired D.C. feedthrough while simultaneously preserving certain stationary signal information.

The modulated frequency offset introduced to the nominal L.O. frequency may be characterized in terms of a mean offset frequency, a minimum and a maximum offset frequency, and an offset modulation frequency (i.e., the rate at which the offset is varied between the minimum and maximum offset frequencies). For example, in a particular embodiment the mean frequency offset is selected to be 100 Hz, the minimum and



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maximum offsets are respectively chosen to be 50 Hz and 150 Hz, and the offset modulation frequency is set at 10 Hz.

If the described embodiment is used to build an FM FSK, or GMSK receiver, then the output of A/D converters 86 and 88 is fed to an FM demodulator (not shown). The modulation signal introduced by L.O. offset modulator 260 (10 Hz in preferred embodiment) can be easily removed after the FM demodulation by a digital high pass filter with a cutoff frequency somewhat higher than L.O. offset modulators 260's maximum offset frequency without affecting audio quality.

The previous description of the preferred embodiments is provided to enable any person skilled in the art to make or use the present invention. The various modifications to these embodiments will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other embodiments without the use of the inventive faculty. Thus, the present invention is not intended to be limited to the embodiments shown herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

**WE CLAIM:**



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# CLAIMS

1. An automatic gain control apparatus including an adjustable gain amplifier, the adjustable gain amplifier having an input port for receiving an input signal, a control port for receiving a gain control signal, and an output port for providing an output signal, the automatic gain control apparatus comprising:

a downconverter coupled to said output port for downconverting frequency of said output signal to a baseband frequency so as to produce a baseband signal, said downconverter being operative to map a carrier frequency of said output signal to a baseband frequency offset by a predetermined margin from D.C.;

a D.C. feedthrough suppression loop, disposed to receive said baseband signal, for suppressing D.C. feedthrough signals produced by said frequency downconverter and for providing a compensated baseband signal;

means for generating a received power signal based on power of said compensated baseband signal; and

saturating integrator means for comparing said received power signal to a reference signal and for generating an error signal in response to a result of the comparison, said saturating integrator means including means for providing said gain control signal by selectively integrating said error signal based on values of said error and gain control signals.

2. The automatic gain control apparatus of claim 1 wherein said D.C. feedthrough suppression loop further includes:

a subtractor having a first input for receiving said baseband signal, and an output port operatively coupled to an input of a low-pass filter; and

an integrator having an integrator input port operatively coupled to an output port of said low-pass filter, and having an integrator output port operatively coupled to a second input of said subtractor .

3. The automatic gain control apparatus of claim 2 wherein said D.C. feedthrough suppression loop further includes:

an analog to digital converter coupled to said output port of said low-pass filter; and

a digital to analog converter interposed between said integrator output port and said second input of said subtractor .



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4. The automatic gain control apparatus of claim 2 wherein said D.C. feedthrough suppression loop further includes a high-pass filter interposed between said output port of said low-pass filter and said integrator input port.

5. The automatic gain control apparatus of claim 1 wherein said saturating integrator means includes first means for selectively enabling said error signal to be integrated only while magnitude of said gain control signal is less than a first predefined threshold, and second means for selectively enabling said error signal to be integrated only while magnitude of said gain control signal exceeds a second predefined threshold.

6. The automatic gain control apparatus of claim 1 wherein said downconverter includes:

a mixer having a first input port for receiving said output signal; and

a local oscillator connected to a second input port of said mixer wherein frequency of said local oscillator is selected such that said center frequency of said output signal mapped to said baseband frequency offset by said predetermined margin from said baseband D.C. frequency.

7. The automatic gain control apparatus of claim 6 wherein said downconverter includes an offset modulator circuit for varying said frequency of said local oscillator circuit so as to vary said predetermined margin by which said center frequency of said output signal is mapped relative to said baseband D.C. frequency.

8. The automatic gain control apparatus of claim 7 wherein said downconverter includes a mixer coupled to said output port of said adjustable gain amplifier, said mixer being operative to downconvert said output signal to I and Q baseband signal components of said baseband signal.

9. The automatic gain control apparatus of claim 8 wherein said D.C. feedthrough suppression loop includes first and second low-pass filters said I and Q baseband signal components, respectively.

10. A method for automatic gain control using an adjustable gain amplifier, the adjustable gain amplifier having an input port for receiving an input signal, a control port for receiving a gain control signal, and an



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output port for providing an output signal, the method comprising the steps of:

downconverting frequency of said output signal to a baseband frequency so as to produce a baseband signal wherein a carrier frequency of said output signal is mapped to a baseband frequency offset by a predetermined margin from D.C.;

suppressing D.C. feedthrough signals accompanying said baseband signal so as to provide a compensated baseband signal;

generating a received power signal based on power of said compensated baseband signal; and

integrating selectively a difference between said received power signal and a reference signal based on values of said error and gain control signals.



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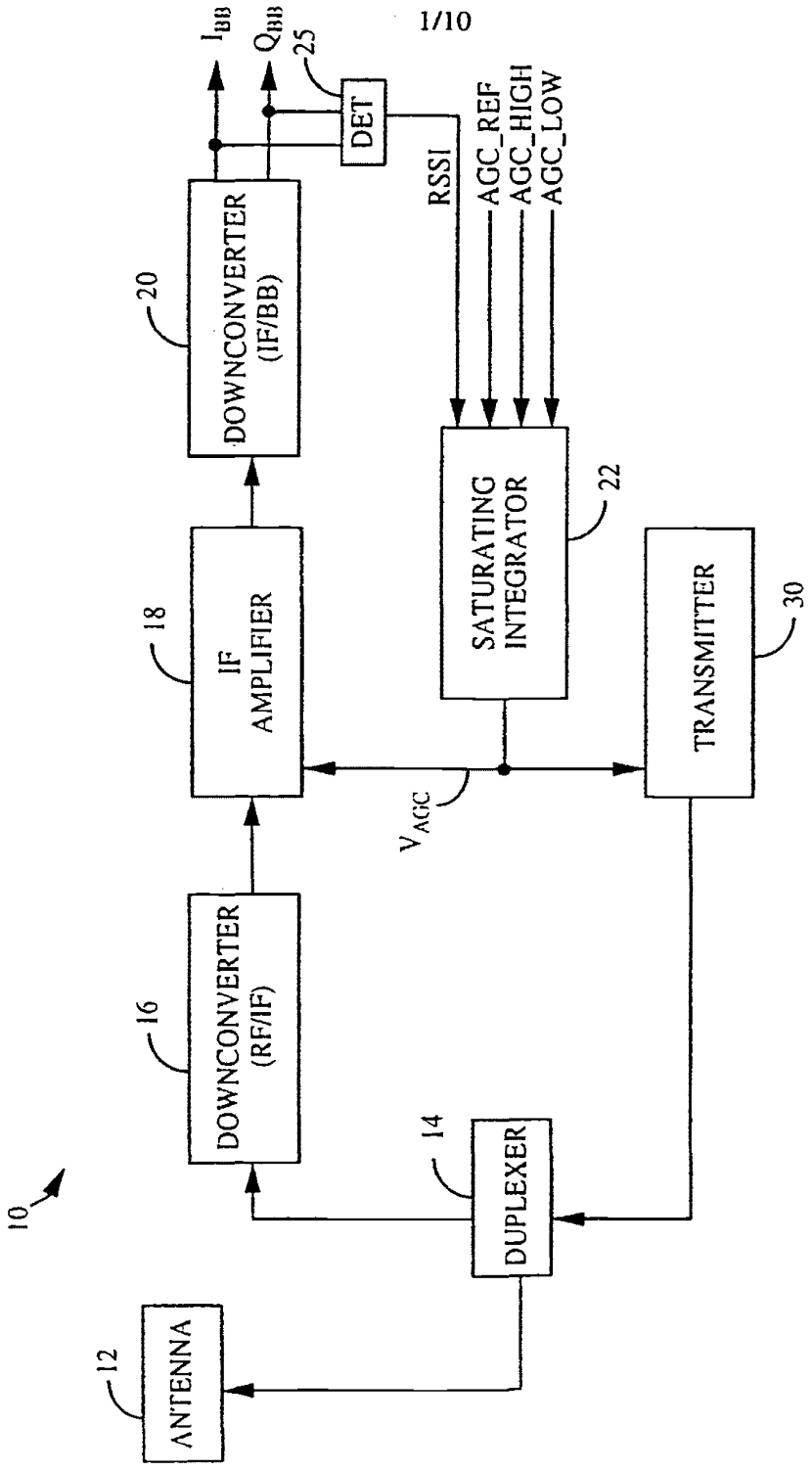



FIG. 1

BNSDOCID: <WO 9530275A1>



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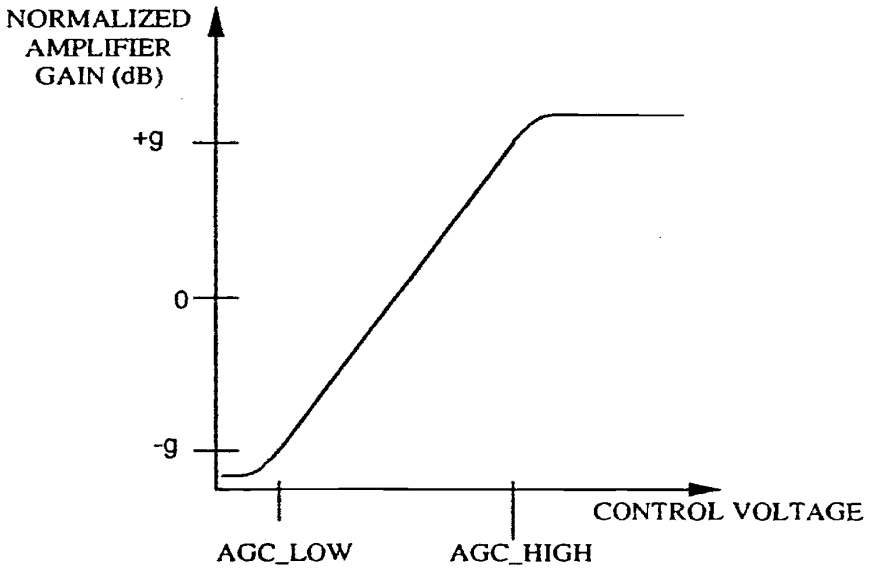



**FIG. 2**



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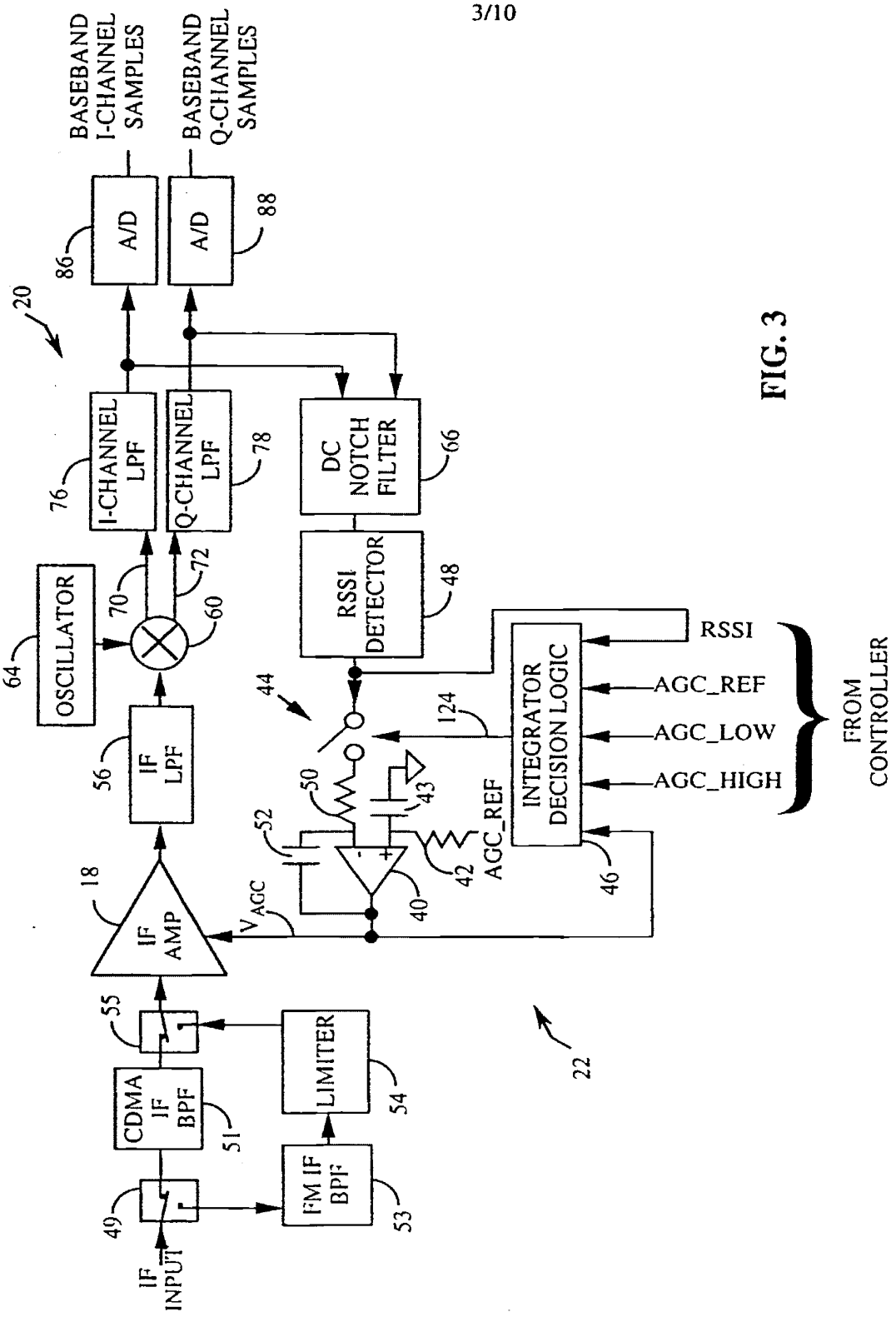



FIG. 3



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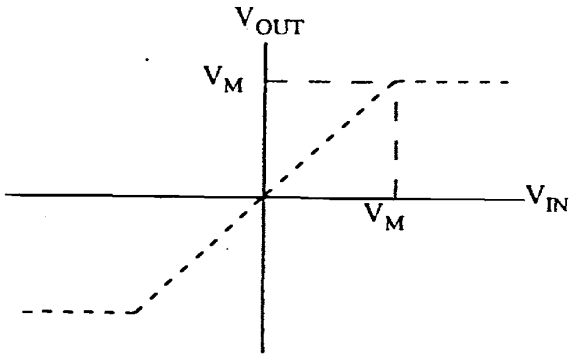



FIG. 4A

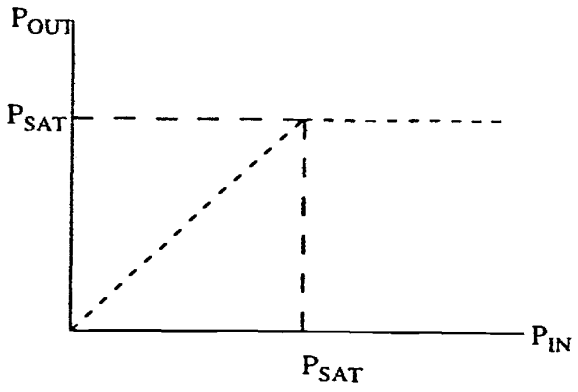



FIG. 4B



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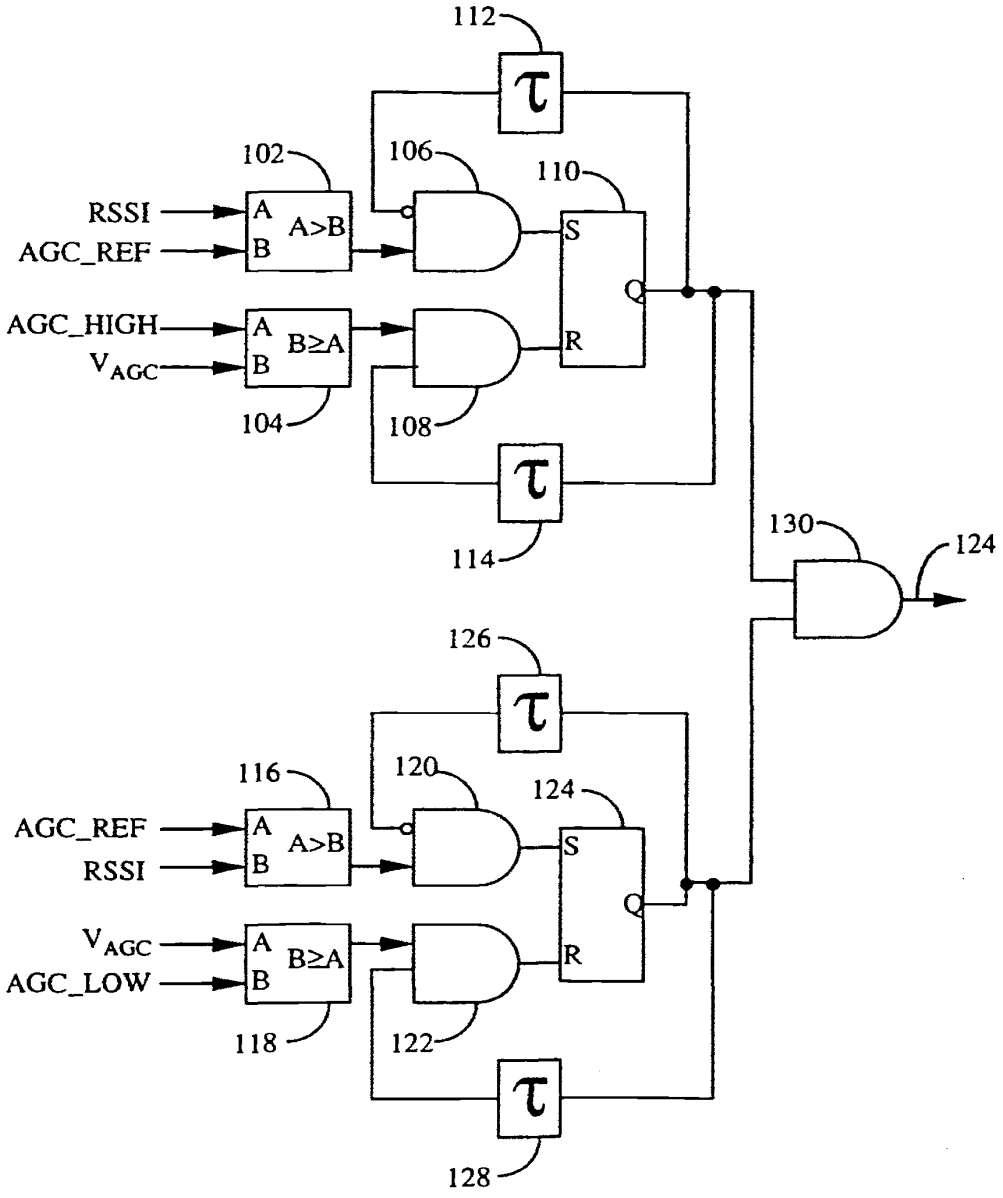

112
τ
102
106
110
RSSI
AGC_REF
A
B
A>B
S
Q
R
AGC_HIGH
$V_{AGC}$
B≥A
104
108
τ
114
130
124
126
τ
116
120
124
AGC_REF
RSSI
A>B
$V_{AGC}$
AGC_LOW
B≥A
118
122
τ
128

FIG. 5

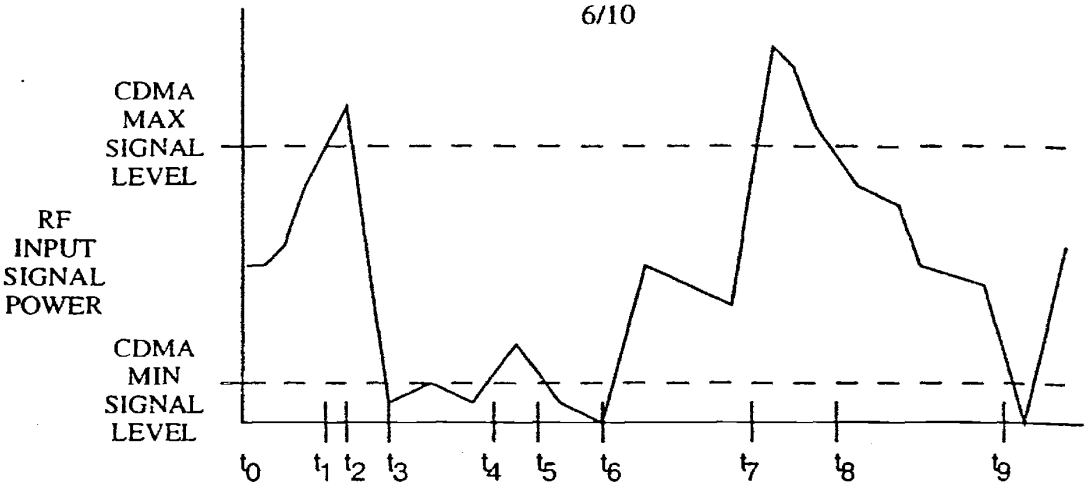



FIG. 6A

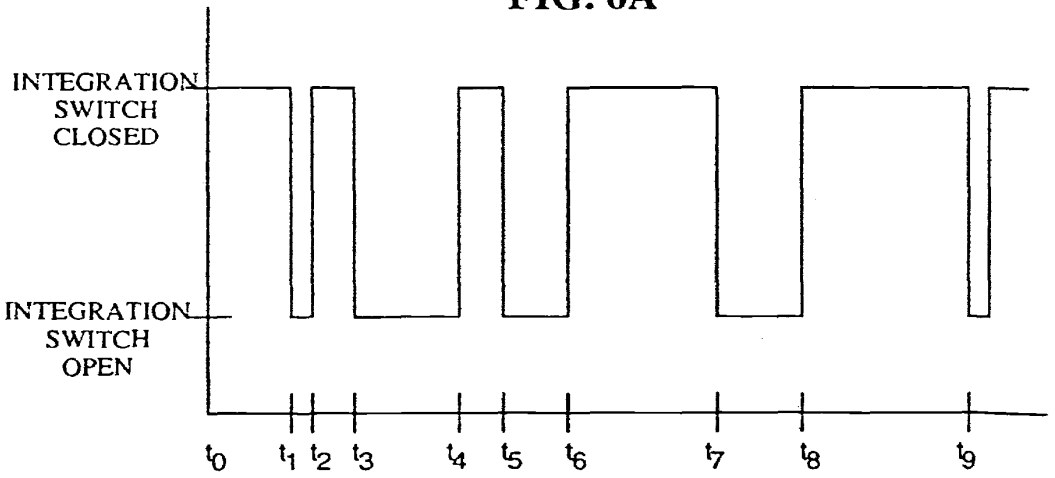



FIG. 6B

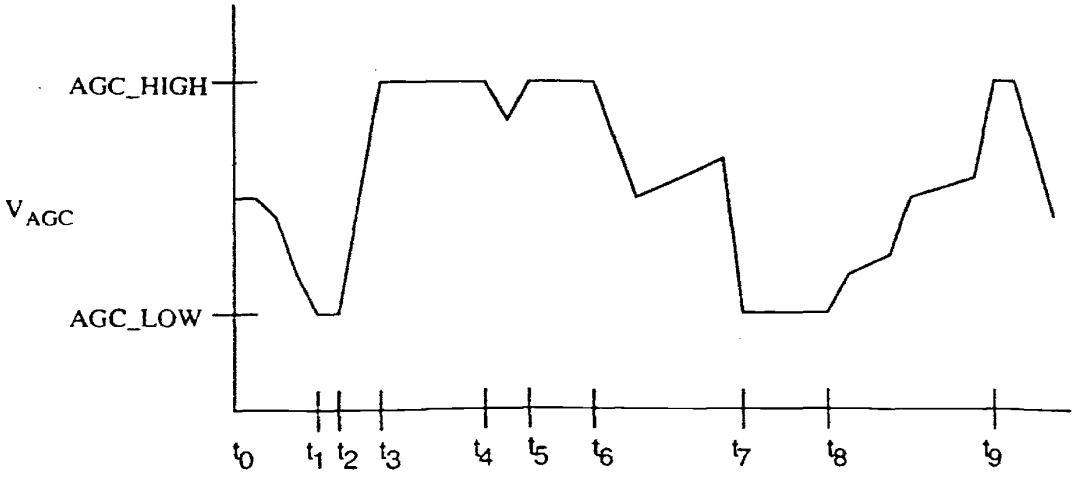



FIG. 6C



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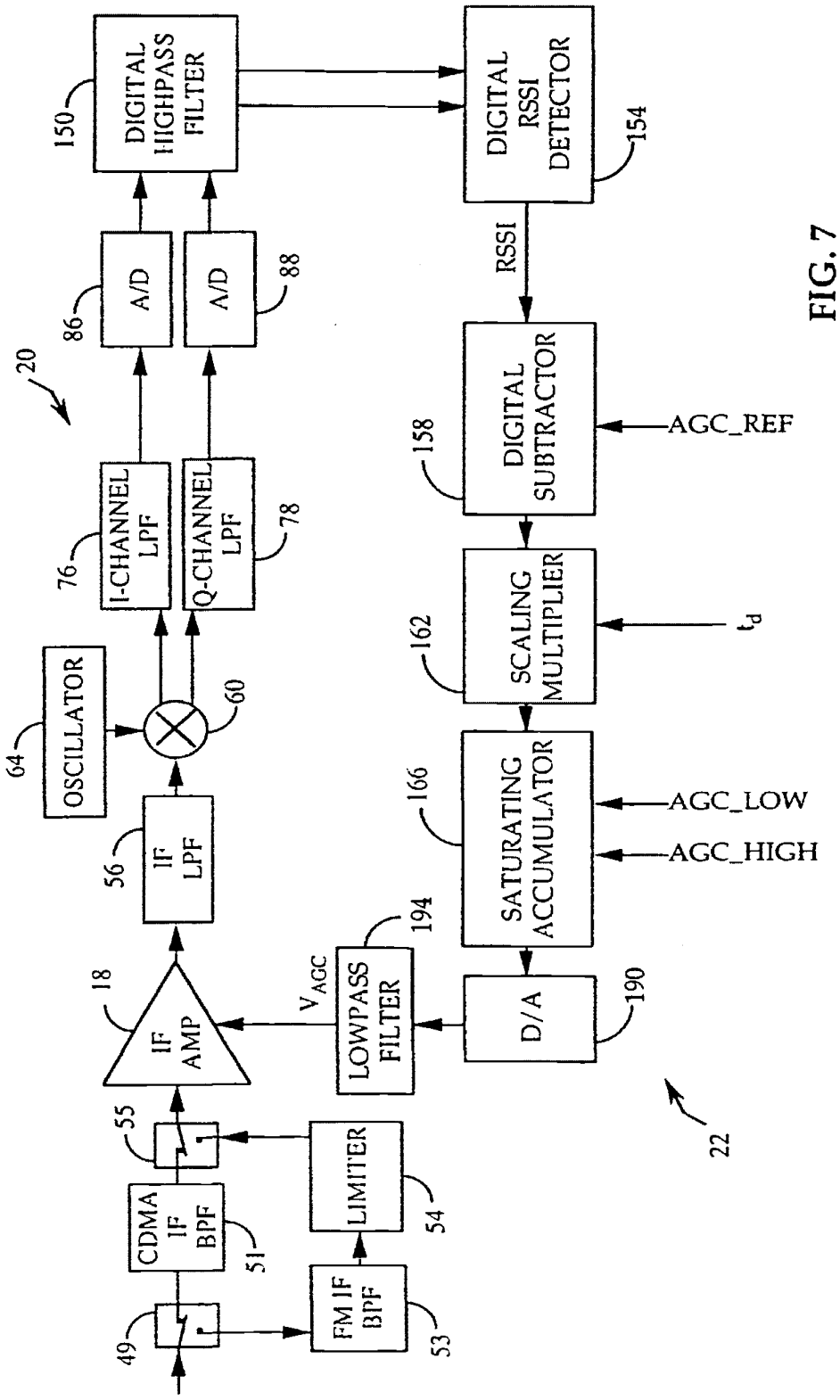



FIG. 7



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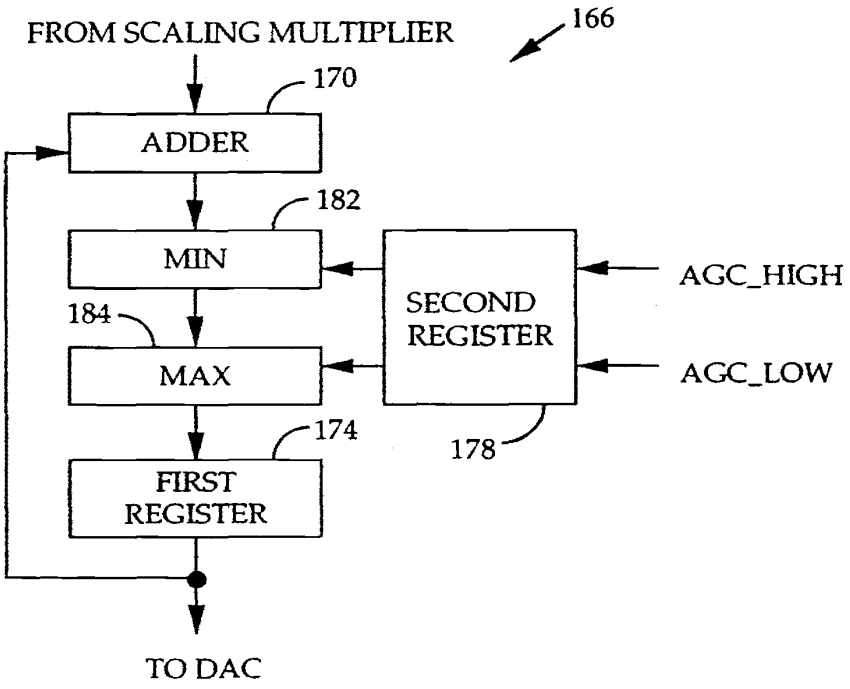



FIG. 8



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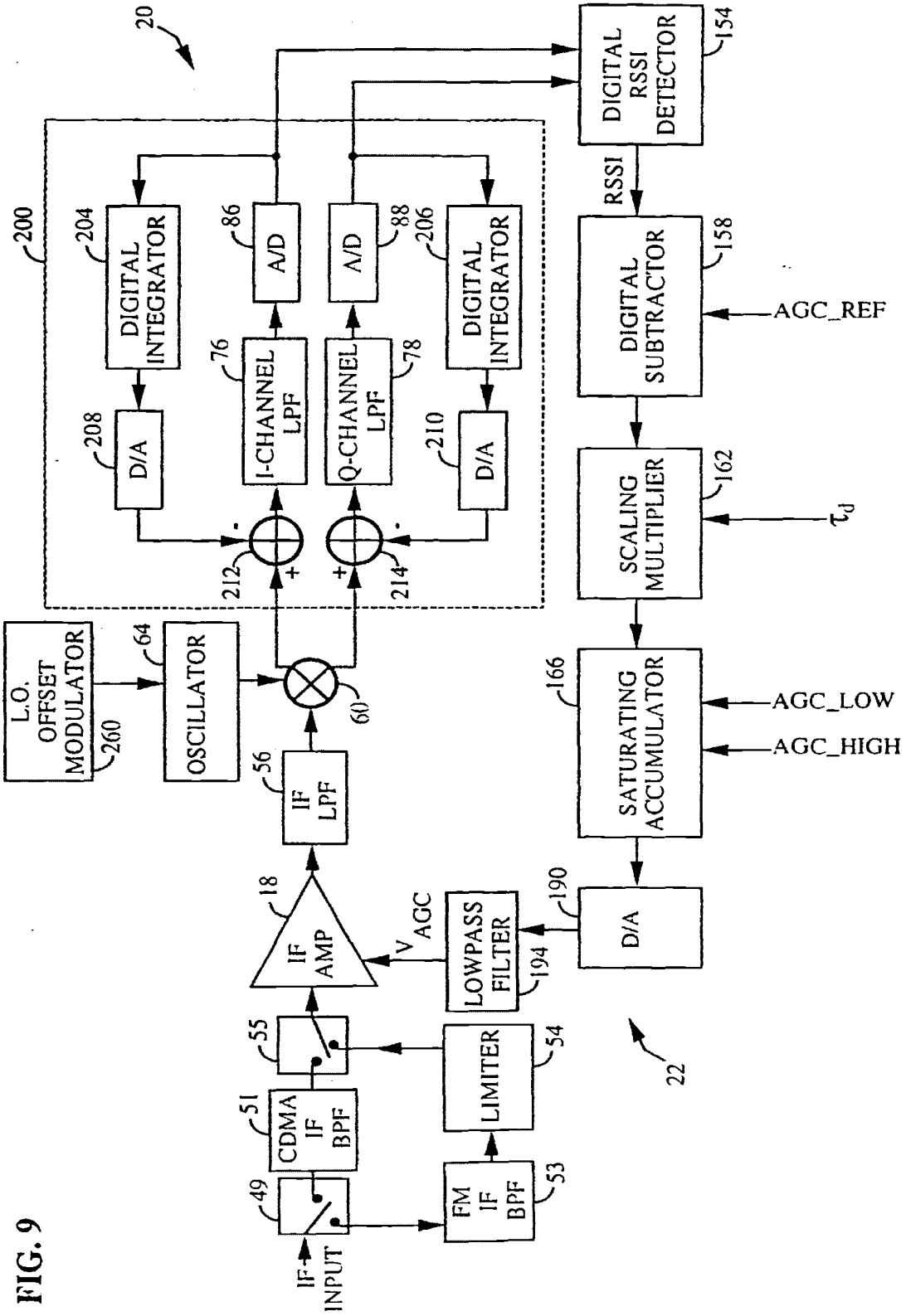



FIG. 9



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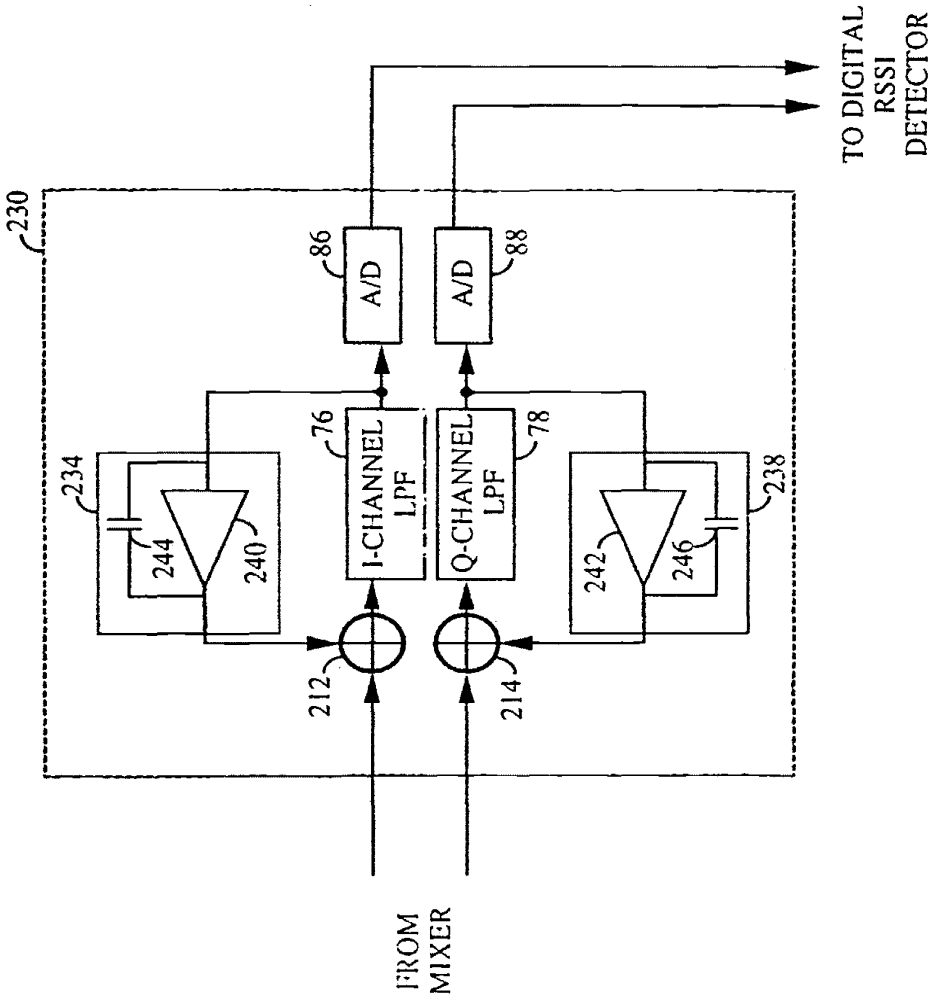



FIG. 10



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# INTERNATIONAL SEARCH REPORT

Intern. Application No
PCT/US 95/05257

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H03G3/30 H03D3/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H03G H03D H04L

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)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US,A,4 653 117 (HECK JOSEPH P) 24 March 1987<br>see column 6, line 64 - column 7, line 29; figure 4 | 1,10 |
| A | EP,A,0 482 927 (NIPPON ELECTRIC CO) 29 April 1992<br>see abstract | 1,10 |
| A | EP,A,0 305 603 (PHILIPS NV) 8 March 1989<br>see page 3, column 31 - page 9, column 57; figures | 1,10 |
| A | US,A,4 944 025 (GEHRING MARK R ET AL) 24 July 1990 | |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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1

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 4 July 1995 | 24. 07. 95 |

| Name and mailing address of the ISA | Authorized officer |
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| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax (+ 31-70) 340-3016 | Blaas, D-L |

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BNSDOCID: <WO 9530275A1>



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# INTER. TIONAL SEARCH REPORT

Information on patent family members

Intern. al Application No
PCT/US 95/05257

| Patent document cited in search report | Publication date | Patent family member(s) | | Publication date |
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| | | AU-B- | 638362 | 24-06-93 |
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| | | CA-A- | 2054173 | 26-04-92 |
| EP-A-0305603 | 08-03-89 | AU-B- | 614702 | 05-09-91 |
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| US-A-4944025 | 24-07-90 | NONE | | |

Form PCT/ISA/210 (patent family annex) (July 1992)



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#1

# EUROPEAN PATENT OFFICE

**Patent Abstracts of Japan**

PUBLICATION NUMBER : 08056121
PUBLICATION DATE : 27-02-96

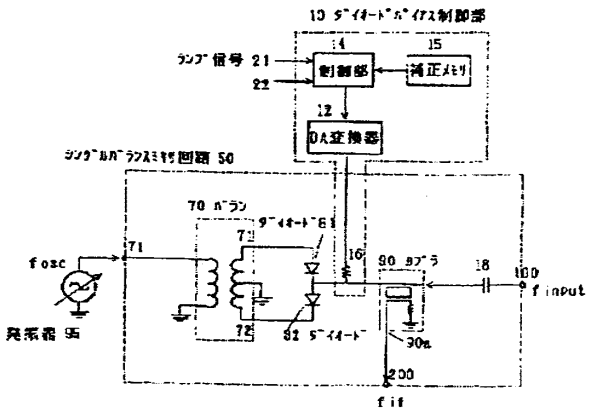
APPLICATION DATE : 10-08-94
APPLICATION NUMBER : 06210499

APPLICANT : ADVANTEST CORP;

INVENTOR : MIYAUCHI YASUSHI;

INT.CL. : H03D 7/14 G01R 23/16

TITLE : FREQUENCY CONVERTER




ABSTRACT : PURPOSE: To considerably reduce the production of a frequency component due to even number order harmonics by controlling the nonlinear resistor of a mixer diode so as to correct the unbalance of a single mixer circuit with a control section thereby providing an ideal single balance mixer state.

CONSTITUTION: A control section 14 receives a ramp signal corresponding to an oscillated frequency $f_{osc}$ of an oscillator 15 and reads a correction value corresponding thereto is read from a correction memory 15 and fed to a D/A converter 12. The D/A converter 12 receives correction data from the control section 14 and converts the data into an analog voltage signal, which is fed to a resistor 16. A bias current is supplied through the resistor 16 to bias either of diodes 81, 82 in a forward/backward direction. Furthermore, the resistor 16 has a high resistance so as not to provide any effect onto a high frequency circuit. Thus, a nonlinear resistor Rj of the mixer diodes 81, 82 is controlled for each unit frequency to correct the unbalance of a single mixer circuit 50.

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#2

XP 000557248

8107 IEEE Journal of Solid-State Circuits
30(1995) December, No. 12, New York, US

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# A 170 MHz RF Front-End for ERMES Pager Applications

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Francesco Piazza and Qiuting Huang, *Member, IEEE*

***Abstract*—A 170 MHz RF front-end for ERMES pager applications has been implemented in a 1.2 $\mu$m BiCMOS technology. The chip comprises a low noise amplifier with AGC, a double balanced mixer, a varactor tuned *LC* local oscillator, and an IF strip containing an AGC amplifier and a double balanced mixer with integrated active output filter. The LNA has a measured gain of 22.3 dB at 170 MHz with a usable AGC range of approximately 20 dB while the conversion transconductance of the mixer is 130 $\mu$S. This front-end is suitable for direct conversion and superheterodyne pager receivers, and its noise figure is 6.2 dB. Low power operation has been achieved with the front-end drawing 230 $\mu$A at 3 V, which is compatible with the intended application in wrist-watch style pagers.**

## I. Introduction

THE EUROPEAN radio messaging system (ERMES) is a new generation of full featured pagers for Europe. It defines different pager types for European wide access from tone only to numeric and alphanumeric. Sixteen channels of 25 kHz bandwidth each are allocated to ERMES. These channels occupy the band from 169.4 to 169.8 MHz using frequency and time division multiplexing [1].

The fast rate at which the wireless communications market, including pagers, is growing today makes integrated solutions with low external part count highly desirable to keep the cost as low as possible. Being a new system, integrated receivers such as the post office code standardization advisory group (POCSAG) pager receiver in [3] are not yet available for the ERMES standard. Although application specific CMOS chips can be found for the digital and base-band analog parts, the front-end of a typical ERMES pager as available at the time of this paper consists of discrete transistors or a few chips and many passive components. Some of these parts are relatively expensive and require adjustments [1].

The trend toward miniaturization not only requires highly integrated RF chips but also lowest power consumption. This is particularly important for extremely miniaturized applications, such as pagers to be integrated in a wrist-watch where battery size must also be minimized. Typically, a miniature button type battery must be used. This means that power consumption must be reduced by about one order of magnitude to achieve sufficient operating time even for a receive-only system such as a pager. The ERMES standard is specified for ON/OFF operation for battery economy, as explained later in this paper, but this is not sufficient to ensure correct operation. Small batteries, especially lithium ones, have a high internal resistance of the order of 100 $\Omega$, rising to some 200 – 500 $\Omega$ with aging, while the maximum current drain rating is usually not higher than a few mA. If power consumption is not low enough, an unacceptable power supply drop may result or battery overloading may occur during the ON time.

Small size also means that a small antenna with a relatively poor efficiency has to be used. To achieve acceptable performance, a front-end with higher gain and lower noise than the one required by larger systems may be necessary, which conflicts with the circuit design requirements for low power consumption. The trade-off between the two requirements must be carefully balanced. Such a trade-off is also affected by the architecture of the receiver front-end.

In this paper, we shall first discuss the two most common receiver architectures: superheterodyne and direct conversion, and the design trade-offs involved in this pager application before proceeding with a short review of the transistor performance degradation at low current. On the basis of these trade-offs, the implementation of the various parts of the chip and the measured performances are discussed.

The term *dBu*, which is defined as *dBV* referred to 223.6 mV, has been used in this paper in place of *dBm* since the impedance level of the various parts of the chip is neither constant nor equal to 50 $\Omega$. This paper was a feasibility study of a low power highly integrated RF receiver chip for wrist-watch style ERMES pagers.

## II. Receiver Architectures

An integrated receiver can be implemented in various different architectures such as those based on single or double conversion superheterodyne and direct conversion principles. The main parameters to be considered for the choice of a suitable architecture are complexity, power consumption, and cost.

### A. Superheterodyne Receiver

The block diagram of a typical superheterodyne receiver is shown in Fig. 1(a). The RF signal is first converted to a usually lower IF where most of the amplification and channel selection occurs before it is detected with a limiter-discriminator. Coherent detection is rarely used in such receivers. For improved performance, a dual conversion scheme, where the first IF signal is converted to a second IF, may be

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The authors are with the Integrated Systems Laboratory, Swiss Federal Institute of Technology (ETH), Zurich, Switzerland.

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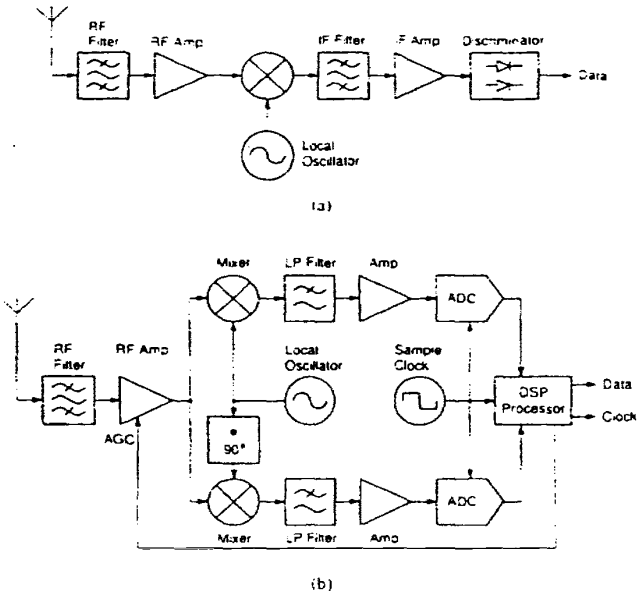



Fig. 1. (a) Superheterodyne and (b) direct conversion receivers.

used. The superheterodyne receiver architecture is the most established architecture because it is relatively simple and usually gives the best performance. However, it requires many external components, especially high quality IF filters and an RF image filter, which are quite expensive and almost impossible to integrate. In terms of power consumption, this architecture also has better performance than direct conversion since the number of active RF parts is minimized.

### B. Direct Conversion Receiver

In a direct conversion receiver, as can be seen in Fig. 1(b), the RF signal is directly converted to base band where it is low-pass filtered for channel selection, amplified, and detected. Because limiter-discriminator detection is not practical at base-band, a coherent detector is usually used. Quadrature local oscillator signals are required to recover the phase before the in-phase ($I$) and quadrature ($Q$) signals are digitized and detected with a DSP. The direct conversion receiver enables the highest level of integration, requires the least amount of adjustments, and potentially has the lowest cost. Since this receiver has no image response, no input filter would be required, but a low $Q$ RF filter should be retained to prevent strong out-of-band signals (e.g., FM broadcast or TV signals) from overloading the RF amplifier. Its drawbacks, however, include sensitivity to flicker noise, AM detection, or local oscillator re-radiation that can make the design difficult. These are briefly discussed below.

- *Flicker noise:* In a direct conversion receiver, most of the gain occurs at base band, while the gain of the RF front-end may be about 20 dB. This means that at the input of the IF-strip, the signal voltage may be only a few microvolts, which is easily masked by noise. At base band, the dominant noise is flicker noise, which can easily be orders of magnitude larger than thermal noise, especially for CMOS processes. A technology with very low flicker noise is then required.
- *AM detection:* Many transmitters, e.g., TV transmitters, amateur radio, etc. are amplitude modulated. Some of these interfering signals may pass through the RF channel filter and reach the input of the mixer. Here, there are enough junctions and other nonlinearities to demodulate these signals and make them indiscernible from the desired signal, eventually destroying the latter completely.
- *Local oscillator re-radiation:* This has two serious effects on the receiver. The first is that the reradiated local oscillator signal is reflected by the antenna and mixed down to dc, where it appears as a large offset. If the reflection coefficient of the antenna changes suddenly, for example, when the user touches the antenna, this offset may fluctuate, eventually reducing the sensitivity of the receiver or overloading the IF-strip completely. The second and more severe effect is that the reradiated signal may disturb other receivers in the same area. For this reason, the ERMES specification [2] imposes a maximum limit of 2 pW of radiated power at the ERMES channels frequency for a receiver to get homologation. This almost seems to preclude direct conversion using existing components.

Power consumption in a direct conversion receiver is also higher due to the extra mixer and accurate 90° phase shifter for the $I$ and $Q$ local oscillator signals required.

Although there is a strong drive in the RF community to overcome the difficulties associated with direct conversion receivers, the trade-offs involved still make it difficult to *a priori* discard either superheterodyne or direct conversion architectures. For this paper, we tried to accommodate both architectures, and the components developed are not customized for one architecture or the other.

## III. Low Current Operation

Due to the application in wrist-watch pagers, the most stringent requirement of this design was low power consumption. The specified power source is a small button-type 3 V lithium battery.

In general, if low power operation of an RF circuit is required, a decrease in performance has to be conceded. When a bipolar transistor is operated at very low current levels, the following problems occur:

- $f_t$ is decreased;
- the equivalent input noise is increased;
- the signal handling capability is reduced.

The noise voltage of a bipolar transistor consists mainly of thermal noise in the base and emitter resistances, shot noise due to dc current flow, and 1/f flicker noise. At RF, flicker noise is negligible but may have to be considered for direct conversion receivers. If the impedance of the signal source is low, as it usually is in most RF circuits, the noise current is also negligible. The noise voltage, referred to the base, is then



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expressed as

$$\overline{v_n^2} = 4kT(R_B - R_E - (2g_m)^{-1})$$

where the first two terms represent thermal noise, and the last one represents shot noise. Since the $g_m$ of a bipolar transistor is a function of its collector current only, in a low current design shot noise becomes dominant. This shot noise is inherent to dc current flowing through a junction and cannot be decreased by careful design or the use of an advanced IC process. The best trade-off between noise and power consumption has to be found. It is not possible to reduce both simultaneously.

Thermal noise originates mainly from the base resistance and can be reduced if the size of the transistor is increased. Unfortunately, this decreases the current density in the transistor and therefore the $f_t$, while the junction capacitances are increased. The effect of junction capacitances on frequency response can be reduced by proper design of the amplifier as can be seen later in this paper. However if the transistor is made too large, an unacceptable $f_t$ reduction may result. Thus, the transistor has to be sized just large enough to make thermal noise low compared to shot noise. Any further increase in size results only in decreased high frequency performance with almost no noise improvement.

Low current operation may cause an excessive increase in the input impedance of the amplifier as well as a reduction of its dynamic range. The small signal input impedance ($r_\pi$ and $C_\pi$) of a transistor is expressed as

$$r_\pi = \frac{\beta}{g_m}, \quad C_\pi = \tau_F g_m$$

and is therefore increased by reducing the collector current, eventually becoming larger than the impedance of the parasitic elements. Matching a high impedance to a 50 Ω source is critical, and the bandwidth of the matching network may become too narrow for this application. This difficulty may be overcome if matching is done in two steps, but this increases both complexity and cost. Due to the large impedance ratio, a substantial voltage gain has to be expected in the input matching network. For example, the one used in this paper (see Section V) has a voltage gain of 17 dB. Since the relationship between collector current and base-emitter voltage is exponential, the intercept point (IP3) is independent of the collector current and is located at −12.7 dBu. However, this value is decreased by the voltage gain of the matching network, resulting in a decrease of the overall signal handling capability.

## IV. The Ermes Chip

Taking into account the trade-offs involved, our ERMES chip has been developed emphasizing low power consumption more than high performance. The block diagram of this chip is shown in Fig. 2. It contains a 170 MHz RF front-end that comprises a low noise amplifier with gain control, a fully balanced mixer, and an $LC$ local oscillator, and an IF strip consisting of an IF amplifier and a mixer with active output filter. No second mixer or phase shifters for the $Q$ channel have been implemented on this chip.

To avoid excessive capacitive loading, the output node of both the RF and IF amplifiers has been connected internally

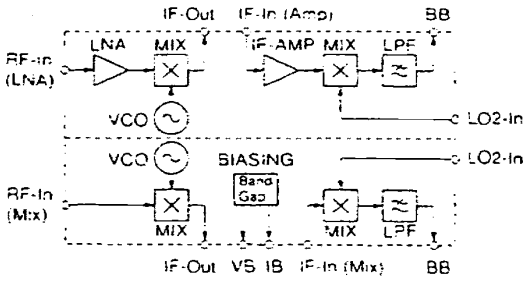



Fig. 2. Block diagram of the chip.

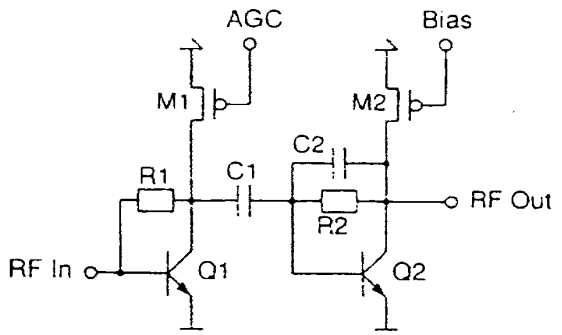



Fig. 3. Schematic diagram of the LNA.

to the mixers and therefore is not externally accessible for measurements. Thus, the circuit has been duplicated omitting the amplifiers to allow the latter to be characterized indirectly.

Supply voltage independent biasing that consists of a $\Delta V_{BE}$ current source and a 1.2 V bandgap voltage reference has also been added. On-chip decoupling capacitors have been used on all supplies, except the voltage reference. The sum of all on-chip capacitors is 10 pF.

This chip has been implemented in a 1.2 μm BiCMOS technology with vertical NPN transistors having a peak $f_t$ of 8 GHz and poly-poly capacitors. The design is largely bipolar with the MOS transistors used only for biasing purposes.

### A. The Low Noise Amplifier

Although the peak $f_t$ of the available bipolar transistor is more than adequate for this design, its high base resistance may limit both the frequency response and the noise performance. To minimize noise while maintaining the frequency performance, the LNA circuit has been configured as shown in Fig. 3. It is a two-stage design consisting of a transconductance stage driving a transimpedance amplifier.

Transistors $Q_1$, $M_1$, and resistor $R_1$ form the transconductance amplifier. In this design, more emphasis has been given to very low power consumption than to highest performance, thus a nominal collector current of only 48 μA has been chosen for $Q_1$, which is just enough to prevent an unacceptable $f_t$ reduction. $Q_1$ is also the major noise contributor of the

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amplifier and at the chosen operating current its shot noise is about 2.2 nV/$\sqrt{\text{Hz}}$. To prevent $r_B$ from contributing too much noise, $Q_1$ has a large size. An $r_B = 105\ \Omega$ has been obtained that adds another 1.32 nV/$\sqrt{\text{Hz}}$. The input referred noise contribution of $M_2$ and $R_1$ is negligible, being 77 pV/$\sqrt{\text{Hz}}$ and 30 pV/$\sqrt{\text{Hz}}$, respectively. The large size of $Q_1$ results in a large collector-substrate parasitic capacitance of about 260 fF, but its influence on the frequency response is small as $Q_1$ drives a low impedance node. In effect, the input impedance of the transimpedance amplifier, assuming its load impedance (the mixer) to be much larger than $R_2$, is $1/g_{m,Q2} \simeq 550\ \Omega$. With $C_{JS} = 260$ fF in parallel with the bottom plate capacitance of $C_1$ (180 fF), this results in a time constant of $RC = 242$ ps or a cutoff frequency of 658 MHz.

The transimpedance stage consists of $Q_2$ and the feedback resistor $R_2$. Since $Q_2$ hardly contributes to noise, it has minimum area to keep all parasitic capacitances low. It is also biased at 48 $\mu$A. Feedback resistors always increase the noise of an amplifier and in this case, an additional equivalent input noise of 1.28 nV/$\sqrt{\text{Hz}}$ is generated. The high operating frequency allows ac interstage coupling with a small 2 pF capacitor that is compatible with IC technology. The stray capacitances connected at the base of $Q_2$, mainly $C_{JS}$ of $Q_1$, and the bottom plate capacitance of $C_1$, add a pole in the feedback around $Q_2$, which may cause peaking in the frequency response. This peaking can be avoided with a small compensation capacitor ($C_2$) of 35 fF in parallel to $R_2$. With such compensation, the LNA is well behaved, showing a flat frequency response and no peaking at all.

Due to the low bias current of the input transistor, a capacitive high input impedance dominated by parasitics has to be expected. Using a simple $LC$ high pass network, matching to 50 $\Omega$ has been achieved. Nevertheless, the real part of these parasitics degrades the noise figure.

The LNA has a nominal gain of 20 dB, which is enough to minimize the noise contribution of the mixer without causing early mixer overloading. Its size is 202 × 80 $\mu$m$^2$. Gain control is achieved by varying the bias current of $Q_1$. Since the $g_m$ of a bipolar transistor is a linear function of its collector current, AGC action is linear. Unfortunately, the input impedance will vary as a result of AGC action, causing mismatch to the RF source. This should not be a problem though, since a gain reduction at the front-end only occurs for very large input signals whose reception will be sufficiently good despite mismatch losses.

### B. The RF Mixer and the VCO

In Fig. 4, the schematic diagram of the mixer and VCO combination, including the external parts for the VCO, is shown. The mixer is fully balanced to achieve good local oscillator rejection. Although a single balanced mixer would have twice the conversion gain for the same bias current and actually would have been a better choice for a superheterodyne receiver where the IF filter is passive, the large local oscillator feedthrough would have made it useless for a direct conversion receiver where the channel filter is active, by saturating the first stage of the latter. The conversion transconductance of

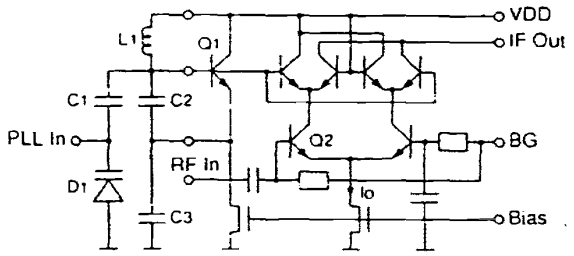



Fig. 4. Schematic diagram of the mixer-VCO combination.

this mixer is

$$g_{m(\text{conv})} = \frac{1}{\pi}\frac{g_{m1Q2}}{2} = \frac{1}{\pi}\frac{I_0}{4V_t} = 147\mu S$$

assuming ideal switching. This agrees well with the measured value of 130 $\mu$S. The output is open collector and can be connected to an external ceramic filter if a superheterodyne receiver is desired or to a transimpedance active load for direct conversion.

The intercept point IP3 is defined by the input differential pair and is 6 dB higher than the IP3 of a single transistor. Its value is thus −6.7 dBu. A direct measurement of IP3 has not been made. However it can be calculated from the −1 dB compression point using a simple method found in many RF handbooks [4], which says that the IP3 is located about 10 dB above the −1 dB compression point. A value of −7.5 dBu can therefore be derived from the measured −1 dB compression point of −17.5 dBu.

Since the conversion transconductance of the mixer is dependent on $1/V_t = q/kT$, it is inversely proportional to the absolute temperature. This is compensated by biasing the mixer with a PTAT ($\Delta V_{be}$) current source. The pin marked $BG$ can be connected to the internal 1.2 V bandgap voltage reference or to an external voltage.

The VCO comprises $Q_1$, an external parallel resonator $L_1, C_1, C_2, C_3$, and the varactor $D_1$ for frequency tuning. It is a Colpitts oscillator and is designed for minimum current consumption of only 48 $\mu$A. To achieve adjacent channel selectivity of 60 dB, as specified for ERMES [2], a phase noise figure of −105 dBc/Hz at 25 kHz offset from the carrier is required for the VCO. Such a stringent phase noise specification virtually excludes any fully integrated oscillator and dictates the use of an external high $Q$ resonator. To save power, the oscillator is directly connected to the mixer without buffering. Although the bias current is very low, neither oscillator pull-in nor instability has been observed during the measurements even for very large input signals. Temperature compensation of the $g_m$ of $Q_1$ has been achieved by biasing this transistor with the same PTAT current as the mixer.

The size of the mixer-VCO combination is 200 × 80 $\mu$m$^2$.

### C. The IF Amplifier

The IF amplifier is a scaled down version of the LNA, and its schematic diagram is shown in Fig. 5. The transconductance stage is realized by $Q_1$ and the transimpedance amplifier



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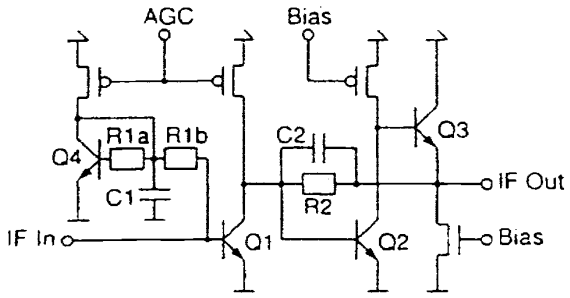



Fig. 5. Schematic diagram of the IF amplifier.

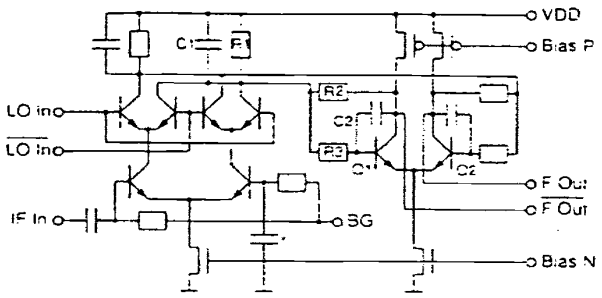



Fig. 6. Schematic diagram of the IF amplifier.

by $Q_2$, $Q_3$, and the resistor $R_2$. Due to the low frequency, ac interstage coupling is not practical here. The two stages are therefore dc coupled and biasing for the first stage is obtained with a replica circuit consisting of $Q_4$ and resistors $R_{1a}$ and $R_{1b}$. The collector current is the same for both $Q_1$ and $Q_4$. Its nominal value is 12.5 $\mu$A and can be varied for gain control, which is also linear. The noise in the IF amplifier is not dominant due to the high gain of the preceeding stages, thus $Q_1$ has minimum size to minimize $C_{js}$.

Transistors $Q_2$ and $Q_3$ form the transimpedance amplifier. Buffer $Q_3$ prevents the collector of $Q_2$ from being loaded by $R_2$ and the IF mixer, allowing more gain to be obtained at a given collector current. Capacitor $C_2$ compensates the amplifier and reduces its bandwidth to about 50 MHz.

The amplifier is designed for a gain of 26 dB, a total current consumption of 48 $\mu$A, and its size is 192 × 80 $\mu$m$^2$. Since the well resistors ($R_2$) have a value that is lower than nominal, the measured gain is 24.3 dB. This gain can be temperature compensated by biasing the IF amplifier with the internal PTAT current source.

### D. The IF Mixer and Output Filter

The IF mixer and output filter is shown in Fig. 6. This mixer is also fully balanced for local oscillator rejection but includes transimpedance active loading and 2-pole active lowpass filtering. The input signal is ac coupled to the mixer. Unlike the IF amplifier, ac coupling here is feasible with a small 2 pF capacitor since the input impedance of the mixer is high. No IF local oscillator has been integrated on chip, and the local oscillator signals have to be supplied externally. Typically, these signals may be derived by dividing a higher frequency with an ECL divider, which also allows the generation of very accurate $I$ and $Q$ signals for coherent detection if necessary. This mixer can also be used for conversion to a second IF, provided it is within the bandwidth of the output filter.

The output filter is a second-order multiple-feedback low pass filter that also represents the transimpedance active load for the mixer. The gain stage consists of the differential pair $Q_1$ and $Q_2$ whose collectors directly drive the output pads and the feedback network $R_1$, $R_2$, $R_3$, $C_1$, and $C_2$. This means that the open loop gain of this stage is low, and only very low $Q$ filters can be built with this simple structure. The filter has two

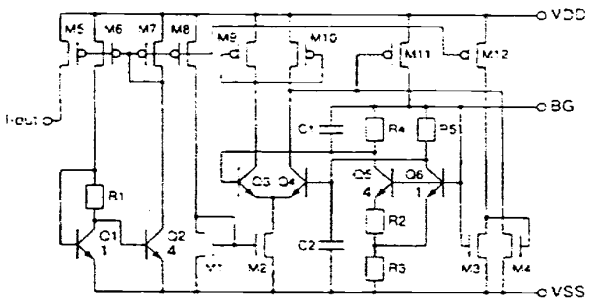



Fig. 7. Schematic diagram of the band-gap voltage reference.

real poles placed at 250 kHz and 1 MHz. The two capacitors between mixer output and VDD (one is marked $C_1$ in Fig. 6) also provide first-order filtering for common mode signals.

The conversion gain of this stage is defined by the conversion $g_m$ of the mixer and $R_2$. Its nominal value is 18 dB. Again, the lower value of the N-well resistors reduce this gain to its measured value of 16.7 dB. The total current consumption is 48 $\mu$A.

The layout of this circuit consists of two blocks, one containing the mixer and the active components of the filter whose size is 273 × 80 $\mu$m$^2$, and the other containing the filter $RC$ network whose area is 346 × 146 $\mu$m$^2$.

### E. Biasing

The biasing circuit, which comprises a $\Delta V_{BE}$ current source and a band-gap voltage reference, is shown in Fig. 7.

In order to maintain the various gains and transconductances constant over temperature and supply voltage changes, a supply independent current source with PTAT characteristic is needed. For this purpose, a $\Delta V_{BE}$ circuit has been used. It consists of $Q_1$, $Q_2$, $M_5$, $M_7$, and the N-well resistor $R_1$ of 36 kΩ, which defines a nominal current of 1 $\mu$A. This current is then mirrored by $M_3$, whose drain is connected to a pad. Start-up is guaranteed by leakage currents, and no explicit start-up circuit was needed to ensure correct operation.

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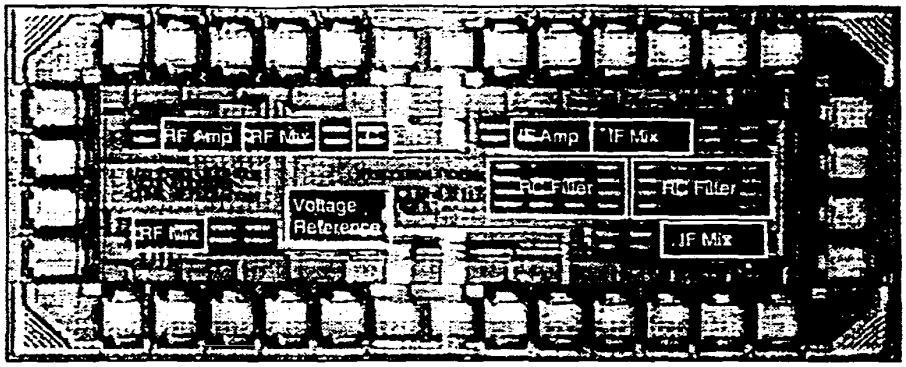



Fig. 8. Photomicrograph of the chip.

Both the RF and the IF mixers also require a voltage to bias their input transistors. This voltage is uncritical, and its value should be about 1.2 V and has thus been realized as a band-gap voltage reference. The band-gap cell consists of $Q_5$ and $Q_6$, the error amplifier comprises $Q_3$ and $Q_4$, and the output stage is $M_{11}$. The latter is P-channel for low drop-out operation, and in effect, the whole circuit operates from 1.4 V. Start-up is ensured by $M_3$ and $M_4$, while frequency compensation is achieved by $C_1$ and $C_2$, both 1.5 pF. No external capacitor is needed for stability, but a 10 nF capacitor is required for good high frequency line/load rejection. This reference can source up to 20 $\mu$A or sink up to 5 $\mu$A, which is adequate as the load (the mixers) sinks almost no current.

The size of the biasing circuit is 243 × 137 $\mu m^2$.

### F. Power Consumption

As stated earlier, the most stringent requirement of this design was low power to enable the construction of wrist-watch style pagers supplied by a small 3 V lithium battery.

The current consumption of the front-end, including LNA, RF-mixer, local oscillator, and biasing, is about 230 $\mu$A. In order to save power, ERMES is specified for intermittent operation. The typical ON:OFF ratio of an ERMES pager is about 1:100, while the worst case is 1:14. This results in an excellent 2.3 $\mu$A and 17 $\mu$A, respectively, in case of a superheterodyne receiver, which are fully compatible with the intended application. Even twice these values, which the direct conversion front-end would require due to the need of a second mixer and a 90° phase shifter, still represent very low power consumption.

## V. Measured Performance

For these measurements, a small PCB containing all the needed components has been constructed. The PCB has one signal plane and one ground plane on opposite sides with the unpackaged chip directly bonded on it. A photomicrograph of the chip is shown in Fig. 8. To keep parasitic inductances and capacitances low, SMD passive components have been used. The supply voltage has been set to 3 V, and the various bias currents have been set to their nominal values using external resistors rather than the internal current source. The internal band-gap voltage reference has been connected to the $BG$ pad of the mixers. The LNA has been matched to 50 Ω using a high pass matching network consisting of a 2.5 pF capacitor and a 175 nH inductance. A schematic diagram of this matching network and the resulting input impedance are both shown in Fig. 9. All other inputs have been resistively matched for simplicity. Resistive matching always increases noise, but this was unimportant as no noise measurements other than the one on the complete front-end have been made. The components for the local oscillator are $L_1$ = 100 nH, $C_2$ = 4.7 pF, and $C_3$ = 2.2 pF. $C_1$ and $D_1$ have been substituted by a 3 ··· 10 pF variable capacitor, while the open collector output of the RF mixer has been loaded with a parallel LRC tank consisting of $L$ = 6.8 nH, $R$ = 5.6 kΩ, and $C$ = 32.5 pF, adjusted to 10.7 MHz. The band-gap voltage reference has been decoupled to ground with a 10 nF capacitor.

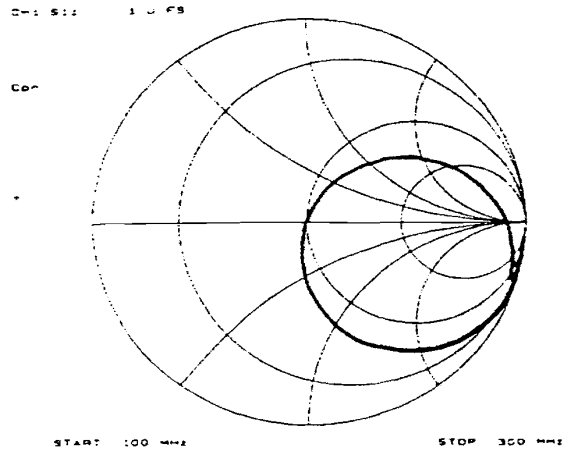
The LNA has a maximum voltage gain of 22.3 dB, referred to its input, not the matching network's input. Gain control is linear with a useful range of about 20 dB. The −1 dB compression point is dominated by the mixer and is located at −39 dBu at maximum gain and −30 dBu if the LNA gain is reduced by 10 to 12.5 dB. Its complex input impedance at 170 MHz is 54 − $j$372 Ω, equivalent to the series connection of a 54 Ω resistor and a 2.5 pF capacitor.

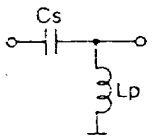
Since the VCO has no buffered output, its spectrum has been measured indirectly. The signal of the free running VCO, tuned at 180.7 MHz has been mixed down to 10.7 MHz using the internal mixer, whose input was connected to a 170 MHz oscillator. Here a very clean, very stable PLL synthesized signal generator has been used to avoid degrading the measurement. The spectrum of the VCO is shown in Fig. 10. The early flattening of the curve is due to white noise at −132 dBm coming from the test setup. This limits the resolution of the measurement, especially for frequency offsets larger than 5 kHz. Since the carrier, as seen at the input of the spectrum analyzer, is at −34 dBm, the resolution of this measurement is −98 dBc/Hz, which is not high enough to check the required limit of −105 dBc/Hz at 25 kHz



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Cs = 2.5pF
Lp = 175nH

Fig. 9. Matching network and LNA input impedance (matched).

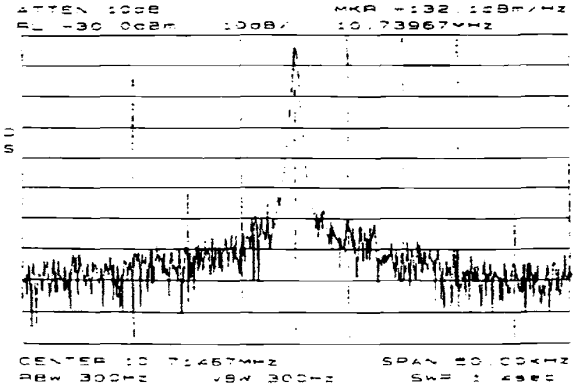



Fig. 10. Spectrum of the VCO (mixed down to 10.7 MHz).

offset. The phase noise at frequency offsets of 0.5, 1.0, and 2.0 kHz is −51.1, −63.2, and −74.9 dBc/Hz, respectively. Extrapolating these measurements to 25 kHz, an approximate value of −118 dBc/Hz is calculated, which fulfills the ERMES requirement by a substantial margin.

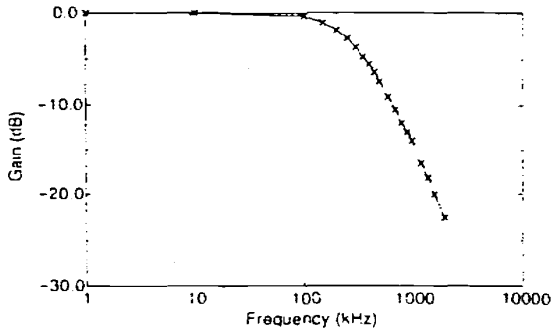



Fig. 11. Frequency response of the output filter.

TABLE I
CHIP CHARACTERISTICS

| | |
|---|---|
| Process | 1.2 $\mu$m BiCMOS |
| Chip size | 2240 x 980 $\mu m^2$ |
| Power supply voltage | 3 V (typical) |
| Front-end supply current | 230 $\mu$A |
| LNA gain | 22.3 dB |
| Front-end noise figure | 6.2 dB |
| RF mixer conversion $g_m$ | 130 $\mu$S |
| VCO phase noise (2 kHz offset) | -74.9 dBc/Hz |
| IF amplifier gain | 24.3 dB |
| IF mixer conversion gain | 16.7 dB |
| Output filter bandwidth | 250 kHz |

The RF mixer has been measured using the on-chip local oscillator tuned at 180.7 MHz as one of the signal sources. The conversion $g_m$ of the RF mixer is 130 $\mu$S, and its −1 dB compression point is −17.5 dBu.

The noise figure has been measured on the complete front-end, with the 170 MHz input impedance matched (not noise matched) to 50 Ω. A value of 6.2 dB has been measured, which as expected is not very good due to very low current operation of the LNA.

The IF components have been measured at 10.7 MHz. The local oscillator signal for the IF mixer was a square wave with a peak-to-peak amplitude of 250 mV. Its frequency has been varied from 10.7 to 12.7 MHz for the measurement of the output filter's frequency response.

The maximum gain of the IF amplifier is 24.3 dB with about 20 dB of linear gain control range. The conversion gain of the IF mixer is 16.7 dB, and the −1 dB compression point is −16.4 dB, as expected.

The output filter attenuation at 250 kHz is 2.8 dB. A plot of the frequency response of this filter is shown in Fig. 11.

The $\Delta V_{BE}$ current source operating current is 1.44 $\mu$A for a supply voltage of 1.2 V, increasing to 1.58 $\mu$A for a VDD of 4.0 V, and at a temperature of approximately 25°C. The output voltage of the band-gap reference is 1.205 V for VDD varying between 1.4 and 4.0 V.

A summary of the characteristics of this chip is shown in Table I.



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## VI. Conclusion

The construction of wrist-watch style pagers requires highly integrated, very low power chips for both the analog RF and the digital parts. An RF receiver chip that fulfills these requirements has been designed using a 1.2 $\mu$m BiCMOS technology. With this paper, we hope to demonstrate that an integrated RF receiver for the ERMES pager can be realized using fewer external components, consuming less power than today's solutions, and using a relatively inexpensive technology.

## References

[1] R. J. Coy and C. N. Smith, "Receiver architectures and VLSI considerations for ERMES," *IEE Coll. on VLSI Implementation for 2nd Gen. Digital Cordless and Mobile Telecommun. Syst.*, London, England, Mar. 1990.

[2] ———, *ERMES Specifications, Tests for Radio Parameter Conformance*, ch. 7, Final Draft prTBR 7, 1992.

[3] ———, UAA2080T VHF/UHF paging receiver features and applications, Philips Semiconductors Laboratory, Tech. Rep. ETT91003, 1993.

[4] ———, *RF/IF Designer's Handbook*, Brooklyn, NY: Mini-Circuits, 1992.



**Francesco Piazza** was born in Olivone, Switzerland, on January 5, 1962. He received the Diploma degree in electrical engineering from the Swiss Federal Institute of Technology (ETH), Zurich, in 1992.

Since May 1992, he has been with the Integrated Systems Laboratory at the same university where he is working toward the Ph.D. degree in the area of RF and other high speed integrated circuits.



**Qiuting Huang** (S'86–M'87) graduated from the Department of Precision Instruments, Harbin Institute of Technology in 1982. He received the Ph.D. degree from Katholieke Universiteit Leuven, Departement Elektrotechniek, ESAT Laboratories, Heverlee, Belgium in 1987.

Between 1987 and 1992, he was a lecturer at the University of East Anglia, Norwich, UK. Since January 1993, he has been Assistant Professor at the Integrated Systems Laboratory, Swiss Federal Institute of Technology. His general field of research is in analog and mixed analog-digital integrated circuits and systems. His current research projects include RF front-end for wireless communications, interface circuits to sensors and actuators, low noise, low power IC's for biomedical applications, smart power IC's as well as high speed CMOS digital circuits in the gigahertz clock range.



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UNITED STATES DEPARTMENT OF COMMERCE
**Patent and Trademark Office**
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
|---|---|---|---|
| 09/292,301 | 04/15/99 | MURTOJARVI S | 297-008576-U |

| EXAMINER | |
|---|---|
| WEST, L | |
| **ART UNIT** | **PAPER NUMBER** |
| 2681 | |

WM01/0131

CLARENCE A GREEN
PERMAN & GREEN LLP
425 POST ROAD
FAIRIELD CT 06430

**DATE MAILED:** 01/31/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

PTO-90C (Rev. 2/95)
*U.S. GPO: 2000-473-000/44602

1- File Copy



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| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/292,301 | MURTOJARVI ET AL. | |
| | Examiner | Art Unit | |
| | Lewis G. West | 2681 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *15 April 1999* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claims _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. § 119**

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. & 119(e).

**Attachment(s)**

15) ☒ Notice of References Cited (PTO-892)
16) ☒ Notice of Draftsperson's Patent Drawing Review (PTO-948)
17) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
18) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
19) ☐ Notice of Informal Patent Application (PTO-152)
20) ☐ Other: .



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### *Specification*

1. The following guidelines illustrate the preferred layout and content for patent applications. These guidelines are suggested for the applicant's use.

### Arrangement of the Specification

2. The following order or arrangement is preferred in framing the specification and, except for the reference to "Microfiche Appendix" and the drawings, each of the lettered items should appear in upper case, without underlining or bold type, as section headings. If no text follows the section heading, the phrase "Not Applicable" should follow the section heading:

(a) Title of the Invention.
(b) Cross-References to Related Applications.
(c) Statement Regarding Federally Sponsored Research or Development.
(d) Reference to a "Microfiche Appendix" (see 37 CFR 1.96).
(e) Background of the Invention.
    1. Field of the Invention.
    2. Description of the Related Art including information disclosed under 37 CFR 1.97 and 1.98.
(f) Brief Summary of the Invention.
(g) Brief Description of the Several Views of the Drawing(s).
(h) Detailed Description of the Invention.
(i) Claim or Claims (commencing on a separate sheet).
(j) Abstract of the Disclosure (commencing on a separate sheet).
(k) Drawings.
(l) Sequence Listing (see 37 CFR 1.821-1.825).

### *Claim Rejections - 35 USC § 102*

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

4. Claims 1-4, 7-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Grandfield et al.

Regarding claim 1, Grandfield discloses a method for eliminating error (unwanted signals) in a receiver in which radio signals are mixed, characterized in that the mixing is balanced by adjusting bias currents in transistors of the mixing circuit. (col. 7 lines 1-67)

Regarding claim 2, Grandfield discloses the method characterized in that the bias currents are adjusted in an input circuit of a radio frequency signal. (col. 3 lines 59-62)

Regarding claim 3, Grandfield discloses the method characterized in that the bias currents are adjusted in an input circuit of a local oscillator. (Fig. 1; col. 3 lines 59-68)

Regarding claim 4, Grandfield discloses the method characterized in that the bias currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit. (col. 5 lines 16-56).

Regarding claim 7, Grandfield discloses a means for eliminating error (unwanted signals) in a receiver in which radio signals are mixed, characterized in that the mixing is balanced by adjusting bias currents in transistors of the mixing circuit. (col. 7 lines 1-67)

Regarding claim 8, Grandfield discloses the receiver characterized in that the bias currents are adjusted in an input circuit of a radio frequency signal. (col. 3 lines 59-62)



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Regarding claim 9, Grandfield discloses the receiver characterized in that the bias currents are adjusted in an input circuit of a local oscillator. (Fig. 1; col. 3 lines 59-68)

Regarding claim 10, Grandfield discloses the receiver characterized in that the bias currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit. (col. 5 lines 16-56)

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 5, 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grandfield in view of Durec et al.

Regarding claim 5, Grandfield does not expressly disclose the adjustment of the bias is performed using a D/A converter to adjust a current for the signal line across parallel resistors. Durec however discloses a receiver with adjustment means that comprises a digital to analog converter with a digital controller that adjusts power to the mixer to eliminate unwanted signals. (col. 3 lines 8-65), and discloses a control signal across resistors in parallel from the D/A converter. (col. 6 lines 8-26) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a signal from a D/A to control current across parallel resistors in a receiver in order to eliminate unwanted signal components.



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Regarding claim 11, Grandfield does not expressly disclose the use of a digital to analog converter to adjust bias with a digital controller. Durec however discloses a receiver with adjustment means that comprises a digital to analog converter with a digital controller that adjusts power to the mixer to eliminate unwanted signals. (col. 3 lines 8-65) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a digital to analog converter and a digital controller to eliminate unwanted signals in a mixer circuit in order to improve signal quality in the receiver.

Regarding claim 12, Grandfield does not expressly disclose the use of D/A and A/D converters or a processor with memory for bias adjustments. However Durec discloses an analog to digital converter that take measurements from a mixer and a digital to analog converter that controls power to the mixer to adjust for unwanted signals. Also disclosed is a "table look-up" which means memory is inherent in the circuit. (col. 3 lines 8-65) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use A/D and D/A converters in conjunction with a processor with memory in order to adjust settings based on stored information.

7. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grandfield in view of Chevallier.

Regarding claim 6, Grandfield does not expressly disclose that the bias currents or voltages are adjusted by tuning the receiver by measuring the balance from the receiver outputs and empirically adjusting the bias. However, Chevallier discloses adjusting the bias according to feedback from the outputs. (col. 6) Therefore it would



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have been obvious to one of ordinary skill in the art at the time of the invention to empirically adjust the bias to correct the balance in tuning a receiver in order to eliminate unwanted signal components.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lewis G. West whose telephone number is 703-308-9298. The examiner can normally be reached on Monday-Thursday 5:30-3:00 and on alternate Fridays.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 703-305-4778. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-6306 for regular communications and 703-308-6296 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-4700.

January 17, 2001

NAY MAUNG
PRIMARY EXAMINER

Form PTO 948 (Rev. 8-98) U.S. DEPARTMENT OF COMMERCE - Patent and Trademark Office Application No. 09/292301

# NOTICE OF DRAFTSPERSON'S PATENT DRAWING REVIEW

The drawing(s) filed (insert date) 4/15/99 are:

A. ☒ approved by the Draftsperson under 37 CFR 1.84 or 1.152.

B. ☐ objected to by the Draftsperson under 37 CFR 1.84 or 1.152 for the reasons indicated below. The Examiner will require submission of new, corrected drawings when necessary. Corrected drawing must be sumitted according to the instructions on the back of this notice.

1. DRAWINGS. 37 CFR 1.84(a): Acceptable categories of drawings: Black ink. Color.
   - ____ Color drawings are not acceptable until petiton is granted. Fig(s) _____
   - ____ Pencil and non black ink not permitted. Fig(s) _____
2. PHOTOGRAPHS. 37 CFR 1.84 (b)
   - ____ 1 full-tone set is required. Fig(s) _____
   - ____ Photographs not properly mounted (must use brystol board or photographic double-weight paper). Fig(s) _____
   - ____ Foor quality (half-tone). Fig(s) _____
3. TYPE OF PAPER. 37 CFR 1.84(e)
   - ____ Paper not flexible, strong, white, and durable. Fig(s) _____
   - ____ Erasures, alterations, overwritings, interlineations, folds, copy machine marks not accepted. Fig(s) _____
   - ____ Mylar, velum paper is not acceptable (too thin). Fig(s) _____
4. SIZE OF PAPER. 37 CFR 1.84(f): Acceptable sizes:
   - ____ 21.0 cm by 29.7 cm (DIN size A4)
   - ____ 21.6 cm by 27.9 cm (8 1/2 x 11 inches)
   - ____ All drawing sheets not the same size. Sheet(s) _____
   - ____ Drawings sheets not an acceptable size. Fig(s) _____
5. MARGINS. 37 CFR 1.84(g): Acceptable margins:

   Top 2.5 cm Left 2.5cm Right 1.5 cm Bottom 1.0 cm
   SIZE: A4 Size

   Top 2.5 cm Left 2.5 cm Right 1.5 cm Bottom 1.0 cm
   SIZE: 8 1/2 x 11

   Margins not acceptable. Fig(s) _____
   _____ Top (T) _____ Left (L)
   _____ Right (R) _____ Bottom (B)
6. VIEWS. 37 CFR 1.84(h)
   REMINDER: Specification may require revision to correspond to drawing changes.
   Partial views. 37 CFR 1.84(h)(2)
   - ____ Brackets needed to show figure as one entity. Fig(s) _____
   - ____ Views not labeled separately or properly. Fig(s) _____
   - ____ Enlarged view not labeled separetely or properly. Fig(s) _____
7. SECTIONAL VIEWS. 37 CFR 1.84 (h)(3)
   - ____ Hatching not indicated for sectional portions of an object. Fig(s) _____
   - ____ Sectional designation should be noted with Arabic or Roman numbers. Fig(s) _____
8. ARRANGEMENT OF VIEWS. 37 CFR 1.84(i)
   - ____ Words do not appear on a horizontal, left-to-right fashion when page is either upright or turned so that the top becomes the right side, except for graphs. Fig(s) _____
9. SCALE. 37 CFR 1.84(k)
   - ____ Scale not large enough to show mechanism without crowding when drawing is reduced in size to two-thirds in reproduction. Fig(s) _____
10. CHARACTER OF LINES, NUMBERS, & LETTERS. 37 CFR 1.84(i)
    - ____ Lines, numbers & letters not uniformly thick and well defined, clean, durable, and black (poor line quality). Fig(s) _____
11. SHADING. 37 CFR 1.84(m)
    - ____ Solid black areas pale. Fig(s) _____
    - ____ Solid black shading not permitted. Fig(s) _____
    - ____ Shade lines, pale, rough and blurred. Fig(s) _____
12. NUMBERS, LETTERS, & REFERENCE CHARACTERS. 37 CFR 1.84(p)
    - ____ Numbers and reference characters not plain and legible. Fig(s) _____
    - ____ Figure legends are poor. Fig(s) _____
    - ____ Numbers and reference characters not oriented in the same direction as the view. 37 CFR 1.84(p)(1) Fig(s) _____
    - ____ English alphabet not used. 37 CFR 1.84(p)(2) Figs _____
    - ____ Numbers, letters and reference characters must be at least .32 cm (1/8 inch) in height. 37 CFR 1.84(p)(3) Fig(s) _____
13. LEAD LINES. 37 CFR 1.84(q)
    - ____ Lead lines cross each other. Fig(s) _____
    - ____ Lead lines missing. Fig(s) _____
14. NUMBERING OF SHEETS OF DRAWINGS. 37 CFR 1.84(t)
    - ____ Sheets not numbered consecutively, and in Arabic numerals beginning with number 1. Sheet(s) _____
15. NUMBERING OF VIEWS. 37 CFR 1.84(u)
    - ____ Views not numbered consecutively, and in Arabic numerals, beginning with number 1. Fig(s) _____
16. CORRECTIONS. 37 CFR 1.84(w)
    - ____ Corrections not made from prior PTO-948 dated _____
17. DESIGN DRAWINGS. 37 CFR 1.152
    - ____ Surface shading shown not appropriate. Fig(s) _____
    - ____ Solid black shading not used for color contrast. Fig(s) _____

COMMENTS

REVIEWER A.D DATE 7/13/99 TELEPHONE NO. _____

ATTACHMENT TO PAPER NO. 7



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## INFORMATION ON HOW TO EFFECT DRAWING CHANGES

**1. Correction of Informalities--37 CFR 1.85**

File new drawings with the changes incorporated therein. The application number or the title of the invention, inventor's name, docket number (if any), and the name and telephone number of a person to call if the Office is unable to match the drawings to the proper application, should be placed on the back of each sheet of drawings in accordance with 37 CFR 1.84(c). Applicant may delay filing of the new drawings until receipt of the Notice of Allowability (PTOL-37). Extensions of time may be obtained under the provisions of 37 CFR 1.136. The drawing should be filed as a separate paper with a transmittal letter addressed to the Drawing Processing Branch.

**2. Timing for Corrections**

Applicant is required to submit **acceptable** corrected drawings within the three-month shortened statutory period set in the Notice of Allowability (PTOL-37). If a correction is determined to be unacceptable by the Office, applicant must arrange to have acceptable corrections resubmitted within the original three-month period to avoid the necessity of obtaining an extension of time and paying the extension fee. Therefore, applicant should file corrected drawings as soon a possible.

Failure to take corrective action within set (or extended) period will result in **ABANDONMENT** of the Application.

**3. Corrections other than Informalities Noted by the Drawing Review Branch on the Form PTO-948**

All changes to the drawings, other than informalities noted by the Drawing Review Branch, **MUST** be approved by the examiner before the application will be allowed. No changes will be permitted to be made, other than correction of informalities, unless the examiner has approved the proposed changes.



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## Notice of References Cited

| Application/Control No. | Applicant(s)/Patent Under Reexamination | |
|---|---|---|
| 09/292,301 | MURTOJARVI ET AL. | |
| Examiner | Art Unit | Page 1 of 1 |
| Lewis G. West | 2681 | |

U.S. PATENT DOCUMENTS

| * | | DOCUMENT NO. | DATE | NAME | CLASS | SUBCLASS | DOCUMENT SOURCE ** APS | DOCUMENT SOURCE ** OTHER |
|---|---|---|---|---|---|---|---|---|
| ☒ | A | 4928314 | May. 1990 | Grandfield et al. | 455 | 236.1 | ☐ | ☐ |
| ☐ | B | 5886547 3/1999 | ~~Dec. 1996~~ | Durec et al. | 327 | 113 | ☐ | ☐ |
| ☐ | C | 5825231 12/1998 | ~~Aug. 1993~~ | Chevallier et al. | 327 | 356 | ☐ | ☐ |
| ☐ | D | | | | | | ☐ | ☐ |
| ☐ | E | | | | | | ☐ | ☐ |
| ☐ | F | | | | | | ☐ | ☐ |
| ☐ | G | | | | | | ☐ | ☐ |
| ☐ | H | | | | | | ☐ | ☐ |
| ☐ | I | | | | | | ☐ | ☐ |
| ☐ | J | | | | | | ☐ | ☐ |
| ☐ | K | | | | | | ☐ | ☐ |
| ☐ | L | | | | | | ☐ | ☐ |
| ☐ | M | | | | | | ☐ | ☐ |

FOREIGN PATENT DOCUMENTS

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| ☐ | N | | | | | | | ☐ | ☐ |
| ☐ | O | | | | | | | ☐ | ☐ |
| ☐ | P | | | | | | | ☐ | ☐ |
| ☐ | Q | | | | | | | ☐ | ☐ |
| ☐ | R | | | | | | | ☐ | ☐ |
| ☐ | S | | | | | | | ☐ | ☐ |
| ☐ | T | | | | | | | ☐ | ☐ |

NON-PATENT DOCUMENTS

| * | | DOCUMENT (Including Author, Title Date, Source, and Pertinent Pages) | DOCUMENT SOURCE ** APS | DOCUMENT SOURCE ** OTHER |
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| ☐ | U | | ☐ | ☐ |
| ☐ | V | | ☐ | ☐ |
| ☐ | W | | ☐ | ☐ |
| ☐ | X | | ☐ | ☐ |

*A copy of this reference is not being furnished with this Office action. (See Manual of Patent Examining Procedure, Section 707.05(a).)
**APS encompasses any electronic search i.e. text, image, and Commercial Databases.

455-236.1 AU 2745 EX
FIP:12-1998 CR 4,928,314

**United States Patent** [19]
**Grandfield et al.**

[11] **Patent Number: 4,928,314**
[45] **Date of Patent: May 22, 1990**

[54] **HETERODYNE STAGE HAVING PRECISE CLOSED-LOOP CONTROL OF THE AMPLITUDE OF THE INJECTION SIGNAL THEREOF**

[75] Inventors: **Walter J. Grandfield**, Lake Worth; **James G. Mittel**, Boynton Beach; **Walter L. Davis**, Coral Springs, all of Fla.

[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

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[52] **U.S. Cl.** ..... **455/236;** 455/317; 455/318; 455/319; 455/323; 331/109; 331/183
[58] **Field of Search** ..... 455/343, 236, 316, 317, 455/318, 319, 323; 331/109, 183

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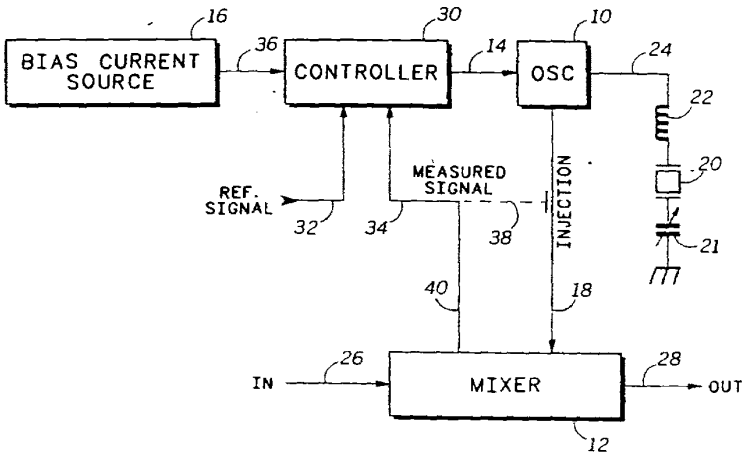
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*Primary Examiner*—Joseph A. Orsino
*Assistant Examiner*—Kinfe-Michael Negash
*Attorney, Agent, or Firm*—William E. Zitelli; Vincent B. Ingrassia

[57] **ABSTRACT**

A heterodyne stage of a receiver which includes a conventional mixer circuit and local oscillator circuit further includes a differential amplifier circuit which measures the amplitude of the injection signal generated by the local oscillator circuit and controls it precisely to a desired reference level by adjusting the current bias supply to the local oscillator circuit within a banded range to ensure start-up of the local oscillator upon energization and to protect against loss of injection signal under all operating conditions. The differential amplifier circuit provides for a precise amplitude reference setting and sufficient closed-loop gain for controlling the amplitude of the injection signal with a minimum of error between the measured and reference values.

**10 Claims, 4 Drawing Sheets**






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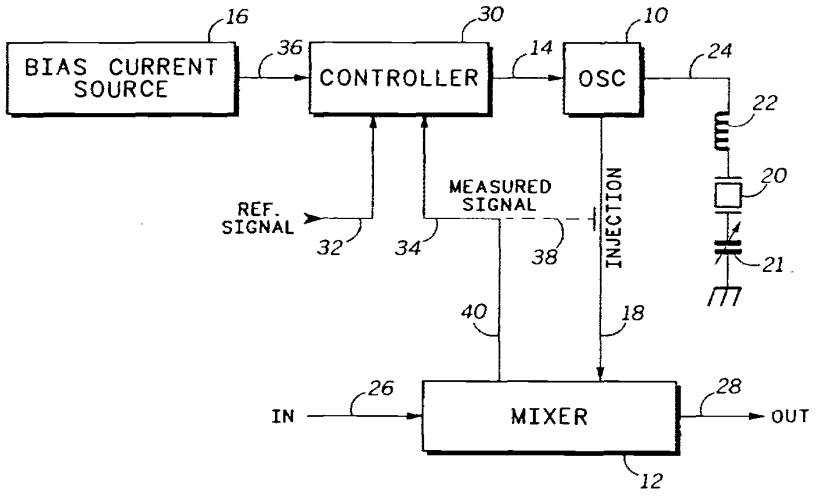



FIG. 1



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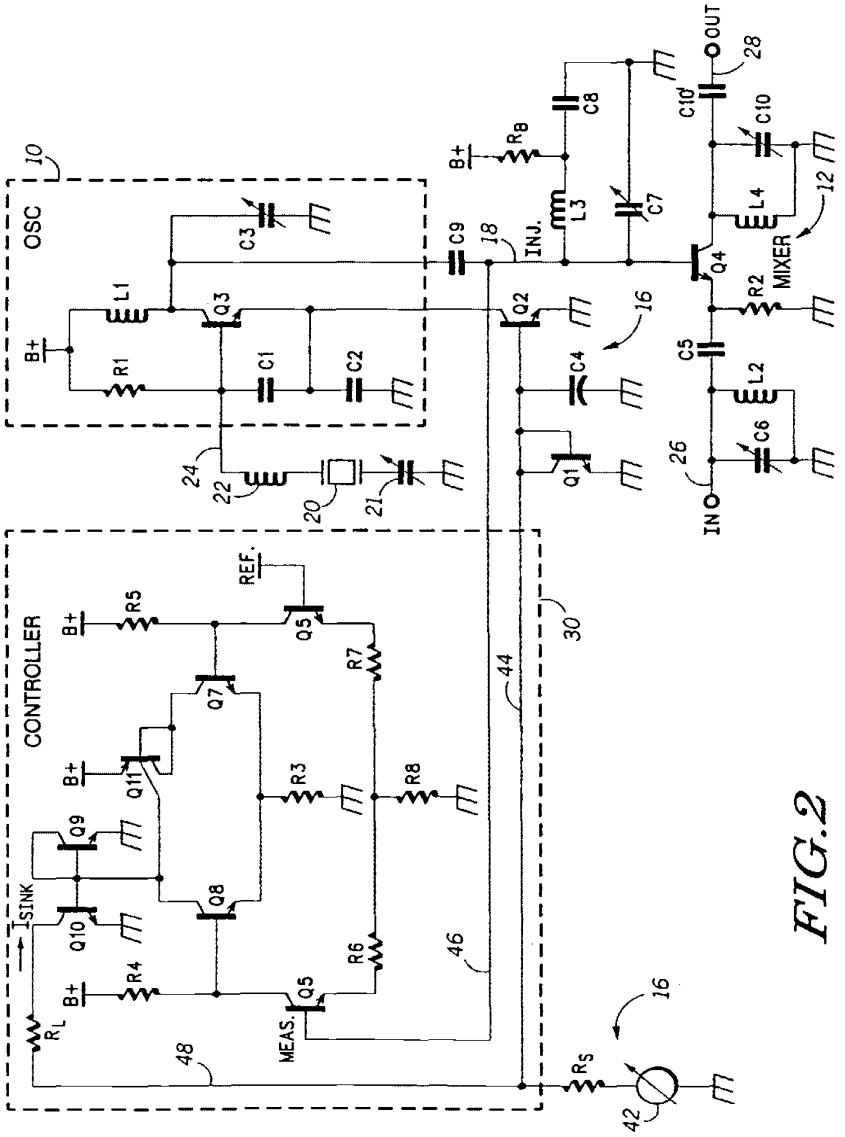
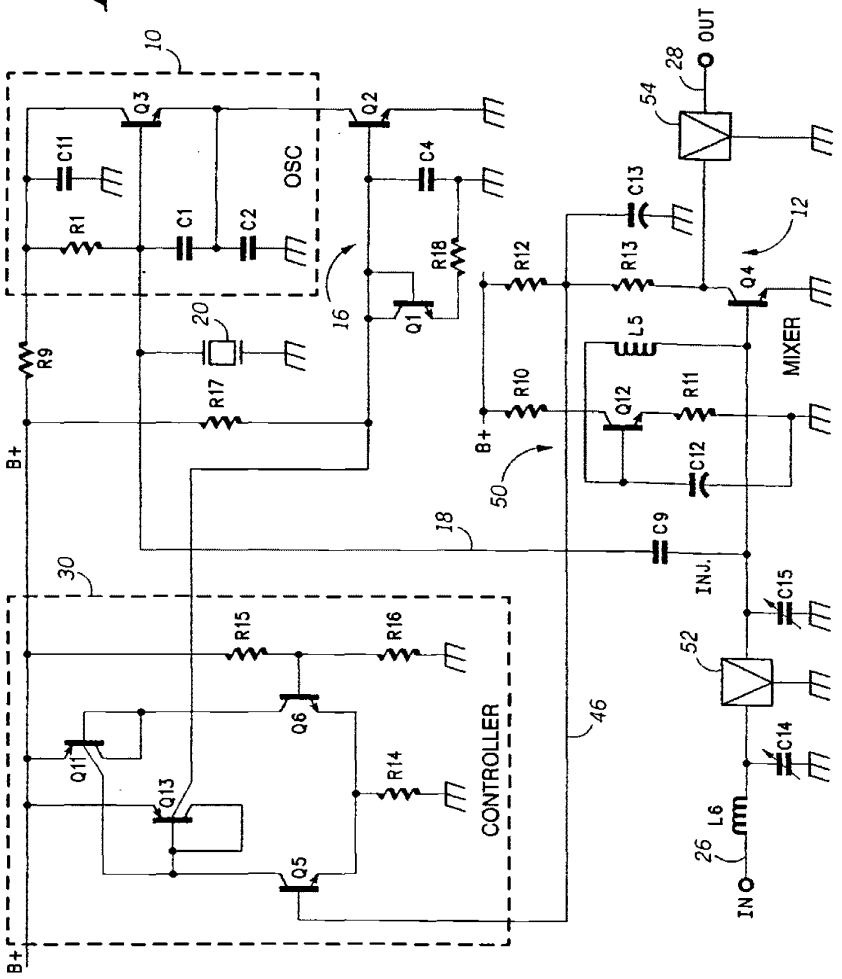



FIG. 2



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FIG. 3






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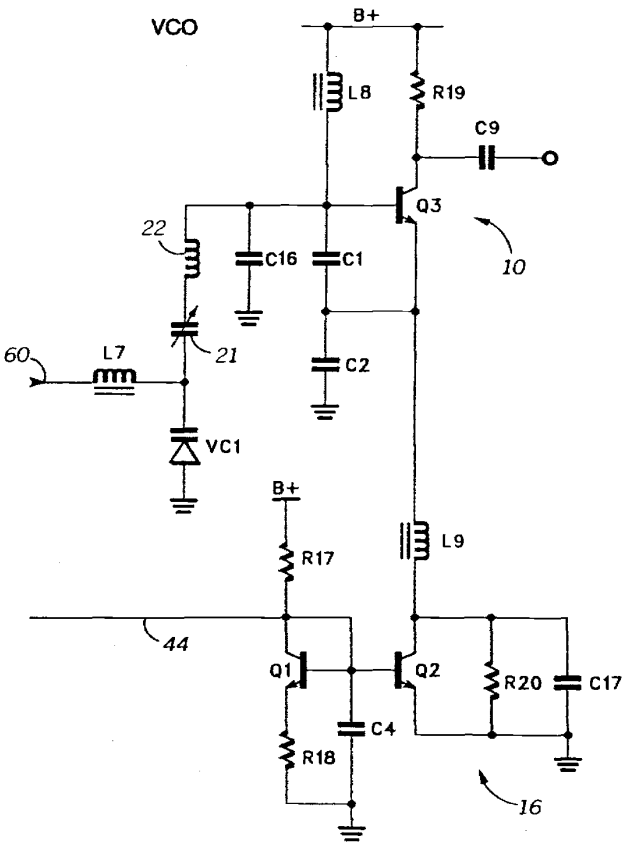



FIG. 4



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# HETERODYNE STAGE HAVING PRECISE CLOSED-LOOP CONTROL OF THE AMPLITUDE OF THE INJECTION SIGNAL THEREOF

## BACKGROUND OF THE INVENTION

The present invention is directed to a heterodyne stage of a radio or pager receiver, and more particularly, to a closed-loop control circuit for use therein in controlling the bias current of a local oscillator within a banded range to render the injection signal thereof precisely at a desired amplitude.

A heterodyne stage of a radio or pager receiver includes a local oscillator which generates an injection signal at a predetermined frequency and at an amplitude that is proportional to the amount of bias current supplied to the oscillator, and a mixer circuit which is governed by the injection signal of the local oscillator to convert a mixer input signal at one frequency to a mixer output signal at another frequency based on the frequency of the injection signal. Normally, in a receiver heterodyne stage, the frequency of the injection signal is subtracted from the frequency of the input signal to the mixer to render an output signal of the mixer at a frequency substantially corresponding to the resulting frequency difference. A receiver of the aforementioned type may include one or more heterodyne stages for converting received radio frequency or RF signalling to an intermediate frequency or IF and possibly to convert one IF signal to another lower IF signal for utilization by further downstream circuitry.

Receivers of the portable variety are battery powered and thus considerable emphasis is placed on conserving power consumption by such receivers to extend the usable operating life thereof without having to recharge or replace its batteries. To this end, some more recent portable receiver units have included power conservation measures which are designed to de-energize certain circuits of the receiver when not needed and then re-energize them according to demand. It is always of some concern in the transition from de-energization to re-energization that each of the circuits restart and operate at designed performance levels in a short time interval.

For example, restarting a crystal-controlled local oscillator circuit requires approximately on the order of twice the bias current than what is needed after the oscillator circuit reaches steady state conditions. Accordingly, what is desired is to provide a large amount of bias current to the oscillator circuit initially upon re-energization and then adjust back to the minimum bias current needed to sustain the oscillator injection signal at a desired amplitude while operating under steady state conditions. The problem is that it is not always easy to estimate these two bias current level extremes under all working conditions. Selecting current levels that are too high may result in unpredictable oscillator performance, as well as excessive gain in the mixer stage and undesirable consumption of power from the battery which will decrease the operational battery life of the receiver. Selecting too low a level may cause the oscillator not to restart upon re-energization or to cause the amplitude of the injection signal to



fall below operational limits, resulting in degraded mixer performance.

One solution to ensuring proper restart of the oscillator circuit and protecting against loss of the injection signal is to provide a closed feedback loop at the heterodyne stage to control the bias current to the oscillator circuit in accordance with a desired injection signal amplitude. Such a solution is proposed in U.S. Pat. No 3,805,162 issued Apr. 16, 1974 to Clive Hoffman et al. which patent being assigned to the same assignee as the instant application. The proposed circuit of the Hoffman et al. patent is directed to detecting an oscillator injection signal amplitude and setting a desired amplitude thereof based on the difference between base-emitter voltages of a mixer transistor having high frequency operational characteristics and a control stage transistor having lower frequency operational characteristics. While the proposed closed loop control circuitry of Hoffman et al. is considered adequate for many operational conditions, it is believed not without need of improvement.

Some factors which must always be considered in evaluating such types of feedback control loop circuits are: (1) the ability to measure the amplitude of the injection signal undistorted by extraneous signals such as broadband RF signalling provided at a first heterodyne stage operational at the input of such a receiver unit, (2) the ability to set a precise reference level for controlling the amplitude of the injection signal to the mixer such that it does not deviate substantially during the heterodyne operation of the mixer circuit, and (3) to ensure that the closed-loop control circuit operates within a bounded bias current range to sustain oscillator operation even under extreme abnormal operating conditions.

In the present invention, these and other factors are provided for in a closed-loop control circuit for controlling the oscillator injection signal to a desired amplitude by adjusting the bias current to the oscillator circuit in a heterodyne stage. The advantages of Applicants' invention over the prior art will become more evident from the following description of preferred embodiments and accompanying drawings.

## SUMMARY OF THE INVENTION

In accordance with the present invention, a heterodyne stage of a receiver comprises a local oscillator circuit which is responsive to bias current supplied from a bias current source for generating an injection signal which governs a mixer circuit to convert a receiver signal from one frequency to another frequency by a heterodyning process, and a differential amplifier circuit having one transistor stage input coupled to a measurement of the amplitude of the injection signal to effect a signal representative thereof and another transistor stage input biased at a reference level and including a circuit stage governed by the amplitude representative signal and the reference level to adjust the amount of bias current supplied to the oscillator circuit by the bias current source within a non-zero bias current range.



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In one embodiment of the present invention, the injection signal is coupled directly from the local oscillator circuit to the one transistor stage input of the differential amplifier circuit. In this embodiment, the bias current source includes a current mirror circuit disposed in a supply line between a governing current source and the local oscillator circuit, said governing current source setting the maximum amount of bias current to be supplied to the local oscillator by the bias current source. The current stage of the differential amplifier is coupled to the supply line for diverting thereto a portion of the governing current, thus decreasing the bias current supply to the local oscillator circuit through the current mirror circuit. In this manner, the bias current supplied to the local oscillator is controlled within a banded range to ensure performance of the local oscillator under all operating conditions.

In another embodiment of the present invention, the measurement of the injection signal amplitude is taken from the delta current signal of the mixer circuit and coupled to the one transistor stage input of the differential amplifier circuit. The current mirror circuit of the bias current source is biased to supply a minimum amount of bias current to the local oscillator circuit. In this embodiment, the circuit stage of the differential amplifier circuit adjusts the amount of bias current supplied to the local oscillator from a minimum amount to a maximum amount which is set by the circuit stage. Accordingly, the bias current is adjusted within a banded range to control the injection signal at a desired amplitude.

In both of the foregoing described embodiments, a precise reference level and sufficient closed-loop gain are provided by the differential amplifier circuit in each case to control the injection signal precisely at a desired amplitude set by the reference level.

## DESCRIPTION OF THE DRAWINGS

FIG. 1 is a functional block diagram schematic of a heterodyne stage suitable for embodying the broad principles of the present invention.

FIG. 2 is a circuit schematic of one embodiment suitable for implementing aspects of the present invention.

FIG. 3 is a circuit schematic of another embodiment which is suitable for implementing further aspects of the present invention.

FIG. 4 is a circuit schematic of an alternate local oscillator circuit suitable for use in either of the embodiments of FIGS. 2 and 3.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a functional block diagram of a heterodyne stage of a radio or pager receiver and includes the conventional elements of a local oscillator circuit shown at block 10 and a mixer circuit shown at block 12. The oscillator circuit 10 is responsive to bias current supplied over line 14 from a bias current source 16 to generate an injection signal over line 18 at a predetermined frequency and an amplitude based on the amount of bias current supplied over line 14. The oscillator circuit 10 may be of the crystal controlled variety in which case a crystal 20 configured in a network of reactive tuning elements 21 and 22 governs the oscillator 10 with a tuned frequency signal over signal line 24. The mixer circuit 12 is governed by the injection signal 18 to convert a receiver signal over line 26 from one frequency to another frequency by using a well-known heterodyning process and the resultant receiver signal at the other frequency is output over signal line 28. The block 30 represents a closed-loop control circuit which is governed by a reference signal 32 and a measured signal 34 to adjust the amount of bias current supplied to the oscillator circuit 10 over line 14 from the bias current source 16 over line 36. The measured signal 34 may be the injection signal 18 itself as indicated by the dashed line 38 or it may be derived from a parameter 40 of the mixer circuit 12 which parameter being representative of the injection signal 18.

In operation, the controller 30 measures the amplitude of the injection signal as provided by the injection signal line 38 or a parameter measured from the mixer circuit over signal line 40 and compares that measurement with a reference level derived from the reference signal 32. In the event that the measured signal falls below the reference level, the bias current supplied to the oscillator circuit 10 is increased causing a proportional increase in the amplitude of the injection signal. Conversely, when the measured signal climbs above the reference level, the bias current supplied to the oscillator circuit 10 is decreased by the controller 30 causing the amplitude of the injection signal to decrease commensurately therewith.

The circuit details of an oscillator circuit 10, a mixer 12, a controller 30, and current source 16 are shown in two separate embodiments depicting respectively in FIGS. 2 and 3. All of the transistor and resistor elements of the embodiments of FIGS. 2 and 3 may be constructed on the same substrate of an integrated circuit for each case and the reactive components of inductors and capacitors may be externally coupled respectively to their associated integrated circuit. Each integrated circuit may be manufactured by Motorola's Semiconductor Division using the well known semiconductor manufacturing process known as MOSAIC 1.5, for example. Reference is made to the Motorola publication "Linear and Interface Integrated Circuits", DL128, Rev. 2, pp. 1-8, for a more detailed description of this type manufacturing process. As a result of the integrated circuit implementation and certain trimming steps which are a part of the manufacturing process thereof, the characteristic parameters of the transistor and resistor components may be more precisely related to one another. In addition, better performance is expected from an integrated circuit implementation than that which would be expected from a circuit comprising discrete components. With that all said and done, it is now time to describe the respective circuit embodiments.

Referring to FIG. 2, the symbol B+ shown throughout the circuit depiction represents the power supply potential which is provided from a battery source (not



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shown) and regulated to approximately 1 volt, for example, for both of the present embodiments. Continuing, the local oscillator circuit shown in the dot dashed lines of block 10 is a conventional Colpitts configuration including an NPN transistor Q3 having its collector coupled to the B+ supply through an inductive element L1. The base of Q3 is coupled to the crystal tuned frequency signal line 24, to the B+ supply through a resistor R1 and to ground potential through a capacitor divider network comprising capacitive elements C1 and C2. The node connection between C1 and C2 is coupled to the emitter of the transistor Q3. For frequency tuning purposes, a variable capacitor C3 is coupled from the collector of Q3 to ground potential.

In the present embodiment, a bias current source 16 comprises in part a voltage source shown at 42 coupled in series with a resistor Rs. The voltage source 42 may be fixed at the B+ supply, for example, or variable, as the case may be. The governing current supplied through Rs is conducted over a supply line 44 to a current mirror circuit configuration comprising the transistors Q1 and Q2 which are also a part of the bias current source 16. More specifically, the supply line 44 is coupled to both the collector and base of transistor Q1 which has its emitter coupled to ground potential and is also coupled to the base of transistor Q2 which has its collector coupled to the emitter of transistor Q3 in the oscillator circuit 10 and also has its emitter coupled to ground potential. In the present embodiment, the device geometries of the transistors Q1 and Q2 are designed to provide a current mirror ratio of 10–12 to 1; thus, the current flow through transistor Q2 is 10 or 12 times the amount of current flowing through transistor Q1 which is the control or bias current generated by the controller. A capacitor C4 may be coupled from the base of transistors Q1 and Q2 to ground potential to offer an enhancement to noise immunity and control circuit stabilization.

The operation of a Colpitts oscillator is considered well known to anyone skilled in the pertinent art, the details of which contributing nothing to the present invention other than the fact that as more bias current is drawn from transistor Q3 through transistor Q2 as a result of the current mirror configuration of Q1 and Q2, the oscillator gain and the amplitude of the generated injection signal over signal line 18 will both increase and conversely, as less bias current is drawn, the oscillator gain and injection amplitude will both decrease. Accordingly, the amplitude of the injection signal 18 may be adjusted in accordance with the amount of bias current drawn through transistor Q2.

The mixer circuit shown at 12 comprises a conventional single NPN transistor stage Q4 connected in a common base configuration. The mixer input signal which may be of a broadband, radio frequency variety may be AC coupled to the emitter of the mixer transistor Q4 through a capacitive element C5. A conventional LC tuning and impedance network comprising the paralleled capacitive and inductive elements C6 and L2, respectively, is provided at the input side of capacitor C5 and coupled conventionally to ground potential. The emitter of transistor Q4 is DC biased through resistor R2. Another conventional LC tuning and impedance matching network comprising the reactive capacitive and inductive elements C7, C8, and L3 are coupled between the base of Q4 and ground potential. The node connection between L3 and C8 may be coupled to B+ through a resistor RB. The injection signal generated from the oscillator circuit 10 over line 18 is AC coupled to the base of the mixer transistor Q4 through a capacitive element C9. The mixer stage 12 includes an additional LC tuning and matching network comprising capacitive and inductive elements C10, C10', and L4, respectively, which is coupled at the collector of Q4 to ground potential and offers selective tuning and AC coupling for the output signal from the collector of Q4 to the output line 28.

In operation, the mixer input signal may be selectively filtered by the tuning circuit L2 and C6 to pass only frequencies within a desirable frequency range through capacitive element C5. The heterodyne mixing operations occur between the filtered mixer input signal and injection signal in the base emitter junction of the mixer transistor Q4 with the resulting frequency converted signal appearing at the collector of Q4 and being filtered by the tuning network C10 and L4 and AC coupled by C10' to the output line 28. The LC tuning circuit comprising the elements C7, C8 and L3 at the base of Q4 substantially attenuates signals having frequencies other than the frequency of the injection signal and thus, substantially minimizes distortion to the injection signal over the signal line 18 caused by the heterodyne mixing process and/or the magnitude of the RF mixer input signal, thus providing an essential distortion free injection signal at the point 18.

In accordance with the present invention, a closed loop control circuit 30 is disposed in the heterodyne stage embodiment of FIG. 2 to control the injection signal at a desired amplitude by adjusting the bias current supplied to the oscillator circuit 10 from the bias current source 16. The circuit of controller 30 is configured as a differential amplifier including the transistor stage inputs of Q5 and Q6. The addition of transistors Q7 and Q8 in the differential amplifier circuit provide for dual differential amplification which provides adequate gain to allow for minimum closed-loop error between the reference and measured amplitudes while minimizing the current drain on the battery source, i.e. B+ supply. Current is supplied to the collectors of NPN transistors Q8 and Q7 through a dual collector PNP transistor Q11 configured as a current mirror circuit having one collector tied to its own base and the collector of Q7 and the other collector tied to the collector of Q8, the emitter of Q11 being coupled to the B+ supply. The emitters of transistors Q8 and Q7 are commonly coupled through a resistor R3 to ground potential and the bases thereof are respectively coupled to the collectors of transistors Q5 and Q6 which collectors also being respectively coupled through the resistors R4 and R5 to the B+ supply. The emitters of transistors Q5 and Q6 are coupled through respective resistors R6 and R7 to a common resistor R8 which is coupled to ground potential.



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A signal line **46** couples the injection signal from the line **18** to the base of the input stage transistor Q5. The base of the other input stage transistor Q6 may be coupled to a reference potential or the B+supply as the case may be. The transistor Q6 is constructed to have an IC area which may be, for example, on the order of eight times that of the IC area of Q5 in order to establish a reference level between the input transistor stages. It is a well-known principle that an IC area differential between transistors establishes a base-emitter junction voltage differential between the transistors which sets a reference voltage threshold level. In the preferred embodiment, the eight times area factor results in a threshold level of **54** millivolts. That is, the differential amplifier will be in a balanced condition when the voltage on the base of Q5 is **54** millivolts above the voltage of the base of Q6.

A current mirror circuit stage is coupled to the differential amplifier at the collector of the transistor Q8 and to the governing current supply line **44** to divert governing current from the supply line. More specifically, the current mirror circuit stage comprises NPN transistors Q9 and Q10 having their bases tied together and their emitters both coupled to ground potential with the common base connection node being coupled to the collector of Q8 and also to the collector of Q9. The collector of Q10 is coupled to the supply line **44** through a current limiting resistor RL In addition, the IC area of transistor Q10 may be on the order of eight times that of the IC area of transistor Q9 which permits the current diverted from the supply line **44** to be substantially greater than that flowing through transistor Q9.

In operation, the input transistor stage Q5 of the control circuit **30** measures the amplitude of the injection signal from the supply line **18** at the base of Q4. More specifically, the base-emitter junction of transistor Q5 rectifies and averages the injection signal to effect a signal which is representative of the amplitude thereof which is then compared to the reference level set for the desired amplitude of the injection signal. When the measured signal is below the reference level, transistors Q5 through Q11 operate cooperatively to limit the current passing through transistor Q9 which in turn limits the current diverted from the supply line through transistor Q10, thus rendering higher bias current via current mirror Q1–Q2 to the oscillator **10** to cause it to increase the amplitude of the injection signal. Should the measured signal exceed the reference level, then the transistors Q5 through Q11 operate in a fashion to cause increased current to flow through transistor Q9 of the current mirror circuit which results in a higher current diversion from the governing current supply line **44** through transistor Q10, rendering less bias current to the oscillator circuit **10**, thereby causing a lower injection signal amplitude. Of course, once brought to steady state conditions, the controller circuit **30** is provided with sufficient gain to sustain the amplitude of the injection signal substantially at the desired amplitude level as set by the precise reference level between the input transistor stages Q5 and Q6.

The current mirror circuit comprising transistors Q9, Q10 and limiting resistor RL is designed to divert only a portion of the governing current from supply line **44**, thus ensuring that the closed- loop control circuit **30** adjusts the amount of bias current supplied to the oscillator circuit **10** only within a non-zero bias current range. This characteristic of the control circuit **30** ensures against loss of oscillator signal during all operating conditions.

It is recognized that during power saving operations where the oscillator circuit may be de-energized and then re-energized by the B+supply line, the bias current supply to the oscillator circuit will continue to be controlled by controller **30** in a closed-loop fashion using the feedback measurement of the injection signal as a guide to determine the required minimum amount of bias current needed by the oscillator circuit. During start-up, when the injection signal level is essentially zero, all of the current available from the bias current source is applied to the oscillator to minimize the start-up time. Accordingly, start-up of the oscillator circuit **10** is assured and once steady-state conditions thereof prevail, only the minimum necessary amount of bias current is supplied to the oscillator circuit to maintain the injection signal at its desired amplitude setting.

Typical values for the circuit components of the embodiment of FIG. **2** are shown in the following table:

TABLE I

| Element | Value |
|---|---|
| R1 | 4K ohms |
| R2 | 550 ohms |
| R3 | 6K ohms |
| R4 | 24K ohms |
| R5 | 24K ohms |
| R6 | 2K ohms |
| R7 | 2K ohms |
| R8 | 16K ohms |
| Rs | 3K ohms |
| C1 | 19 pf |
| C2 | 36 pf |
| C3 | 5–35 pf (trimmer) |
| C4 | .05 uf |
| C5 | 1000 pf |
| C6 | 5–35 pf (trimmer) |
| C7 | 5–35 pf (trimmer) |
| C8 | 220 pf |
| C9 | 220 pf |
| C10 | 5–35 pf (trimmer) |
| L1 | 70 nH |
| L2 | 70 nH |
| L3 | 70 nH |
| L4 | 2.6 uH |
| 20 | 51 MHz (3rd overtone) |
| 21 | 5–35 pf (trimmer) |
| 22 | 1.2 uH |

The foregoing described heterodyne stage embodiment depicted in FIG. **2** has primary application to a first stage heterodyning process dealing with received broadband RF signalling. An alternate embodiment of a heterodyne stage embodying the principles of the present invention which will be described in connection with that shown in FIG. **3** has primary application to a second heterodyne stage of a receiver in which IF signalling is converted from one frequency to another. The receiver IF signalling input to a second heterodyne stage has a much narrower bandwidth and limited

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power level than that of the RF signalling input to the first heterodyne stage, enabling a more beneficial measuring point of the injection signal. Much of that depicted in FIG. 3 is substantially similar to the embodiment described in connection with FIG. 2. Accordingly, reference numerals for common or substantially equivalent components will be maintained between the two embodiments; however, it should be understood that while the same or similar components may be performing same or similar functions, their values in the alternate embodiment may be changed due to different design considerations.

Referring to FIG. 3, the oscillator circuit 10 remains crystal controlled for this embodiment and is of the same Colpitts design; however, because the application is primarily directed to a second heterodyne stage, the frequency of the injection signal generated thereby will be at a much lower value and thus may require fewer reactive tuning components. Nevertheless, the functioning thereof is substantially similar to that described in connection with the oscillator circuit 10 of FIG. 2. The addition of resistor R9 and capacitor C11 provides a decoupling of the B+ supply from the oscillator circuit 10.

The mixer 12 similarly comprises a single stage NPN transistor Q4, but in this alternate embodiment, it is configured in a common emitter arrangement with the emitter thereof coupled to ground potential. The mixer 12 of this alternate embodiment further includes a current mirror circuit shown at 50 comprising an NPN transistor Q12 having its collector tied to its base and also to the B+ supply through a resistor R10 and having its emitter coupled to ground through a resistor R11. To protect against noise and unwanted signal coupling, a capacitor C12 is coupled between the base of Q12 and ground potential. An inductor component L5 is coupled between the collector of Q12 and base of Q4 to provide a DC bias current path to Q4 while highly attenuating the high frequency signals at the base of Q4.

Note that the mixer input signal over line 26 and the injection signal over line 18 are combined at the base of Q4 and that the base emitter junction of Q4 is still used to perform the heterodyning process. The resultant difference frequency signal is provided at the collector of Q4 and coupled to the output line 28. A resistor divider network comprising resistors R12 and R13 is coupled between the collector of Q4 and the B+ supply and a capacitor C13 is coupled between the node connection of R12 and R13 and ground potential to provide for a stable signal at such node. The voltage potential appearing at the node connection of R12 and R13 is representative of the current drain (delta current) of the mixer 12 and may be used as a measure of the amplitude of the injection signal supplied to the mixer from the oscillator circuit 10 in that the mixer drain will increase as the injection level is increased.

A narrow bandpass filter having a center frequency set at the desired frequency of the mixer input signal is disposed in the input line and shown as block 52. Variable capacitive tuning elements C14 and C15 are disposed respectively upstream and downstream of filter 52 and coupled to ground. An inductive element L6 is disposed in series with the filter 52. The aforementioned reactive components are provided for additional frequency tuning of the filter 52. In a similar manner, another narrow band frequency filter shown at block 54 is disposed at the output line 28 of the mixer 12 and has a center frequency set at the frequency of the resultant mixer output signal. In summary, then, the primary difference up to this point in the description of the alternate embodiment is that the measurement of the injection signal representative of the amplitude thereof is a delta current measurement of the mixer stage 12 and is taken from the node between the resistor divider connection of R12 and R13 in the collector of the mixer transistor Q4. The measurement signal is connected by signal line 46 to the base of an input transistor stage Q5 of the differential amplifier of the controller circuit 30.

Referring now to the controller circuit 30 of the embodiment depicted in FIG. 3, the input stages are similarly comprised of transistors Q5 and Q6 having their emitters commonly coupled through a common resistor R14 to ground potential. However, the collectors of Q5 and Q6 are directly coupled respectively to the dual collectors of Q11 without the need of the dual differential transistors Q8 and Q7 as described in connection with the embodiment of FIG. 2. Another difference of the controller circuit 30 in the present embodiment is that the reference level of the other input transistor stage Q6 is set by a resistor divider network comprising resistors R15 and R16 coupled in series coupled between the B+supply and the ground potential. The resistor divider network of R15 and R16 provides a precise voltage reference level at the node connection thereof which is coupled to the base of the other input transistor stage Q6 of the differential amplifier. Since this reference level is representative of the desired amplitude, the injection signal may be precisely amplitude controlled with a minimum of bias current supply.

The bias current source 16 comprises a similar mirror circuit arrangement comprising similar transistors Q1 and Q2 with the collector of Q2 being coupled to the oscillator circuit 10 to control the bias current supply thereto. In this alternate embodiment, a resistor R17 is coupled between the current mirror circuit and the B+ supply for setting a minimum bias current supply to the oscillator circuit 10 to ensure against loss of injection signal under all oscillator operating conditions. A current adjusting resistor R18 is coupled between the emitter of Q1 and ground potential. As part of the control of the bias current, the differential amplifier of the control circuit 30 includes a circuit stage comprising a dual collector PNP transistor Q13 having one of its collectors tied to its base which is in turn coupled to the collector of the input stage transistor Q5. The emitter of Q13 is coupled to the B+ supply and the other collector thereof is coupled to the current mirror circuit of Q1 and Q2 for controlling the amount of bias current being supplied to the oscillator circuit 10. The maximum governing current through Q13 which may be adjusted by the value of R14 sets the maximum bias current supply via Q1–Q2 to the oscillator circuit 10. Accordingly, a non-zero bias current range is created between the mini-



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mum setting of bias resistor R17 and maximum setting of the governing current of Q13, which maximum setting ensures proper power start-up of the oscillator circuit **10**.

In operation, the control circuit **30** is governed by the measured signal over line **46** and the reference potential set by the resistor divider network **R15** and **R16** such that when the measured signal is below the reference level, governing current is conducted through Q13 to the bias current source circuit **16** to increase the bias current supply to the oscillator circuit **10** which renders an increase in amplitude of the injection signal generated thereby. Conversely, when the measured signal becomes greater than the reference level, less current is conducted through Q13 reducing the bias current supply to the oscillator circuit, thus rendering a lower amplitude of the injection signal. The control circuit **30** is set with tight enough control loop parameters to control the amplitude of the injection signal substantially at the desired level. Further, at re-energization, the maximum bias current supply is applied to the oscillator to ensure proper start up of the oscillator circuit **10**. Accordingly, after energization and once steady state conditions prevail with the amplitude of the injection signal at the desired level, the control circuit **30** governs the bias current supplied to the oscillator circuit to a minimum level necessary to maintain the desired amplitude of its generated injection signal. Typical values for the circuit elements of the embodiment of FIG. 3 are shown in the following table:

TABLE 2

| Element | Value |
|---|---|
| R1 | 20K ohms |
| R9 | 100 ohms |
| R10 | 15K ohms |
| R11 | 3K ohms |
| R12 | 1K Ohms |
| R13 | 1.8K Ohms |
| R14 | 4K ohms |
| R15 | 20K ohms |
| R16 | 80K ohms |
| R17 | 30K ohms |
| R18 | 3K ohms |
| C1 | 80 pf |
| C2 | 30 pf |
| C4 | .01 uF |
| C11 | .1 uF |
| C12 | .1 uF |
| C13 | .1 uF |
| C14 | 2-10 pf |
| C15 | 2-10 pf |
| L5 | 4.2 uH |
| L6 | 2.6 uH |
| 52 | 17.9 MHz (crystal filter) |
| 54 | 455 KHz (ceramic filter) |
| 20 | 17.445 MHz (fundamental crystal) |

While the embodiments of FIGS. 2 and 3 were described using a crystal controlled oscillator circuit, this is not the case for all heterodyne stages of a receiver. Some stages may use another type of oscillator circuit, such as a voltage controlled oscillator (VCO), for example. A suitable circuit embodiment of a VCO for use in a heterodyne stage embodying the invention is shown in FIG. 4. The VCO embodiment includes a conventional Colpitts oscillator circuit **10** similar to the oscillator circuit described in connection with the depictions of FIGS. 2 and 3. Reference numerals are maintained for the same or similar elements. Instead of being driven by a tuned crystal circuit, the frequency of the Colpitts oscillator **10** is governed by a varactor or varicap element VC1 which is coupled between the variable capacitor **21** and ground potential. A choke coil L7 is coupled between the node connection between **21** and VC1 and a variable source of voltage potential at **60**. Further, a fixed capacitor element may be coupled between the base of Q3 and ground potential to provide additional oscillator tuning. Still further, a choke coil L8 is disposed between the base of Q3 and B+ supply for biasing purposes and for decoupling the B+ supply from the varactor tuned driver stage. A resistor R19 coupled between the collector of Q3 and the B+supply provides both impedance matching and source or local impedance.

A similar current mirror stage comprising transistors Q1 and Q2 is coupled to the VCO **10** to control the bias current thereof which in turn adjusts the amplitude of the injection signal output AC coupled through capacitor C9. Another choke coil L9 and capacitive C17 are disposed in the bias current line between the oscillator circuit **10** and current mirror **16** to provide AC decoupling of the bias current from the transistor Q2. Resistor R20 sets a minimum current level to ensure that the oscillator has sufficient current under all loop conditions.

In operation, the frequency of the injection signal coupled through C9 to the mixer may be controlled by varying the voltage potential applied to the VCO at **60**. For example, varying the voltage at **60** between 0.5 V and 3 V alters the capacitance of VC1 in the present embodiment for 24 to 44 pf which commensurately adjusts the frequency of the oscillator about a center frequency of approximately 150 MHz. Typical values of the circuit elements for a suitable embodiment of a VCO tuned for a center frequency of approximately 150 MHz are shown in the table below.

TABLE 3

| Element | Value |
|---|---|
| C1 | 22 pf |
| C2 | 15 pf |
| C4 | .05 uf |
| C9 | 220 pf |
| C16 | 30 pf |
| C17 | 125 pf |
| 21 | 5-35 pf |
| VC1 | 24-44 pf (.5V-3V) |
| L7 | 2.6 uH |
| L8 | 2.6 uH |
| L9 | 2.6 uH |
| 22 | 87 nH |
| R17 | 3 K ohms |
| R18 | 1 K ohms |
| R19 | 50 ohms |
| R20 | 1 K ohms |

In summary, both of the embodiments of the present invention described in connection with the depictions of FIGS. 2 and 3 provide a very ample and viable feedback control loop having the ability to measure the injection signal generated by the oscillator circuit in each case undisturbed by extraneous signals, the ability

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to set a precise reference level for controlling the injection to a desired amplitude signal which becomes particularly important when using a VCO for which precise channel selectivity is needed and because of the substantial increase in sideband noise when the amplitude of the injection signal deviates from that desired, and a bias current control range to ensure that the closed-loop controller operates within a banded range to start-up and sustain oscillator operation under all operating conditions with a minimum current drain from the battery source.

While the present invention has been described in connection with two specific embodiments, it is understood that additions, deletions, and modifications of these embodiments may be made without deviating from the principles of such invention. Accordingly, the present invention should not be limited to any specific embodiment but rather construed in scope and breadth according to the claims appended hereto.

What is claimed is:

1. A heterodyne stage of a receiver comprising:

source of bias current;

local oscillator circuit responsive to bias current supplied from said source for generating an injection signal at a predetermined frequency and an amplitude based on the amount of bias current supplied;

mixer circuit governed by said injection signal to convert a receiver signal from one frequency to another frequency by a heterodyning process;

means for measuring the amplitude of said injection signal; and

differential amplifier circuit having one transistor stage input coupled to said measuring means to effect a signal representative of the amplitude of said injection signal and another transistor stage input biased at a reference level, and including a circuit stage governed by said amplitude representative signal and said reference level to adjust the amount of bias current supplied to said oscillator circuit by said source within a non-zero bias current range.

2. The heterodyne stage in accordance with claim 1 wherein the measuring means includes means for coupling the injection signal from the local oscillator circuit to the one transistor stage input of the differential amplifier circuit.

3. The heterodyne stage in accordance with claim 1 including a current supply line for governing the supply of bias current to the local oscillator circuit by the bias current source; and wherein the circuit stage of the differential amplifier circuit is coupled to the supply line for diverting to the circuit stage a portion of the current intended for governing the bias current supply to the local oscillator circuit in accordance with the amplitude representative signal of the reference signal and the differential amplifier circuit.

4. The heterodyne stage in accordance with claim 3 wherein the circuit stage comprises a current mirror circuit for setting the maximum amount of diverted governing current from said supply line.

5. The heterodyne stage in accordance with claim 3 wherein the bias current source includes a current mirror circuit disposed in the supply line between a governing current source and the local oscillator circuit for setting the maximum amount of bias current to be supplied to the local oscillator circuit by the bias current source.

6. The heterodyne stage in accordance with claim 1 wherein the differential amplifier circuit is constructed as an integrated circuit; and wherein the integrated circuit areas of the one and another transistor stage inputs of the differential amplifier circuit are preselected to set the reference level thereof.

7. The heterodyne stage in accordance with claim 1 wherein the mixer circuit comprises a common emitter transistor configuration operative to generate a delta current signal representative of the amplitude of the injection signal governing its heterodyne operation; and wherein the measuring means includes means for coupling said delta current signal from the mixer circuit to the one transistor stage input of the differential amplifier circuit.

8. The heterodyne stage in accordance with claim 1 wherein the bias current source comprises a current mirror circuit biased to supply a minimum amount of bias current to the local oscillator circuit; and wherein the circuit stage of the differential amplifier circuit is coupled to the current mirror circuit of the bias current source to adjust the amount of bias current supplied to the local oscillator circuit in accordance with the amplitude representative signal and the reference level of the differential amplifier circuit.

9. The heterodyne stage in accordance with claim 8 wherein the circuit stage comprises a current mirror circuit for setting the maximum amount of bias current for supply to the local oscillator circuit by the bias current source.

10. The heterodyne stage in accordance with claim 1 including a resistor divider network coupled between two voltage potentials for generating a reference voltage signal which is coupled to the other transistor stage input of the differential amplifier circuit for biasing said stage to the desired reference level.

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# United States Patent [19]

Durec et al.

[11] Patent Number: 5,886,547
[45] Date of Patent: Mar. 23, 1999

[54] **CIRCUIT AND METHOD OF CONTROLLING MIXER LINEARITY**

[75] Inventors: **Jeffrey C. Durec**, Chandler; **William E. Main**, Mesa, both of Ariz.

[73] Assignee: **Motorola, Inc.**, Schaumburg, Ill.

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[22] Filed: **Dec. 16, 1996**

[51] **Int. Cl.**[6] ..... **H04B 1/28**

[52] **U.S. Cl.** ..... **327/113**; 327/359; 455/296; 455/333

[58] **Field of Search** ..... 327/113, 114, 327/116, 119, 355, 356, 358, 359; 455/296, 323, 333

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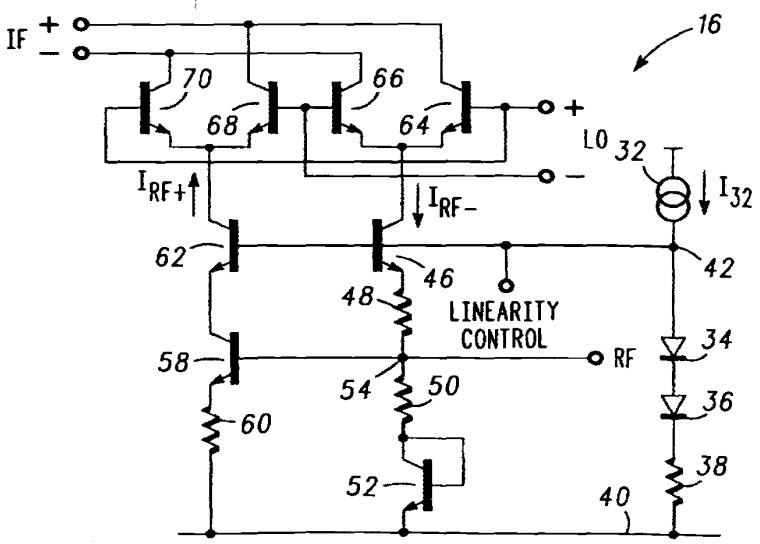
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*Primary Examiner*—Kenneth B. Wells
*Assistant Examiner*—Terry L. Englund
*Attorney, Agent, or Firm*—Robert D. Atkins

[57] **ABSTRACT**

An integrated receiver circuit (**10**) has a first amplifier (**12**) coupled for receiving a radio frequency (RFIN) input signal. A mixer (**16**) has an RF input coupled to an output of the first amplifier, a local oscillator (LO) input coupled for receiving an LO signal, and an output for providing an intermediate frequency (IF) signal. A second amplifier (**20**) has an input coupled for receiving the IF signal, and an output for providing a receive signal strength indicator (RSSI) signal representative of an input power level of the receiver signal path. A feedback circuit (**22–26** or **72**, **78**) is coupled between the first output of the second amplifier and a linearity control input of the mixer for controlling linearity of the mixer.

**18 Claims, 1 Drawing Sheet**






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FIG. 1

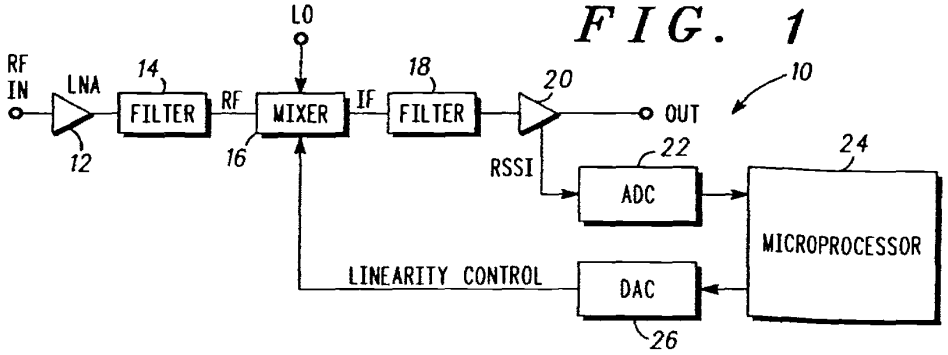



FIG. 2

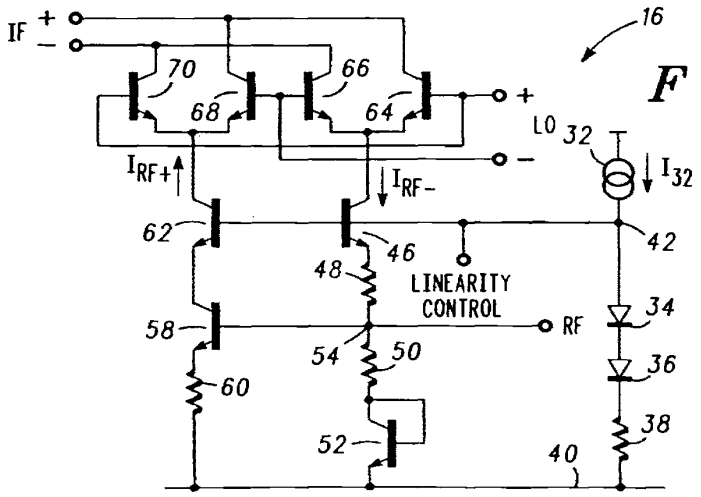
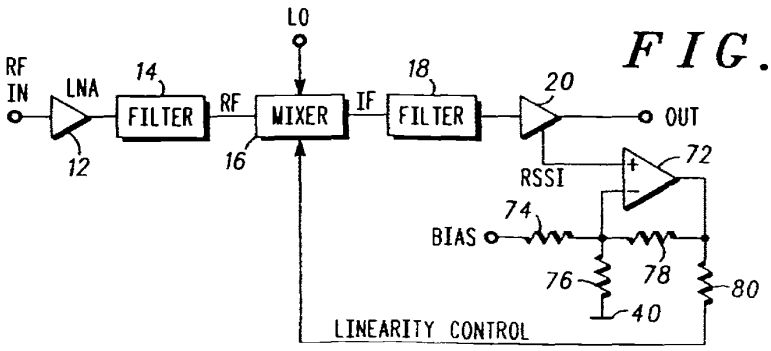



FIG. 3






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# CIRCUIT AND METHOD OF CONTROLLING MIXER LINEARITY

## BACKGROUND OF THE INVENTION

The present invention relates in general to integrated circuits and, more particularly, to a circuit and method of controlling mixer linearity in a receive signal path.

Receiver circuits are used in a myriad of wireless communication applications such as cordless telephones, pagers, and cellular telephones. A receiver circuit typically receives a radio frequency (RF) modulated signal from an antenna. The airways are continuously flooded with many distinct RF signals operating at different frequencies. The user, for example operating a cordless telephone, is only interested in a particular frequency, namely the channel frequency transmitted from the matching base unit. The receiver should as much as possible differentiate the desired RF signal and eliminate unwanted interfering RF signals, for example from a neighbor's cordless telephone, operating in an adjacent frequency channel.

The RF signals can range from power levels as low as −120 dBm to higher power levels around −10 dBm. A problem arises when the desired RF signal operates at a low power level in one frequency channel and the interfering RF signal in at least two adjacent channels operate at a higher power level. The receiver includes a mixer that downconverts the RF signal to an intermediate frequency (IF). During the mixing process, a number of inter-modulation products are generated involving the adjacent channel RF signals. In particular, the third order inter-modulation component of the adjacent channel RF signals can be translated to a frequency at or near the desired IF frequency and thereby interfere with the desired IF signal. If the adjacent channel RF signals inter-modulate directly onto or near the desired IF signal frequency, then the adjacent channels become indistinguishable from the desired channel. The distortion product can overwhelm the desired IF signal if the inter-modulation power is greater than the desired IF signal power. The interfering RF signal can overpower and prevent the receiver from discerning the desired RF signal.

In the prior art, the receiver includes an input low-noise amplifier (LNA) followed by a filter and the mixer for downconverting the RF signal to an IF signal according to a local oscillator (LO) signal. The receiver uses an automatic gain control (AGC) loop that senses the power levels of the incoming RF signals and adjusts the gain of the input LNA accordingly to control the dynamic range of the signal processed through the receiver. The AGC controls inter-modulation interference by reducing the gain in the receive signal path, typically by controlling the LNA, and thereby reducing the signal level of the adjacent channels going into the mixer.

One problem with the AGC approach is that reducing the gain of the input LNA adversely impacts the noise contribution of subsequent receiver stages and degrades the overall receiver noise figure, i.e. ratio of output SNR to input SNR. If the gain of the input LNA is high, then noise contribution from the other receiver components, e.g. filter and mixer, is non-dominant. That is, with high input LNA gain, the RF input signal is a sufficiently high level that any noise from the filter and mixer does not adversely affect the receiver sensitivity, i.e. minimum level RF signal above the noise floor that can be detected. However, when the gain of the input LNA is low, then the noise contributions from the filter and mixer becomes appreciable. The lower gain of the input LNA is especially problematic when the adjacent



channel signal power is greater than the desired channel signal power. The desired channel becomes distorted with noise and the sensitivity of the receiver decreases. It is desirable to maintain the receiver sensitivity and the noise figure constant over a wide range of input signal levels.

Hence, a need exists to control the dynamic range of the receiver independent of the system noise figure and without degrading the receiver sensitivity.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a block diagram illustrating a receiver with a linearity controlled mixer;

FIG. **2** is a schematic diagram illustrating further detail of the mixer of FIG. **1**; and

FIG. **3** is a block diagram illustrating an alternate embodiment for the receiver.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1**, a receiver circuit **10** is shown suitable for use in a wireless communication device such as a pager, cellular telephone, or cordless telephone. Receiver **10** includes a receive signal path including amplifier **12**, filter **14**, mixer **16**, filter **18**, and limiting amplifier **20**. Receiver **10** receives a modulated RF input signal RFIN operating at say 900 MHz. Voice signals or other data is modulated onto the RFIN signal. Amplifier **12** is a low-noise amplifier (LNA) that provides 15 dB of gain for the RFIN signal. Filter **14** filters the amplified signal. Filter **14** is a ceramic two-pole Chebyshev bandpass filter centered at 900 MHz with a pass bandwidth of 3 MHz. Alternately, filter **14** can be implemented as a surface acoustic wave (SAW) filter, an inductor-capacitor (LC) filter, or a resistor-capacitor (RC) filter. The output of filter **14** is coupled to the RF input of mixer **16**. Mixer **16** has an LO input that receives an LO signal operating at 910 MHz for downconverting the RF signal to a 10 MHz IF output signal. Mixer **16** provides the IF signal to filter **18**. Filter **18** is a ceramic two-pole Chebyshev bandpass filter centered at 10 MHz with a pass bandwidth of 300 KHz. Amplifier **20** is a limiting amplifier that receives the filtered IF signal and provides 100 dB of gain. A first output of amplifier **20** provides an output signal OUT to other components in receiver **10** such as a demodulator (not shown).

The principal function of receiver **10** is to process the RFIN input signal operating at a particular frequency. The desired information, e.g. telephone voice signal or pager data, is modulated at that RF frequency. The desired RF signal has a certain power level depending on many factors such as the output power of the transmitting device, the distance between the transmitter and receiver, and environmental conditions. In most situations, there are other RF signals operating in nearby frequencies or adjacent channels. The other adjacent channels' RF signals can have power levels that are higher than the desired RF signal. Filter **14** has limited effectiveness in rejecting the adjacent channel RF signals depending in part on their frequency and power level.

As described in the background, during the mixing process where the desired RF signal is downconverted to an IF signal, a number of inter-modulation products are generated involving the adjacent channel RF signals. In particular, the third order inter-modulation component of at least two adjacent channel RF signals can be translated to a frequency at or near the desired IF frequency and thereby interfere with



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the desired IF signal. If the adjacent channel RF signals inter-modulate directly onto or near the desired IF signal frequency, then the adjacent channels become indistinguishable from the desired channel. The distortion product can overwhelm the desired IF signal if the inter-modulation power is greater than the desired IF signal power. The desired voice signal becomes distorted or lost.

The inter-modulation products arise because of non-linearities in mixer **16**. If the inter-modulation power is reduced, then the desired RF signal is subject to less distortion. One way of reducing the power in the inter-modulation products is to linearize the operation of mixer **16**. To provide linearity control for mixer **16**, the power level in the receive signal path is monitored and a linearity control feedback signal is generated according to that power level. A higher power level in the receive signal path corresponds to a greater linearity control signal which in turn makes the operation of mixer **16** more linear, and reduces the inter-modulation power and distortion of the desired RF signal.

To monitor the receive signal path power level, amplifier **20** uses a logarithmic amplifier with an output RC filter to provide a received signal strength indicator (RSSI) signal having an amplitude representative of the power in the receive signal path. In the present embodiment, the receive signal path power is monitored at the input to amplifier **20**, e.g. RSSI=K log ($P_{IN}$) where K is a constant and $P_{IN}$ is the input power of amplifier **20**. For example, amplifier **20** can detect power ranges from −100 dBm to −20 dBm. The RSSI signal correspondingly ranges from 0 volts for $P_{IN}$=−100 dBm to 4 volts for $P_{IN}$=−20 dBm, or in other words 1 volt/20 dBm. A second output of amplifier **20** provides the RSSI signal to a 4-bit analog-digital converter (ADC) **22**.

In the present invention, the power level in the receive signal path can be monitored at other or additional points as well. For example, a second limiting amplifier (not shown) following the first limiting amplifier could provide a second RSSI signal. The first limiting amplifier **20** monitors lower power levels and the second limiting amplifier monitors higher power levels. The first and second RSSI signals are summed together to provide a composite RSSI signal to ADC **22**.

Microprocessor **24** operates as a logic control block to make a decision based on the digital value from ADC **22** of the power level in the receive signal path. Microprocessor **24** performs a comparison of the digital value of RSSI against a threshold to determine a linearity control factor. Assume the threshold is set to a level corresponding to a −60 dBm power level in the receive signal path (RSSI=2 volts). If the RSSI signal is less than 2 volts then microprocessor **24** generates a linearity control factor of zero. If the RSSI signal is greater than 2 volts then microprocessor **24** generates a linearity control factor of one. Alternatively, microprocessor **24** performs a table look-up, or other transformation, to match the digital value of RSSI to a linearity control factor. For example, an RSSI signal less than 1 volt could translate to a digital linearity control factor of "00" in microprocessor **24**. Similarly, a RSSI signal between 1 volt and 2 volts translates to a linearity control factor of "01", and a RSSI signal between 2 volts and 3 volts becomes a linearity control factor of "10" in microprocessor **24**. A RSSI signal between 3 volts and 4 volts translates to a linearity control factor of "11". In another embodiment, the logic control block could be implemented with dedicated logic gates to make the translation from the digital value of the RSSI signal to the linearity control factor.

The digital linearity control factor from microprocessor **24** is converted to a LINEARITY CONTROL feedback signal by digital-analog converter (DAC) **26**. In the present embodiment, the LINEARITY CONTROL signal is a feedback current that is applied to a linearity control input of mixer **16** to control its linearity. The LINEARITY CONTROL signal could also be a feedback voltage. If the receive signal path power level power is low, the LINEARITY CONTROL signal is small or zero. In the above example, if RSSI is less than 1 volt, then the linearity control factor is "00" and LINEARITY CONTROL becomes a zero current. In this case, the power in the receive signal path is low indicating little or no inter-modulation distortion. Mixer **16** is allowed to operate in a non-linear manner to save overall power consumption in receiver **10**.

As the receive signal path power level increases, the LINEARITY CONTROL signal steps up to cause mixer **16** to operate in a more linear manner as discussed below. If RSSI is between 1 volt and 2 volts, then the linearity control factor is "01" and LINEARITY CONTROL is set to a 0.1 milliamp (mA) current. If RSSI is between 2 volts and 3 volts, then the linearity control factor is "10" and LINEARITY CONTROL is a 0.2 mA current. If RSSI is between 3 volts and 4 volts, then the linearity control factor is "11" and LINEARITY CONTROL becomes a 0.3 mA current.

Turning to FIG. **2**, mixer **16** is shown including current source **32** providing a 0.2 mA reference current $I_{32}$ to a voltage reference circuit comprising diodes **34** and **36** and resistor **38**. The reference current $I_{32}$ is returned to power supply conductor **40** operating at ground potential. Resistor **38** is selected at 1000 ohms. Given the voltage across each diode in FIG. **2** as approximately 800 millivolts (mV), there is a 1.8 volt reference voltage is established at node **42**.

Transistor **46**, resistors **48** and **50**, and transistor **52** form a first conduction path in mixer **16**. The first conduction path conducts current $I_{RF}-$ in response to the RF input signal applied at node **54**. First consider a neutral operating state without the RF signal and zero LINEARITY CONTROL current. From the 1.8 volt reference at node **42**, there is one base-emitter junction potential ($V_{be}$) in transistor **46**, the voltage drop across resistors **48** and **50**, and another $V_{be}$ in transistor **52**. Resistors **48** and **50** are matched at 60 ohms and each develop approximately 100 mV of potential with the current $I_{RF}-$ flowing in the first conduction path. Node **54** is therefore about 900 mV.

Transistors **58** and **62** and resistor **60** form a second conduction path in mixer **16**. The second conduction path conducts current $I_{RF}+$ in response to the RF input signal at node **54**. Resistor **60** is selected at 60 ohms and develops a potential of 100 mV with the current $I_{RF}+$ flowing in the second conduction path. The emitter of transistor **62** is 800 mV less than node **42** or approximately 1 volt. The bases of transistors **46** and **62** are coupled together and receive the reference voltage developed at node **42** which is the common control input of mixer **16**.

Now consider the operation of mixer **16** with the RF signal. When the RF signal increases, more current flows through transistor **52** as its $V_{be}$ increases. Less current flows through transistor **46** because its $V_{be}$ decreases with node **42** fixed. The RF input of mixer **16** sources the additional current for transistor **52**. The increase current in transistor **52** causes more current to flow in transistor **58**. The same current flows through transistors **58** and **62**. Therefore, as the RF signal increases, the $I_{RF}-$ current decreases and the $I_{RF}+$ current increases.

When the RF signal decreases, less current flows through transistor **52** as its $V_{be}$ decreases. More current flows through transistor **46** because its $V_{be}$ increases. The decreas-



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ing current in transistor 52 causes less current to flow in transistor 58. Therefore, as the RF signal decreases, the $I_{RF}-$ current increases and the $I_{RF}+$ current decreases.

Transistors 64 and 66 and transistors 68 and 70 operate as a switching circuit under control of differential local oscillator signal ±LO. When +LO is greater than −LO, transistors 64 and 70 conduct collector currents from transistors 46 and 62, respectively. When −LO is greater than +LO, transistors 66 and 68 conduct collector currents from transistors 46 and 62, respectively. A differential signal ±IF is provided at the common collectors of transistors 66 and 70 and at the common collectors of transistors 64 and 68. The RF signal seen differentially as current $\pm I_{RF}$ in the collectors of transistors 46 and 62 is switched between transistors 64–70 at the LO signal rate. The RF signal operating at 900 MHz is thus downconverted by the LO signal operating at 910 MHz to an IF signal operating at 10 MHz, i.e. $IF_{FREQ}=LO_{FREQ}-RF_{FREQ}$.

The transfer function of mixer 16 is given as:

$$\Delta I_{RF}/\Delta V_{RF}=2/(1/g_m+R_E) \quad (1)$$

where:

$\Delta I_{RF}$ is difference $I_{RF}+$ and $I_{RF}-$

$\Delta V_{RF}$ is the RF signal voltage at node 54

$g_m$ is the transconductance of the transistors

$R_E$ is the value of resistors 48 and 50

The transconductance $g_m$ of transistors 46, 52, 58, and 62 is determined by their emitter resistor $r_e$ as follows:

$$r_e=V_t/I_C=(kT/q)/I_C \quad (2)$$

where:

k is Boltzmann's constant

T is temperature

q is an electron charge

$I_C$ is the collector current

When $R_E$ is negligible compared to $1/g_m$, then $\Delta I_{RF}/\Delta V_{RF}\approx 2g_m$. The transconductance $g_m$ of a transistor is non-linear because of the well known exponential relationship between collector current and emitter-base voltage. On the other hand, resistance $R_E$ (resistors 48 and 50) is linear. When $R_E$ is much larger than $1/g_m$ ($R_E>>1/g_m$), then $\Delta I_{RF}/\Delta V_{RF}\approx 2/R_E$ and equation (1) becomes more linear. The linearity of mixer 16 can be controlled by adjusting the contribution of $r_e$ to equation (1) such that $R_E$ dominates the transfer function. The emitter resistance $r_e$ is made effectively smaller by increasing collector current $I_C$ as per equation (2). In other words, if collector current $I_C$ is made larger, then resistance $r_e$ becomes effectively smaller and the overall operation of mixer 16 becomes more linear. By operating more linearly, the IF output frequency of mixer 16 linearly tracks the difference between LO frequency and the RF frequency. The cost of linearizing mixer 16 is greater power consumption, but the benefit is reducing the generation of inter-modulation products from adjacent channels during the mixing process.

As a feature of the present invention, the LINEARITY CONTROL feedback current is used to control the linearity of mixer 16. When the receive signal path power level is less than the minimum threshold determined by microprocessor 24, i.e. RSSI<1 volt, the LINEARITY CONTROL feedback current is zero and mixer 16 operates its most non-linear fashion where 1/gm dominates the transfer function in equation (1). In full non-linear mode, mixer 16 downconverts the RF signal to the IF signal with transistors 46–62 operating in their most non-linear mode. The linearity control is not necessary because the power level in the receive signal path is sufficiently low that inter-modulation products from adjacent channels should not interfere with the desired RF signal. Mixer 16 consumes less power in full non-linear mode as compared with the varying levels of linearity control mode discussed below.

When the receive signal path power level is greater than the minimum threshold determined by microprocessor 24, i.e. RSSI>1 volt, the LINEARITY CONTROL signal becomes non-zero and mixer 16 begins to operate in linearity control mode. The reference voltage at node 42 increases as the LINEARITY CONTROL feedback current flows through diodes 34 and 36 and resistor 38. The principal change in the reference voltage at node 42 is due to the greater voltage drop across resistor 38. As the reference voltage at node 42 increases, the $V_{be}$ of transistors 46, 52, 58, and 62 increase and thereby conduct more collector current. For example, if the LINEARITY CONTROL feedback current is 0.1 mA, the reference voltage increases by 100 mV to 1.9 volts. The voltage drop across resistors 48 and 50 increase by 50 mV each with the additional collector current flow. The increasing collector current $I_C$ makes the emitter resistance $r_e$ effectively smaller as per equation (2). The resistor $R_E$ in the transfer function of equation (1) begins to dominate over $1/g_m$ and linearize mixer 16.

If the LINEARITY CONTROL feedback current goes to 0.2 mA with an even greater receive signal path power level, the reference voltage increases by another 100 mV to 2.0 volts. The voltage drop across resistors 48 and 50 increase by another 50 mV each with the additional collector current flow. The increasing collector current $I_C$ makes the emitter resistance $r_e$ effectively smaller as per equation (2). The resistor $R_E$ in the transfer function of equation (1) has an even greater dominance over $1/g_m$ and increases the linearity of mixer 16. If the LINEARITY CONTROL feedback current is 0.3 mA as described above, the reference voltage increases by yet another 100 mV to 2.1 volts. The voltage drop across resistors 48 and 50 increase by another 50 mV each with the additional collector current flow. The resistor $R_E$ in the transfer function of equation (1) has total dominance over $1/g_m$ and provides maximum linearity of mixer 16. The linearity control of mixer can provide 48 dB reduction in the inter-modulation power level and thereby reduce distortion in the desired RF signal.

An alternate embodiment of the present invention is shown in FIG. 3. Circuit elements assigned the same reference numbers used in FIG. 1 provide a similar function. In the feedback path, the RSSI signal is applied to a non-inverting input of amplifier 72. A BIAS voltage is applied through resistor 74 to an inverting input of amplifier 72. Resistors 76 and 78 provide feedback around amplifier 72 to set its gain. Amplifier 72 provides a linear gain such that its output voltage is some constant times the input voltage. Resistor 80 converts the output voltage of amplifier 72 to a current which is applied to the linearity control input of mixer 16. Alternatively with sufficient gain, amplifier 72 could operate as a comparator and provide either no linearity control or maximum linearity control.

By now it should be appreciated, the present invention provides linearity control for a mixer. The linearity of the mixer is externally controlled in a feedback loop by monitoring the power level in the receive signal path. The feedback loop generates a linearity control signal representative of the power level in the receive signal path that increases the current flow in the mixer conduction paths and thereby increases its linearity. By controlling the linearity of



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the mixer. the inter-modulation power level is reduced which results in less distortion for the desired RF signal. Since controlling the linearity of the mixer does not effect its gain. a high level RF signal can be processed through the mixer without increasing the noise figure of the system. There is substantially no increase in noise contribution from the mixer because its gain is not changed. The dynamic range of the receiver becomes independent of the system noise figure without degrading the receiver sensitivity.

While specific embodiments of the present invention have been shown and described. further modifications and improvements will occur to those skilled in the art. It is understood that the invention is not limited to the particular forms shown and it is intended for the appended claims to cover all modifications which do not depart from the spirit and scope of this invention.

What is claimed is:

1. A mixer. comprising:

first and second conduction paths for conducting first and second currents respectively in response to an input signal operating at a first frequency. the first and second conduction paths having a common control input coupled for receiving a linearity control signal that increases the first and second currents to increase linearity in the mixer;

a reference voltage circuit providing a reference voltage to the common control input; and

a switching circuit coupled for receiving the first and second currents and responsive to an oscillator signal for switching the first and second currents and providing an output signal of the mixer operating at a second frequency different than the first frequency of the input signal.

2. The mixer of claim 1 wherein the first conduction path includes:

a first transistor having a first conduction terminal for providing the first current. and a control terminal coupled to the common control input for receiving the reference voltage; and

a second transistor having a first conduction terminal coupled to a second conduction terminal of the first transistor at a first node where the input signal is applied. a control terminal coupled to the first conduction terminal of the second transistor. and a second conduction terminal coupled to a power supply conductor.

3. The mixer of claim 2 wherein the first conduction path further includes:

a first resistor coupled between the second conduction terminal of the first transistor and the first node; and

a second resistor coupled between the first node and the first conduction terminal of the second transistor.

4. The mixer of claim 2 wherein the second conduction path includes:

a third transistor having a first conduction terminal for providing the second current. and a control terminal coupled to the common control input for receiving the reference voltage; and

a fourth transistor having a first conduction terminal coupled to a second conduction terminal of the third transistor. a control terminal coupled to the first node. and a second conduction terminal coupled to the power supply conductor.

5. The mixer of claim 4 wherein the second conduction path further includes a resistor coupled between the second conduction terminal of the fourth transistor and the power supply conductor.

6. The mixer of claim 1 wherein the switching circuit includes:

a first transistor having a first conduction terminal coupled for receiving the first current. a control terminal coupled for receiving a first component of the oscillator signal. and a second conduction terminal for providing a first component of the output signal of the mixer;

a second transistor having a first conduction terminal coupled for receiving the first current. a control terminal coupled for receiving a second component of the oscillator signal. and a second conduction terminal for providing a second component of the output signal of the mixer;

a third transistor having a first conduction terminal coupled for receiving the second current. a control terminal coupled for receiving the second component of the oscillator signal. and a second conduction terminal for providing the first component of the output signal of the mixer; and

a fourth transistor having a first conduction terminal coupled for receiving the second current. a control terminal coupled for receiving the first component of the oscillator signal. and a second conduction terminal for providing the second component of the output signal of the mixer.

7. An integrated circuit. comprising:

a receive signal path including a mixer having an RF input coupled for receiving a radio frequency (RF) input signal. a local oscillator (LO) input coupled for receiving an LO signal. and an output for providing an intermediate frequency (IF) signal. wherein the mixer includes.

(a) first and second conduction paths for conducting first and second currents respectively in response to the RF input signal operating at a first frequency. wherein the first and second conduction paths have a common control input coupled for receiving a linearity control signal that increases the first and second currents to increase linearity in the mixer.

(b) a reference voltage circuit providing a reference voltage to the common control input. and

(c) a switching circuit coupled for receiving the first and second currents and responsive to the LO signal for switching the first and second currents and providing the IF signal of the mixer operating at a second frequency different than the first frequency of the RF input signal; and

a feedback circuit coupled for receiving a receive signal strength indicator (RSSI) signal representative of a power level in the receive signal path and providing the linearity control signal to the common control input of the first and second conduction paths of the mixer.

8. The integrated circuit of claim 7 wherein the receive signal path further includes. comprising:

a first amplifier having an input coupled for receiving the RF input signal. and an output coupled to the RF input of the mixer; and

a second amplifier having an input coupled to the output of the mixer. and a first output for providing the receive signal strength indicator (RSSI) signal to an input of the feedback circuit.

9. The integrated circuit of claim 7 wherein the feedback circuit includes a comparator having a first input coupled for receiving the RSSI signal. a second input coupled for receiving a bias signal. and an output providing the linearity control signal to the common control input of the mixer.



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10. The integrated circuit of claim 7 wherein the first conduction path includes:

a first transistor having a first conduction terminal for providing the first current, and a control terminal coupled to the common control input for receiving the reference voltage; and

a second transistor having a first conduction terminal coupled to a second conduction terminal of the first transistor at a first node where the RF input signal is applied, a control terminal coupled to the first conduction terminal of the second transistor, and a second conduction terminal coupled to a power supply conductor.

11. The integrated circuit of claim 10 wherein the first conduction path further includes:

a first resistor coupled between the second conduction terminal of the first transistor and the first node; and

a second resistor coupled between the first node and the first conduction terminal of the second transistor.

12. The integrated circuit of claim 10 wherein the second conduction path includes:

a third transistor having a first conduction terminal for providing the second current, and a control terminal coupled to the common control input for receiving the reference voltage;

a fourth transistor having a first conduction terminal coupled to a second conduction terminal of the third transistor, and a control terminal coupled to the first node; and

a resistor coupled between a second conduction terminal of the fourth transistor and the power supply conductor.

13. The integrated circuit of claim 7 wherein the switching circuit includes:

a first transistor having a first conduction terminal coupled for receiving the first current, a control terminal coupled for receiving a first component of the LO signal, and a second conduction terminal for providing a first component of the IF signal of the mixer;

a second transistor having a first conduction terminal coupled for receiving the first current, a control terminal coupled for receiving a second component of the LO signal, and a second conduction terminal for providing a second component of the IF signal of the mixer;

a third transistor having a first conduction terminal coupled for receiving the second current, a control terminal coupled for receiving the second component of the LO signal, and a second conduction terminal for providing the first component of the IF signal of the mixer; and

a fourth transistor having a first conduction terminal coupled for receiving the second current, a control terminal coupled for receiving the first component of the LO signal, and a second conduction terminal for providing the second component of the IF signal of the mixer.

14. The integrated circuit of claim 7 wherein the feedback circuit includes:

an analog-digital converter (ADC) having an input coupled for receiving the RSSI signal;

a logic control circuit having an input coupled to an output of the ADC for translating the RSSI signal to a linearity control factor which is provided at an output; and

a digital-analog converter (DAC) having an input coupled to the output of the logic control circuit and an output providing the linearity control signal to the common control input of the mixer.

15. The integrated circuit of claim 7 wherein the feedback circuit includes an amplifier having a first input coupled for receiving the RSSI signal, a second input coupled for receiving a bias signal, and an output providing the linearity control signal to the common control input of the mixer.

16. The integrated circuit of claim 15 wherein the feedback circuit further includes a voltage-current converter coupled between the output of the amplifier and the common control input of the mixer.

17. A method of linearizing a mixer coupled in a receive signal path, comprising the steps of:

conducting first and second currents in first and second conduction paths respectively in response to an input signal operating at a first frequency;

applying a reference voltage to a common control input of the first and second conduction paths;

applying a linearity control signal representative of power in the receive signal path at the common control input of the first and second conduction paths for increasing the first and second currents to increase linearity in the mixer; and

switching the first and second currents in response to an oscillator signal and providing an output signal from the mixer operating at a second frequency less the first frequency of the input signal.

18. The method of claim 17 wherein the step of applying a linearity control signal at a common control input of the first and second conduction paths includes the step of injecting the linearity control signal as a current to increase the reference voltage.

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# United States Patent [19]

Chevallier et al.

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[54] **TRANSFORMER CIRCUIT, DOUBLE-BALANCED MIXER**

[75] Inventors: **Gilles Chevallier**, Langune Sur Mer, France; **Eduard F. Stikvoort**, Eindhoven, Netherlands

[73] Assignee: **U.S. Philips Corporation**, New York, N.Y.

[ * ] Notice: The terminal 23 months of this patent has been disclaimed.

[21] Appl. No.: **110,038**

[22] Filed: **Aug. 20, 1993**

[30] **Foreign Application Priority Data**

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[51] **Int. Cl.**[6] ..... **H03D 7/14**

[52] **U.S. Cl.** ..... **327/356**; 327/359

[58] **Field of Search** ..... 328/156, 158, 328/160; 307/261, 262, 529, 490, 494, 513; 330/301, 254, 277, 278, 285; 327/105, 113, 116, 119, 355, 356, 359, 256, 257

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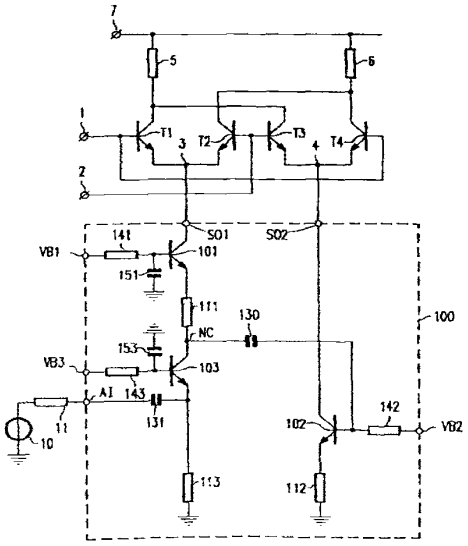
Search Report.

*Primary Examiner*—Timothy P. Callahan
*Assistant Examiner*—T. T. Lam
*Attorney, Agent, or Firm*—Edward Blocker

[57] **ABSTRACT**

An integratable transformer circuit for converting an asymmetrical input signal into a pair of symmetrical output signal currents and requiring only one IC connection pin. The circuit exhibits a low input impedance combined with good noise, gain and intermodulation performance up to high frequencies. The asymmetrical input terminal of the circuit is coupled to a node commonly coupled to the emitter of a common base transistor and to the base of a common emitter transistor. The common base transistor acts as a non-inverting current follower, the common emitter transistor as an inverting transimpedance amplifier. An input signal current is transferred to a first symmetrical output terminal via the node and the common base transistor, thereby producing a signal voltage at the node. This signal voltage modulates the collector current of the common emitter transistor, which is in phase opposition to the input signal current and is transferred to the second output terminal.

**23 Claims, 7 Drawing Sheets**






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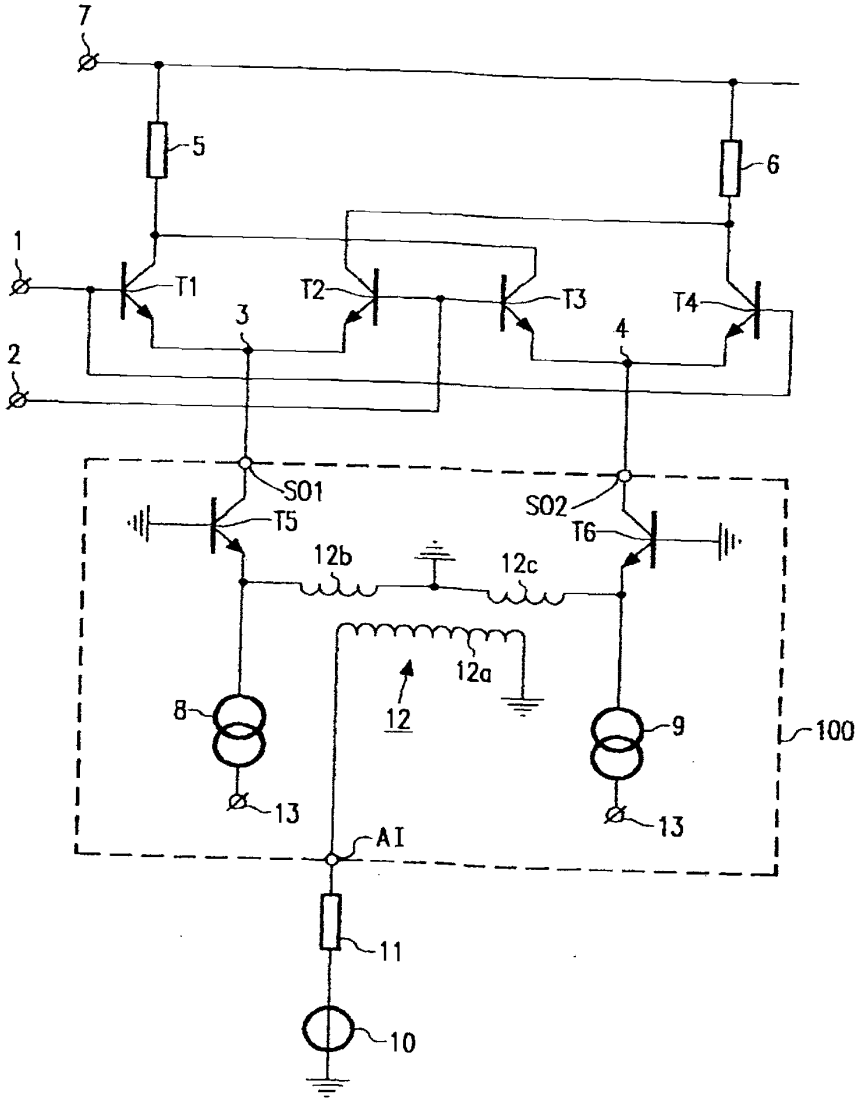



FIG. 1
PRIOR ART


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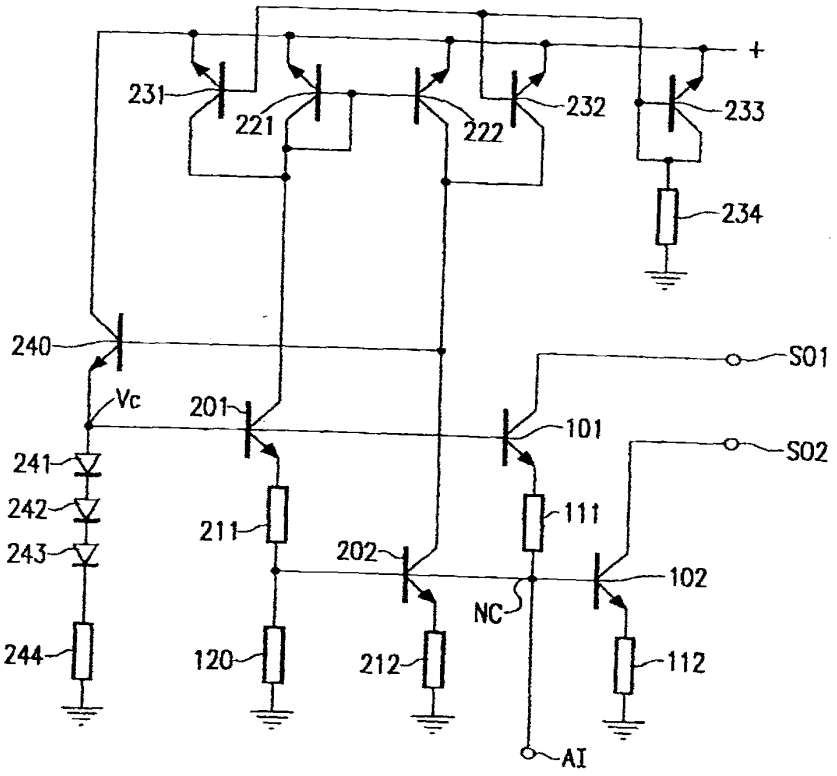



FIG.2


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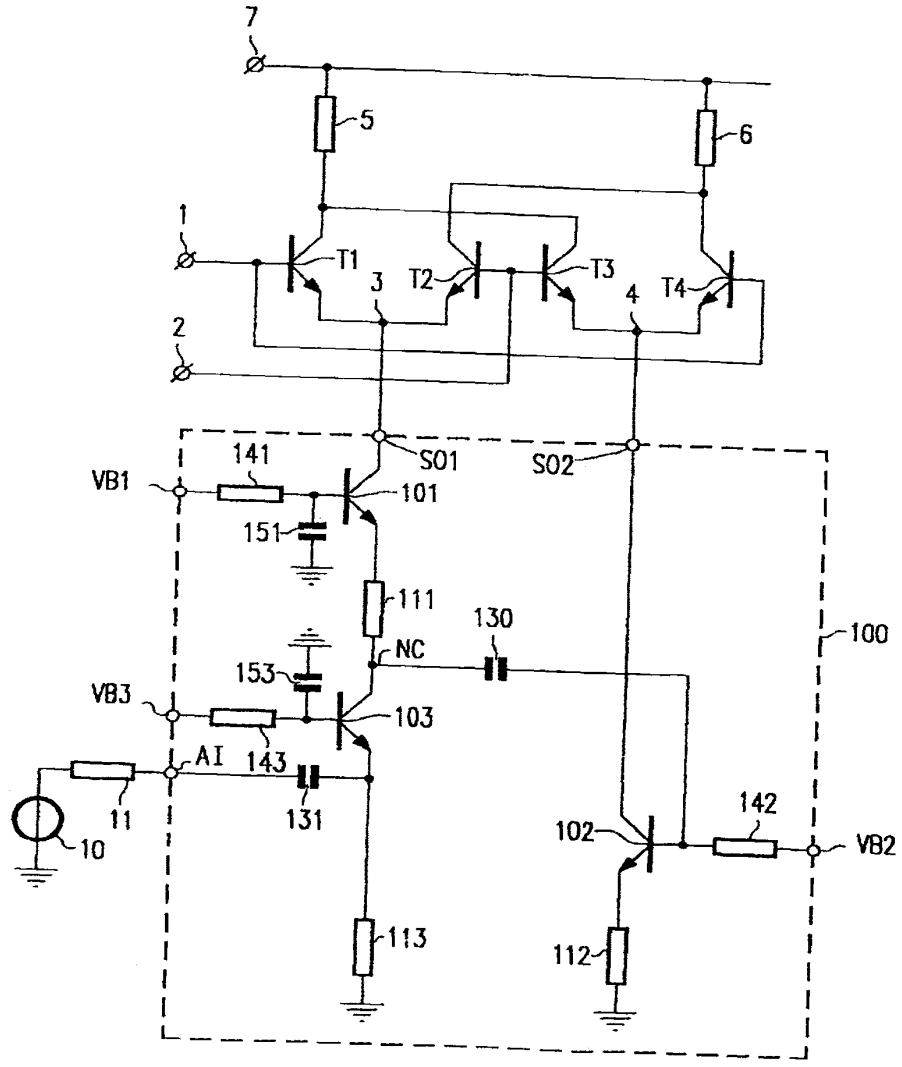



FIG.3


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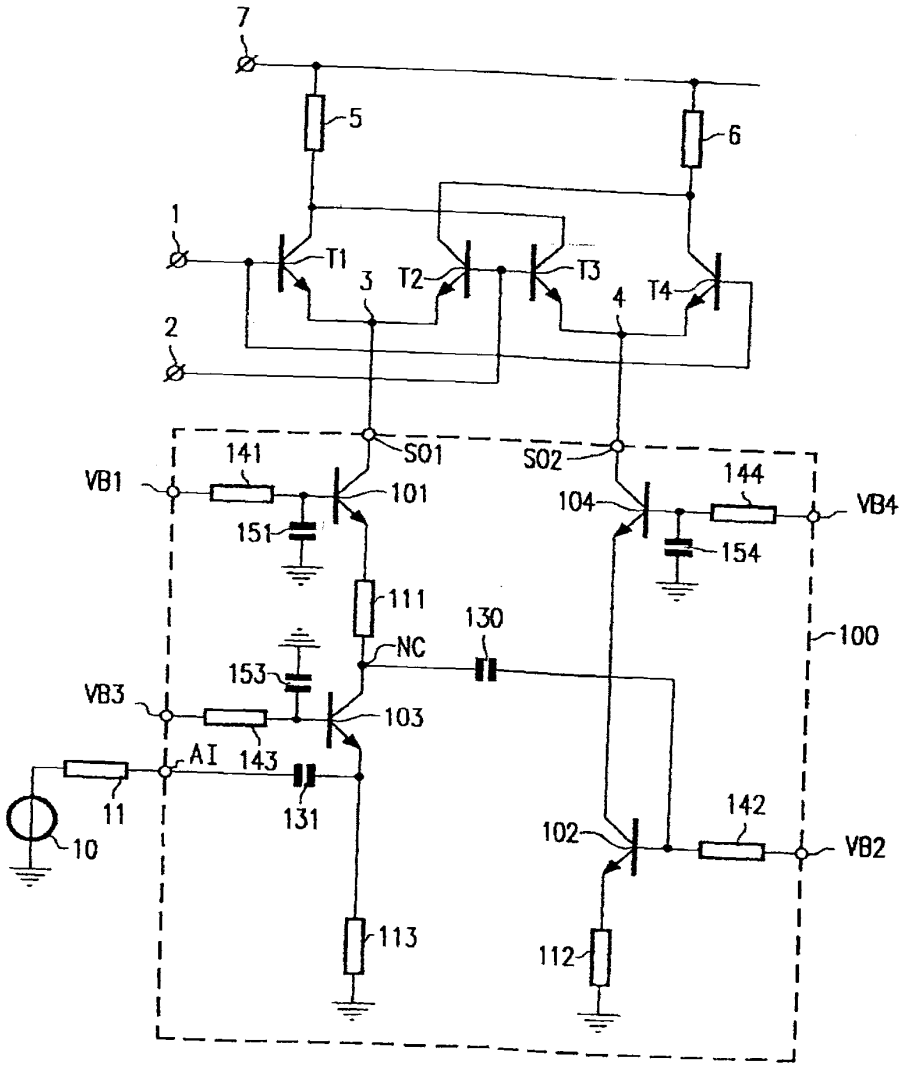



FIG.4


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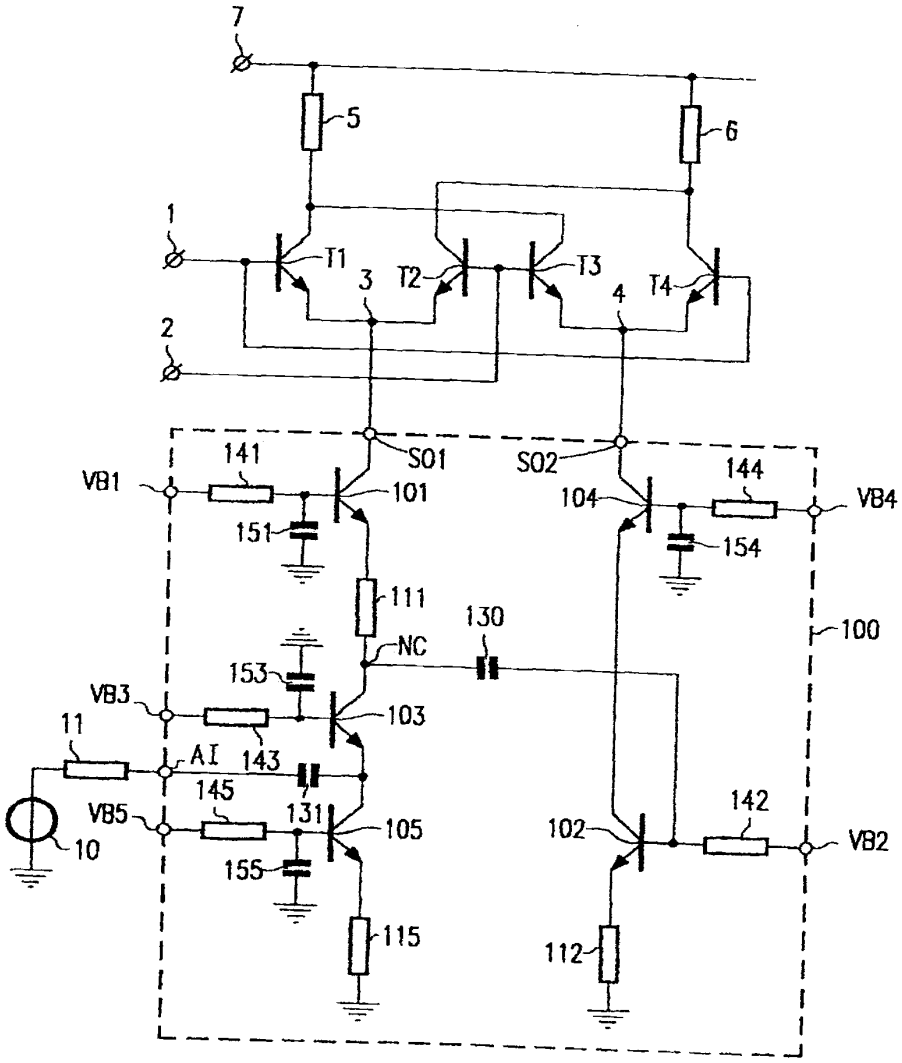



FIG.5


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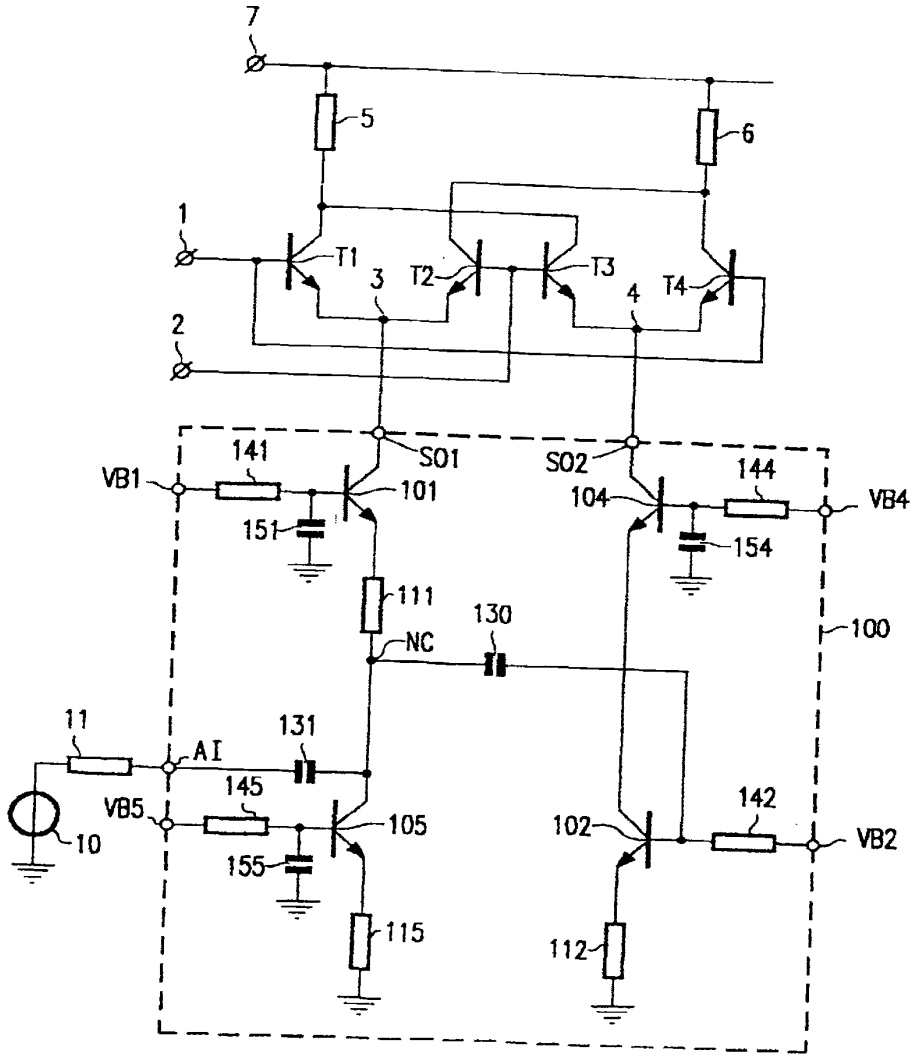



FIG.6



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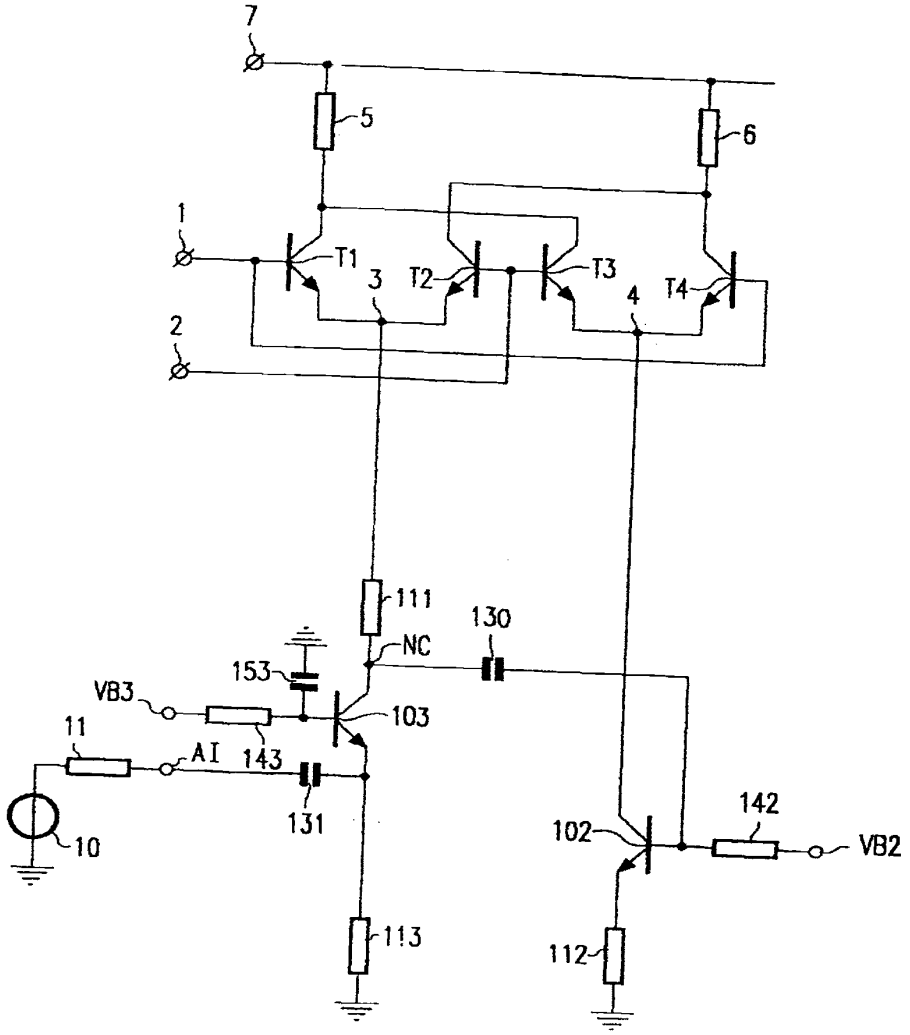



FIG.7


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# TRANSFORMER CIRCUIT, DOUBLE-BALANCED MIXER

## BACKGROUND OF THE INVENTION

This invention relates to a transformer circuit for converting an asymmetrical input signal into a pair of substantially symmetrical output signal currents, comprising a first and a second transistor, the emitter of the first transistor being coupled to an asymmetrical input terminal, the collector of the first transistor and the collector of the second transistor being coupled to a first and to a second symmetrical output terminal, respectively.

The invention also relates to a double-balanced mixer circuit.

Such a transformer circuit is known from the European Patent Application number 84200975.5, where it is used as an input stage **100** in a double-balanced mixer circuit, as shown in FIG. **1**. Its symmetrical output terminals SO1 and SO2 are coupled to the common emitter terminals 3 and 4 of the differential mixer transistor pairs T1, T2 and T3, T4, respectively.

In the known transformer circuit both the emitter of a first transistor T5 and a second transistor T6 are coupled to the asymmetrical input terminal AI via an inductive transformer **12**. The inductive transformer converts the asymmetrical signal from signal source **10** into a pair of symmetrical signals at the emitters of transistors T5 and T6. Thus, the signals applied to the emitters of transistors T5 and T6 are in phase opposition. Since the bases of transistors T5 and T6 are connected to signal ground, these transistors constitute a symmetrical current follower. The pair of symmetrical signal currents at the emitters of these transistors is transferred with nearly unity gain as a pair symmetrical output signal currents at terminals SO1 and SO2.

Although the known transformer circuit is suitable to be used in a high performance receiver front-end, it inherently requires an inductive transformer to transform an asymmetrical input signal into a pair of symmetrical signals. Such an inductive transformer is relatively expensive and occupies a relatively large space. More and more receiver functions are integrated on a single chip to meet the demand for cheap and small size receivers, for example, in cordless telephony. The inductive transformer is unsuited to be integrated on a chip. Furthermore, at least two connection pins are required to couple the inductive transformer to the integrated components of the transformer circuit. The number of connection pins may increase and therewith the size and the price of the housing of the chip.

As such, transformer circuits are known that do not require an inductive transformer, for example, a long-tail pair input stage in a double-balanced mixer circuit as known from the German Offenlegungsschrift 28,39,061 which corresponds to U.S. Pat. No. 4,216,431 Aug. 5, 1980. However, the performance of the long-tail pair input stage is inferior to that of a transformer circuit comprising an inductive transformer as previously discussed. First of all, the long-tail pair input stage exhibits a worse noise and intermodulation behaviour, as explained in the aforementioned European Patent Application. Secondly, the long-tail pair input stage has a relatively high input impedance compared to the inductive transformer circuit. This makes the long-tail pair input stage more susceptible to interferences due to parasitic capacitive couplings of unwanted signal sources with the asymmetrical input terminal. Thirdly, the symmetry between the pair of output signal currents, applied at the common emitter terminals of the two pairs of mixer transistors, will in general be less than that of the known transformer circuit.



## SUMMARY OF THE INVENTION

It, inter alia, an object of the invention to provide a transformer circuit for converting an asymmetrical input signal into a pair of substantially symmetrical output signal currents, which has a performance comparable to that of the known transformer circuit, comprising an inductive transformer but which is better suited to integration on a chip and which requires only one input connection pin and less voluminous and/or expensive external components.

To this end the transformer circuit is characterized in that the asymmetrical input terminal is coupled to a node commonly coupled to the emitter of the first transistor and to the base of the second transistor, the first and the second transistor being arranged in common base configuration and in common emitter configuration, respectively.

The invention is based on the recognition that a pair of symmetrical output signal currents can be obtained by directing an input current from the signal source to flow to the first symmetrical output terminal via the first transistor and that at least the signal voltage across the emitter-base junction of the first transistor should be used to drive the second transistor, which can provide a collector current that is substantially in phase opposition to the collector current of the first transistor. The first transistor is arranged in common base configuration and constitutes a non-inverting current follower, whereas the second transistor is arranged in common emitter configuration and constitutes an inverting transadmittance amplifier.

The input current from the signal source transferred to the node will substantially flow into the emitter of the first transistor since the input impedance of the current follower is relatively low. The signal voltage at the node results from a current-to-voltage conversion (transimpedance) due to the non-zero input impedance of the current follower. This signal voltage is applied at the base of the second transistor and modulates its collector current, which will be in phase opposition with that of the first transistor. The voltage-to-current conversion (transadmittance) by the second transistor can be made substantially inverse to that of the previously mentioned current-to-voltage conversion, such that the collector currents of the first and the second transistor are substantially symmetrical.

A preferred embodiment of the transformer circuit according to the invention is characterized in that a first impedance is arranged between the emitter of the first transistor and the node and that a second impedance is arranged between the emitter of the second transistor and signal ground. The addition of impedances in series with the emitters of the first and second transistors improves the large signal handling and/or the noise behaviour of the circuit.

A further preferred embodiment of the transformer circuit according to the invention is characterized in that an input stage is arranged between the asymmetrical input terminal and the node. The noise figure of this embodiment is comparable to that of the known transformer circuit and is mainly determined by the input stage. The input stage provides power gain, such that the noise contribution of the first and the second transistors with their respective emitter series impedances is relatively small compared to that of the input stage.

A further preferred embodiment of the transformer circuit according to the invention is characterized in that a cascode transistor in common base configuration is arranged between the collector of the second transistor and the second symmetrical output terminal. The cascode transistor may help to improve the symmetry of the pair of output signal currents



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by equalizing the collector-base voltage difference of the first and the second transistor, such that the so-called 'early effect' affects the signal transfer via both transistors to the same extent.

In order to improve the stability in biasing the transformer circuit according to the invention, an embodiment is preferably characterized in that a DC-blocking capacitor is arranged between the node and the base of the second transistor to decouple the bias voltage of the emitter of the first transistor from the bias voltage of the base of the second transistor.

Said improvement is alternatively achieved by another preferred embodiment of the transformer circuit according to the invention which is characterized in that it comprises a bias control loop comprising a first current sensing circuit coupled to the first transistor, a second current sensing circuit coupled to the second transistor and a difference detection circuit with a first and a second input coupled to the output of the first and the second current sensing circuit respectively. The output of the difference detection circuit is coupled to the base of the first transistor via at least one loop capacitor.

When the transformer circuit is equipped with such a bias control loop, it is possible to obtain stable biasing of the circuit without the use of said DC-blocking capacitor. This transformer circuit may advantageously be used when parasitic capacitances, introduced by said DC-blocking capacitor, give rise to an unacceptable asymmetry in the pair of output signal currents and/or when said DC-blocking capacitor requires too much chip-area.

A further preferred embodiment, based on the aforementioned embodiment of the transformer circuit according to the invention, is characterized in that a loop transistor is inserted between the output of the difference detection circuit and the base of the first transistor, the base-emitter junction of the loop transistor constituting said loop capacitor.

An embodiment of a double-balanced mixer circuit according to the invention comprises a first differential pair of first and second mixer transistors, whose emitters are coupled to a first common emitter terminal, a second differential pair of third and fourth mixer transistors, whose emitters are coupled to a second common emitter terminal, wherein the bases of the first and the fourth transistor and the bases of the second and the third transistor are coupled to a first common and a second common base terminal respectively, between which base terminals a mixing signal may be applied. This embodiment is characterised in that the asymmetrical input terminal is coupled to a node being commonly coupled to the first common emitter terminal and the base of a transistor, being arranged in a common emitter configuration, its collector coupled to the second common emitter terminal.

This embodiment of a double-balanced mixer circuit is particularly suited to operate at very low supply voltages (e.g. in 1 or 2 1.5 volt battery operated equipment) since the number of emitter-base junctions arranged in series between the supply voltage connections can be reduced to two. In this embodiment the first and the second mixer transistor fulfil the role of the first transistor in a transformer circuit according to the invention. The base of the first and the second mixer transistor are in general coupled to a low impedance signal source such that these transistors are arranged in a common base configuration and act as current followers. The portion of the current from the input signal source flowing through the first and through the second mixer transistor is determined by the voltage difference between their respective bases. However, the input impedance at the first common emitter terminal is the same as in the case where the first and the second mixer transistor were to be replaced by a single transistor in common base configuration. Consequently, the transimpedance of both aforementioned cases has the same magnitude, and the signal voltage at the node may therefore be used to drive the base of the second transistor.

## BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in detail with reference to the accompanying drawing which will help to clarify the invention, and in which:

FIG. **1** is a double-balanced mixer circuit with a conventional transformer circuit as an input stage.

FIG. **2** is a first embodiment of a transformer circuit according to the invention.

FIG. **3** is a double-balanced mixer circuit with a second embodiment of a transformer circuit according to the invention.

FIG. **4** is a double-balanced mixer circuit with a third embodiment of a transformer circuit according to the invention.

FIG. **5** is a double-balanced mixer circuit with a fourth embodiment of a transformer circuit according to the invention.

FIG. **6** is a double-balanced mixer circuit with a fifth embodiment of a transformer circuit according to the invention.

FIG. **7** is an embodiment of a double-balanced mixer circuit according to the invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. **2** shows a first embodiment of a transformer circuit according to the invention and which is particularly suited for integration on a chip. The asymmetrical input terminal AI is directly coupled to the node NC. The node NC is commonly coupled to the emitter of a first transistor **101** via a first impedance **111** and to the base of a second transistor **102**. Transistor **101** is effectively arranged in common base configuration, since the base of transistor **101** is coupled to signal ground via a relatively low impedance network constituted by diodes **241**, **242** and **243** and impedance **244** connected in series. Transistor **102**, whose emitter is coupled to signal ground via impedance **112**, is arranged in common emitter configuration. The collectors of transistors **101** and **102** constitute the first and the second symmetrical output terminals (SO1, SO2) respectively, of the transformer circuit. The components whose reference numeral comprise a most significant decimal '**2**' and impedance **120** serve to correctly bias transistors **101** and **102**, as will be discussed later.

Transistor **101** and impedance **111** can be regarded as a non-inverting current follower, its input terminal being node NC, its output terminal being terminal SO1. The input impedance of this current follower is approximately equal to the sum of impedance **111** and the emitter impedance of transistor **101**. Transistor **102** and impedance **112** can be regarded as an inverting transadmittance amplifier, its input terminal being node NC too, and its output terminal being terminal S02. The input impedance of this transadmittance amplifier is at least an order of magnitude higher than that of the current follower. Its transadmittance gain, that is the



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voltage-to-current conversion factor, is approximately equal to the inverse of the sum of impedance **112** and that of the emitter impedance of transistor **102**.

The input current drawn from a signal source connected to the asymmetrical input terminal AI will substantially flow into the emitter of transistor **101**, thus to the symmetrical output terminal SO2. This is because the magnitude of impedance **111** is relatively low compared to that of impedances **211** and **120**, to avoid unnecessary signal loss. In fact, the impedance between the node and signal ground is at least an order of magitude higher than the input impedance formed by the emitter of the first transistor **101**. Hence, the input impedance of the transformer circuit is approximately equal to that of the current follower as indicated above. The signal voltage at node NC is approximately equal to the product of the input current and the input impedance of the current follower. This signal voltage is the input voltage of the transadmittance amplifier indicated above.

Good symmetry between the collector signal currents of transistor **101** and transistor **102** can be obtained if the product of transimpedance gain and the input impedance of the current follower approximates unity gain. Such is the case, for example, if there is little difference between the bias currents of transistors **101** and **102** and if there is little difference between the impedances **111** and **112**. Some asymmetry may result from the impedance between the base of transistor **101** and signal ground being non-zero, the so-called 'imperfect' common base configuration. This asymmetry may be compensated by a decrement of the magnitude of impedance **111** with respect to that of impedance **112**.

The linear operation of the transformer circuit can be understood by recognizing that the sum of the base-emitter junction voltages of transistors **101** and **102** is constant and equal to control voltage Vc. An input current from a signal source at terminal AI flowing into the emitter of transistor **101** modulates the base-emitter junction voltage of transistor **101**. This current-to-voltage conversion exhibits a logarithmic characteristic and is therefore non-linear. Consequently, the base-emitter junction voltage of transistor **102** is modulated inversely and non-linearly since the sum of the junction voltages is constant. However, the relation between collector current and base-emitter junction voltage of transistor **102** is also logarithmic. Thus, the non-linear logarithmic current-to-voltage conversion (transistor **101**) is compensated by the non-linear, exponential voltage-to-current conversion (transistor **102**), such that the transfer of an input current at terminal AI to an inverse output current at terminal SO2 is substantially linear.

Impedances **111** and **112** have little influence on the linearity of the transformer circuit, but do increase the maximum allowable input voltage at terminal AI by reducing the input voltage to input current conversion factor. If impedance **111** and **112** were omitted, the conversion of an asymmetrical input signal into a pair of symmetrical output signal currents would still be substantially linear, provided the input voltage remains below the maximum allowable value.

To obtain a stable operation, such that, for example, the output signal currents at terminals SO1 and SO2 are substantially symmetrical over a wide temperature range, the transformer circuit shown in FIG. 2 is equipped with a bias control loop. This bias control loop adjusts the base bias voltage of transistor **101**, which is control voltage Vc, to make the bias current of transistor **102** substantially equal to that of transistor **101**. The bias current of transistor **101** is, inter alia, determined by the magnitude of impedance **120**.

The bias control loop comprises a first and a second current sensing circuit formed by transistor **201** in series with impedance **211** and transistor **202** in series with impedance **212**, respectively. The collector currents of transistors **201** and **202** are scaled replica's of the collector currents of transistor **101** respectively **102**. The scaling factor depends on the ratio between the dimensions of transistors **201** and **202** with respect to transistors **101** and **102** and the ratio between the impedances **211** and **212** with respect to impedances **111** and **112**. The collectors of transistors **201** and **202** are coupled to transistors **221** and **222**, respectively. The latter transistors form a current mirror acting as a difference detection circuit. The collector current of transistor **201** is first mirrored, thus inverted, and summed with the collector current of transistor **202**, to generate a difference current flowing into the base of transistor **240** and possible parasitic capacitances (not shown). The base-emitter junction capacitance of transistor **240** integrates, inter alia, the difference current into a control voltage Vc. The base-emitter junction capacitance increases with the size of the transistor **240**, which is relatively large to sufficiently filter out high frequency components in the difference current. In that case a distinct filtering capacitor between the base connection of transistor **240** and signal ground is superfluous. Diodes **241**, **242** and **243** and impedance **244** are used to correctly bias transistor **240**. Preferably these diodes are schottky diodes to promote a temperature independent operation of the transformer circuit.

In a steady-state situation, the bias currents of transistors **101** and **102** will be substantially equal. The bias control loop is an integrating control loop that strives for zero error, that is: zero difference current. A difference between the collector currents of transistors **101** and **102** results in a non-zero difference current, that is integrated into a continuously changing control voltage Vc. The change in control voltage Vc corrects in turn the ratio of the collector currents of transistors **101** and **102** such that the difference current is reduced to zero. Then, the voltage Vc remains constant.

A change in control voltage Vc mainly affects the bias current of transistor **102** in the case where the voltage drop over impedance **112** is at least one order of magnitude less than the base-emitter voltage of transistor **102**. The base-emitter voltage of transistor **102** varies only slightly as a function of the transistor bias current. Since the bias current of transistor **101** substantially flows through impedance **120**, this bias current has to be approximately equal to the quotient of the base-emitter voltage of transistor **102** and the resistance of impedance **120**. Thus, impedance **120** mainly determines the magnitude of the bias currents of transistors **101** and **102**, which bias currents are kept in balance by the bias control loop adjusting the control voltage Vc to this end.

In order to guarantee start-up of the transformer circuit over a wide temperature range, a start-up circuit is added comprising transistors **231**, **232** and **233** and impedance **234**. Transistors **231** and **232** act as current sources, whose collectors deliver a pair of symmetrical bias currents generated for initial biasing.

An interesting feature of the embodiment described above is that good symmetry between the output signal currents is maintained at frequencies only a few times lower than the cut-off frequencies of the transistors used in the circuit. The emitter-base capacitances of transistors **101** and **102** affect the high frequency input signal transfer via these transistors to much the same extent. Unbalance of the output signal at high frequencies will mainly result from the collector-base capacitances of transistors **101** and **102**. As transistor **102** is



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arranged in common emitter configuration and transistor **101** in common base configuration, the collector-base signal voltage of transistor **102** is larger than the collector-base signal voltage of transistor **101**. This causes a somewhat larger current in the collector-base capacitance of transistor **102**. This current flows from the collector to the internal base causing a signal voltage across the internal base resistance of transistor **102**.

FIG. **3** shows a double-balanced mixer circuit comprising a second embodiment of a transformer circuit according to the invention. The symmetrical current outputs SO1 and SO2 of the transformer circuit **100** are connected to the common emitter terminals **3** and **4**, respectively of the mixer transistors. Between the terminals **1** and **2** an oscillator signal may be applied such that the mixer transistors act as current switches. For example, when the voltage at terminal **1** is one base-emitter junction voltage higher than the voltage at terminal **2**, mixer transistors T1 and T4 are conductive, whereas T2 and T3 are not. Then, the signals currents at SO1 and SO2 are directed to flow into impedance **5** and **6**, respectively. Conversely, when the voltage at terminal **2** is higher than the voltage at terminal **1**, mixer transistors T2 and T3 are conductive, whereas T1 and T4 are not. Then, the signals currents at SO1 and SO2 are directed to flow into impedance **6** and **5**, respectively. Thus the current flowing into impedances **5** and **6** are alternately derived from SO1 and SO2.

A difference with respect to the embodiment shown in FIG. **2** is that the transformer circuit **100** of FIG. **3** has an input stage arranged between the asymmetrical input terminal AI and the node NC. This input stage comprises an input transistor **103** arranged in common base configuration and acting as a current follower. A further difference is that a DC blocking capacitor **130** is arranged between the node NC and the base of transistor **102**. The embodiment of FIG. **3** does not require a bias control loop for stable operation. Bias voltages are supplied to terminals VB1, VB2 and VB3, which are further supplied to the bases of transistors **101**, **102** and **103** via impedances **141**, **142** and **143**, respectively. The bases of transistors **101** and **103** are coupled to ground by capacitors **151** and **153**, respectively. Thus, transistors **101** and **103** are arranged in common base configuration. Impedance **113** acts as a passive current source and determines, inter alia, the bias current of transistors **101** and **103**. Capacitor **131** is a DC-blocking capacitor to decouple the emitter bias voltage of transistor **103** from the DC voltage applied at the asymmetrical input terminal AI.

The signal source voltage **10** is converted into a signal current at terminal AI, which substantially flows to the symmetrical output terminal SO1 via transistors **101** and **103**. The conversion factor, inter alia, determined by the source impedance **11** and the emitter impedance of transistor **103**. Preferably, the magnitude of impedance **113** is some orders of magnitude larger than that of the emitter impedance of transistor **103**, such that most of the current from signal source **10** flows into the emitter of transistor **103**. The signal current transferred via transistor **103** with nearly unity gain is converted into a signal voltage at the node NC. The current-to-voltage conversion factor, inter alia, determined by the impedance **111** and the emitter impedance of transistor **101**.

The signal voltage at the node NC is supplied to the base of transistor **102** via a bidirectional current path that includes the DC-blocking capacitor **130**, which constitutes a high-pass network together with impedance **142**. Transistor **102** and impedance **112** constitute an inverting transadmittance amplifier supplying a signal current to output SO2 which is phase opposed to the signal current at terminal SO1.

The embodiment of FIG. **3** has some features worth while noting. First of all the noise performance of this embodiment can be superior to that of the embodiment shown in FIG. **2**. This feature relates to the fact that the transfer from the asymmetrical input terminal AI to the node NC, may exhibit a voltage gain. This voltage gain depends, inter alia, on the magnitude of impedance **111**. As the voltage gain increases, the noise figure of the transformer circuit shown in FIG. **3** decreases, since the contribution of the noise voltage of transistors **101** and **102** diminishes. With sufficient voltage gain, the noise voltage of transistors **101** and **102** may become negligible, such that the noise voltage of only one transistor (**103**) dominates. This is in contrast to the embodiment of FIG. **2** where both transistors **101** and **102** equally contribute to the noise voltage at the input terminal AI since they are both effectively arranged in series with this terminal.

As the frequency increases, the maximum obtainable voltage gain in the embodiment shown in FIG. **3** diminishes and consequently the noise figure will deteriorate. At a frequency which is an order of magnitude less than the cut-off frequency of the transistor **103**, the noise figure of the embodiment shown in FIG. **2** may be superior to the one shown in FIG. **3**. In the transformer circuit shown in FIG. **2**, two transistors (**101**,**102**) have dominant noise contribution, whereas in the embodiment of FIG. **3** three transistors may contribute to the noise of the transformer circuit. Thus, with relatively low frequency input signals, an embodiment comprising an input stage as shown in FIG. **3** may be preferred and with relatively high frequency input signals, an embodiment without an input stage, as shown in FIG. **2**, may be preferred.

A second interesting feature of the transformer circuit as shown in FIG. **3** is that a higher gain may be obtained compared to the known transformer circuit when both circuits have similar performance with respect to noise, linearity and current consumption. Gain is defined as the conversion factor of an asymmetrical input signal source voltage to a pair of symmetrical output signal currents. The gain of both the known transformer circuit and that of one according to the invention is, inter alia, determined by the magnitude of the sum of the source impedance **11** and the input impedance at the asymmetrical input terminal AI of the transformer circuit.

As an illustration of said feature, assume the bias currents of transistors T5 and T6 in circuit of FIG. **1** and transistors **101**, **102** and **103** in the circuit of FIG. **3** to be **1** milliAmpere. This limits symmetrical output signal currents at SO1, SO2 of both circuits to a peak value of **1** milliAmpere. The input impedance at the asymmetrical input terminal AI of the transformer circuit in FIG. **3** will be approximately 25 Ohms, the emitter impedance of a typical silicon bipolar transistor biased at **1** milliampere. The impedance at terminal AI of the transformer circuit in FIG. **1** will be approximately 2 times 25 Ohms, if the transformation ratio of transformer **1** in FIG. **1** is **1**:1. This is because the emitter impedance of transistors T5 and T6 are effectively arranged in series. Due to the higher input impedance of the known transformer circuit in this example, its gain will be less. Changing the transformer transformation ratio will either further reduce the gain or deteriorate the linearity and noise performance of the circuit.

The double-balanced mixer circuit shown in FIG. **4** comprises a third embodiment of a transformer circuit according to the invention. Different from the second embodiment of FIG. **3**, the transformer circuit **100** of FIG. **4** comprises a so-called cascode transistor **104**, which is arranged between



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the collector of transistor **102** and the symmetrical output terminal SO2. This cascode transistor acts as a signal current follower, since it is arranged in common base configuration, by coupling its base to signal ground via capacitor **154**. Cascode transistor **104** receives at its base a bias voltage applied at terminal VB4 via impedance **144**.

A cascode transistor arranged in series with the second transistor, as shown in FIG. **4**, may help to improve the symmetry between the output currents at terminals SO1 and SO2. In the embodiment of FIG. **4**, the collector bias voltage of transistor **102** is independent of the collector bias voltage of transistor **101**, determined by the voltages applied at terminals **1** and **2**. In contrast with the embodiment of FIG. **3**, the collector bias voltage of transistor **102** can be adjusted by mean of the bias voltage applied at terminal VB4, which is an additional parameter to reduce asymmetry between the output signal currents. Asymmetry may be caused by the so-called 'Early-effect' of the transistors, which is, inter alia, determined by the voltage across the collector-base junction. The influence of the Early effect on the output signal currents at SO1 and SO2 can be balanced by adjusting the bias voltage applied at terminal VB4.

FIG. **5** shows a double-balanced mixer circuit comprising a fourth embodiment of a transformer circuit according to the invention. Compared to the third embodiment shown in FIG. **4**, the passive current source for biasing transistors **101** and **103**, that is impedance **113** in FIG. **4**, is replaced in FIG. **5** by an active current source comprising transistor **105** and impedance **115**. The bias current from this active current source is determined by the value of impedance **115** and the bias voltage applied at terminal VB5 which is then applied to the base of transistor **105** via impedance **145**. The base is decoupled to ground via capacitor **155**, inter alia, to prevent possible parasitic high frequency components on the bias voltage applied at terminal VB5 from parasitically modulating the active current source.

The embodiment shown in FIG. **5** offers the advantage that, due to the high collector impedance of transistor **105**, almost all of the input signal current at terminal AI is directed to flow into the emitter of transistor **103**. The gain of the transformer circuit presented in FIG. **5** may therefore be higher than that of FIG. **4**, especially when the circuits are to operate at low supply voltages. To enable low voltage operation, the DC resistance value of impedance **113** is to be kept small to limit the voltage drop across its terminals. The magnitude of the impedance **113** (FIG. **4**) at input signal frequencies could be enlarged using an inductor. However, only small inductances can be integrated on a chip. Thus, the magnitude of the collector impedance of transistor **115** in FIG. **5** will generally be higher than that of impedance **113** in FIG. **4**.

FIG. **6** shows a double-balanced mixer circuit comprising a fifth embodiment of a transformer circuit according to the invention. In this embodiment, the input transistor **103** and its associated elements (impedance **143**, capacitor **153** and terminal VB3) shown in FIG. **5** are omitted. Thus, the asymmetrical input terminal AI is coupled to the node NC via passive elements only. A similar case is shown in FIG. **2**, of which of embodiment also does not comprise an input transistor between the terminal AI and the node NC.

Omitting the input transistor **103** shown in FIG. **5** may be an option if the circuit is to operate at relatively low supply voltages. However, this may have a detrimental effect on the noise performance at relatively low frequencies since there is no longer a voltage gain between the terminal AI and the node NC. To obtain the same gain at the same current consumption with respect to the embodiment shown in FIG. **5**, impedances **111** and **112** of the embodiment shown in FIG. **6** may be omitted too (not shown).

A double-balanced mixer circuit according to the invention, very well suited to operate at relatively low supply voltages, is shown in FIG. **7**. Compared to FIG. **3**, transistor **101** and its associated elements (impedance **141**, capacitor **151** and terminal VB1) have been omitted. The gist of the circuit shown in FIG. **7** is that mixer transistors T1 and T2 can take over the function of transistor **101**. In practice terminals **1** and **2** are coupled to an oscillator signal source, whose source impedance is relatively low, such that mixer transistors T1 and T2 are effectively arranged in common base configuration. The impedance at the common emitter terminal **3** is practically equal to the emitter impedance of transistor **101** in FIG. **3**, assuming that transistor **103** of FIG. **3** and transistor **103** of FIG. **7** are biased at the same current. Thus, the signal current from the signal source **10** will substantially flow to common emitter terminal **3** via transistor **103** and produce a signal voltage at the node NC. This signal voltage can be used to drive transistor **102** such that its collector current and the current flowing to common emitter terminal **3** are substantially symmetrical.

Although the double-balanced mixer circuit presented in FIG. **7** can operate at lower supply voltages than the circuits of FIGS. **3** to **6**, it may exhibit a higher level of spurious signals at the asymmetrical input terminal AI and in the mixer output voltages across impedances **5** and **6** respectively. Such spurious signals originate from an oscillator signal applied at terminals **1** and **2**, producing a residual signal at the common emitter terminals **3** and **4**, substantially composed of the second harmonic of the oscillator signal. In the circuits shown in FIGS. **3** to **6**, transistor **101** is arranged between the common emitter terminal **3** and the node NC. Transistor **101** prevents, to a large extent, a cross-talk of the residual signal at the common emitter terminal **3** to the node NC. In the circuit shown in FIG. **7**, however, there will be little cross-talk attenuation of the residual signal to the node NC. Such an unwanted residual signal at node NC may further the cross-talk to the asymmetrical input terminal AI. Moreover, it also modulates the collector current of transistor **102** and consequently produces a parasitic component in the mixer output voltage.

While **6** embodiments are shown and described to clarify the invention, a person skilled in the art may conceive many other altemative embodiments of a transformer circuit or a double-balanced mixer circuit without departing from the spirit and the scope of the invention claimed. The circuitry to bias the first and the second transistor may differ from that in the embodiments as described. Passive current sources, for example, impedance **113**, or active current sources, for example, transistor **105** and impedance **115**, may be used altematively. Cascode transistors may be arranged between the collector of the first transistor and the first symmetrical output terminal, as well as additional cascode transistors between the collector of the second transistor and the second symmetrical output terminal. Alternative input stages can be arranged between the asymmetrical input terminal AI and the node NC.

Wherever in the text a circuit element is designated as 'impedance', it is to be understood that this element may be resistive and/or inductive. For example, impedances **111** and **112** as shown in FIGS. **2** to **7** may comprise integrated inductors, to improve the high frequency noise behaviour of the circuit. Impedance **113** in FIGS. **3**, **4** and **7** could be an inductor, being an external component arranged between the input pin of an integrated transformer circuit and signal



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ground. In this case capacitor 131 would also be an external component. Thus, it will be evident that, although the transformer circuit is very well suited for integration on a chip, not all of its elements need to be integrated.

Furthermore, having knowledge of the invention, it will be obvious to a person skilled in the art that the effectiveness of the invention does not rely on the use of bipolar NPN transistors as shown in the embodiments. Alternatively, field-effect transistors may be used, in which case emitter, collector and base in the present Application should read: source, drain and gate, respectively. Furthermore, it will be evident that the polarity of the transistor not ciritical. Instead of a bipolar NPN or N-channel field effect transistor, PNP or P-channel field-effect transistors may be used.

In a double-balanced mixer circuit, the symmetrical output terminals (SO1, SO2) of the transformer circuit need not be directly coupled to the common emitter terminals (3, 4) of the differential mixer transistor pairs. For example, DC-blocking capacitors may be arranged between the symmetrical output terminals and the common emitter terminals in order to bias the differential mixer transistor pairs independently from the transformer circuit.

The application of a transformer circuit according to the invention is not limited to double-balanced mixer circuits. It can also be applied advantageously in other types of circuitry where the conversion of an asymmetrical signal into a pair of symmetrical signals is required. For example, in automatic gain control (AGC) amplifiers comprising two differential pairs as balanced voltage controlled current attenuators.

We claim:

1. Transformer circuit for converting an asymmetrical input signal into a pair of substantially symmetrical output signal currents, comprising a first and a second transistor, the emitter of the first transistor being coupled to an asymmetrical input terminal, the collector of the first transistor and the collector of the second transistor being coupled to a first and to a second symmetrical output terminal, respectively, wherein the asymmetrical input terminal is coupled to a node commonly coupled to the emitter of the first transistor and to the base of the second transistor, said node being connected to a point of reference voltage via a bidirectional current path, and wherein the first and the second transistor are connected in common base configuration and in common emitter configuration, respectively.

2. The transformer circuit according to claim 1, wherein a cascode transistor in common base configuration is coupled between the collector of the second transistor and the second symmetrical output terminal.

3. The transformer circuit according to claim 1 further comprising an input transistor coupled between the asymmetrical input terminal and the node and having a control electrode coupled to a reference voltage.

4. The transformer circuit according to claim 1, wherein said bidirectional current path includes a DC-blocking capacitor coupled between the node and the base of the second transistor.

5. Transformer circuit according to claim 1, which further comprises a bias control loop comprising a first current sensing circuit coupled to the first transistor, a second current sensing circuit coupled to the second transistor, a difference detection circuit having a first and a second input coupled to respective outputs of the first and the second current sensing circuit, the output of the difference detection circuit being coupled to the base of the first transistor via at least one loop capacitor.

6. Transformer circuit according to claim 5, wherein a loop transistor is coupled between the output of the difference detection circuit and the base of the first transistor, a base-emitter junction of the loop transistor constituting said loop capacitor.

7. Transformer circuit according to claim 2, wherein a first impedance is coupled between the emitter of the first transistor and the node and a second impedance is coupled between the emitter of the second transistor and signal ground.

8. The transformer circuit according to claim 2, wherein said bidirectional current path includes a DC blocking capacitor coupled between the node and the base of the second transistor.

9. The transformer circuit according to claim 1 wherein a first impedance is coupled between the emitter of the first transistor and said node and a second impedance is coupled between the emitter of the second transistor and signal ground.

10. The transformer circuit according to claim 1 further comprising circuit means coupled to said first and second transistors so as to maintain bias currents of said transistors substantially equal.

11. A double-balanced mixer circuit comprising: a first differential pair of first and second mixer transistors, whose emitters are coupled to a first common emitter terminal, a second differential pair of third and fourth mixer transistors, whose emitters are coupled to a second common emitter terminal, bases of the first and the fourth transistor and bases of the second and the third transistor being coupled to a first common and a second common base terminal respectively, for receiving a mixing signal, wherein an asymmetrical input terminal is coupled to a node coupled to the first common emitter terminal and to the base of a transistor connected in a common emitter configuration and having its collector coupled to the second common emitter terminal, wherein said node is coupled to the first common emitter terminal via a further transistor connected in common base configuration with its emitter coupled to the node and its collector coupled to the first common emitter terminal and said node is connected to a point of reference voltage via circuit means that provide an impedance between the node and point of reference voltage which is at least an order or magnitude higher than the input impedance of the emitter of the further transistor whereby a signal current received at the asymmetrical input terminal flows substantially and continuously to the first common emitter terminal via the emitter of said further transistor.

12. The double-balanced mixer circuit according to claim 11 wherein said node is coupled to the base of said transistor via a capacitor.

13. A transformer circuit comprising: an asymmetrical input terminal, a first and a second symmetrical output terminal at which is derived a pair of symmetrical output signals, a first transistor in common base configuration whose collector is coupled to said first symmetrical output terminal, a second transistor in common emitter configuration whose collector is coupled to said second symmetrical output terminal, a node commonly coupled to the emitter of the first transistor, to the base of the second transistor, to said asymmetrical input terminal and to signal ground via circuit means providing an impedance between the node and signal ground which is at least an order of magnitude higher than an input impedance formed by the emitter of the first transistor, the circuit means being coupled so as to direct a signal current received at said asymmetrical input terminal to substantially flow to the first symmetrical output terminal via the emitter of said first transistor.

14. A transformer circuit according to claim 13 wherein the circuit means further comprises a third transistor having



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a collector which is coupled to the emitter of the first transistor via a first impedance and which collector is coupled to the base of the second transistor, said asymmetrical input terminal being coupled to the emitter of said third transistor, and means coupling the base of said third transistor to a reference voltage terminal.

15. The transformer circuit according to claim 13, further comprising a DC blocking capacitor coupled between said node and the base of the second transistor.

16. The transformer circuit according to claim 13, wherein the circuit means further comprises a bias control loop having:

current sensing means for providing a scaled replica of the collector current of the first transistor and that of the collector current of the second transistor, respectively;

difference detection means for providing a difference current proportional to the difference between the scaled replica currents; and

feedback means for supplying said difference current to the base of the first transistor.

17. The transformer circuit according to claim 13 wherein a first impedance is coupled between the emitter of the first transistor and said node and a second impedance is coupled between the emitter of the second transistor and signal ground.

18. The transformer circuit according to claim 17 wherein said circuit means includes an input transistor which is coupled between the asymmetrical input terminal and said node, said input transistor having a control electrode coupled to signal ground.

19. The transformer circuit according to claim 13, wherein a cascode transistor in common base configuration is coupled between the collector of the second transistor and the second symmetrical output terminal.

20. The transformer circuit according to claim 16, wherein said feedback means comprise a loop transistor having a base-emitter junction that constitutes a loop capacitor.

21. A double-balanced mixer circuit comprising: a first differential pair of first and second mixer transistors, whose emitters are coupled to a common first emitter terminal, a second differential pair of third and fourth mixer transistors, whose emitters are coupled to a common second emitter terminal, bases of the first and the fourth transistor and bases of the second and the third transistor being coupled to a common first and a common second base terminal, respectively, which in operation receive a mixing signal, wherein the first common emitter terminal and the second common emitter terminal are coupled to the first symmetrical output terminal and the second symmetrical output terminal, respectively, of the transformer circuit according to claim 13.

22. A double-balanced mixer circuit comprising: a first differential pair of first and second mixer transistors, whose emitters are coupled to a first common emitter terminal, a second differential pair of third and fourth mixer transistors, whose emitters are coupled to a second common emitter terminal, bases of the first and the fourth transistor and bases of the second and the third transistor being coupled to a first common and a second common base terminal respectively, for receiving a mixing signal, wherein an asymmetrical input terminal is coupled to a node coupled to the first common emitter terminal and to the base of a transistor connected in a common emitter configuration and having its collector coupled to the second common emitter terminal, wherein said node is coupled to the first common emitter terminal via a further transistor connected in common base configuration with its emitter coupled to the node and its collector coupled to the first common emitter terminal, and further comprising an input transistor coupled between the asymmetrical input terminal and the node and having a control electrode coupled to a reference voltage.

23. A double-balanced mixer circuit comprising: a first differential pair of first and second mixer transistors, whose emitters are coupled to a first common emitter terminal, a second differential pair of third and fourth mixer transistors, whose emitters are coupled to a second common emitter terminal, bases of the first and the fourth transistor and bases of the second and the third transistor being coupled to a first common and a second common base terminal respectively, for receiving a mixing signal, wherein an asymmetrical input terminal is coupled to a node coupled to the first common emitter terminal and to the base of a transistor connected in a common emitter configuration and having its collector coupled to the second common emitter terminal, wherein said node is coupled to the first common emitter terminal via a further transistor connected in common base configuration with its emitter coupled to the node and its collector coupled to the first common emitter terminal, and further comprising a cascode transistor in common base configuration coupled between the collector of said transistor and the second common emitter terminal.

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APPLICANT: Murtojarvi
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FILED: 4/15/99 EXAMINER: West, L.
TITLE: METHOD AND ATTENUATING SPURIOUS SIGNALS AND RECEIVER
ATTORNEY DOCKET NO.: 297-008576-US (PAR)

Commissioner of Patents and Trademarks
Washington, D.C. 20231

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RESPONSE UNDER 37 C.F.R. 1.111

Sir:

This is in response to the Office Action dated 1/31/01. Please amend the Application as follows:

IN THE SPECIFICATION:

~~On page~~ 1, before line 1, insert --(a) TITLE OF THE INVENTION--;

On page 1, after the title, insert --(b) CROSS-REFERENCES TO RELATED APPLICATIONS

Not Applicable

(c) STATEMENT REGARDING FEDERALLY SPONSERED RESEARCH OR DEVELOPMENT

08/04/2001 HARDY1 00000038 09292301
01 FC:115 110.00 OP



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Not Applicable

(d) BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION--;

On page 1, between lines 8 and 9, insert --2. DESCRIPTION OF THE RELATED ART INCLUDING INFORMATION DISCLOSED UNDER 37 CFR 1.97 AND 1.98--;

On page 2, between lines 24 and 25, insert --(e) BRIEF SUMMARY OF THE INVENTION--;

On page 3, between lines 9 and 10, insert --(f) BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)--;

On page 3, between lines 24 and 25, insert --(g) DETAILED DESCRIPTION OF THE INVENTION--;

On page 9, delete "Claims", insert therefor --(h) CLAIMS--;

On page 11, delete "(57) Abstract" and insert therefor --(i) ABSTRACT OF THE DISCLOSURE--.

Remarks

2. Captions have been added.

4. In Granfield, the signal level of an oscillator signal, as applied to the mixer of this circuit, is measured, and the



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measured level is compared by means of a differential stage (controller) to a pre-adjusted level REF. The resulting difference signal from the comparing step is used to control the oscillator level by adjusting the oscillator bias current. Such procedure is necessary only when a totally unbalanced mixer as shown in figure 2 is used, since such a mixer has properties with a great dependency on the level of the oscillator signal, and when desired to optimize mixer performance properties in the whole frequency range and in different temperatures.

In a double balanced mixer (a Gilbert cell, for instance), the level of oscillator signal is of minor relevance when that level just exceeds a certain minimum level. But within a balanced mixer, the balance of that signal has an influence on the attenuation of resulting even order distortion. In the invention of claim 1, the oscillator signal level is not adjusted, but instead its balance is controlled to reduce its own unbalance and the unbalances of the mixer, which originate due to the component tolerances.

For claim 7, Granfield is irrelevant since (the indicated part of) it does not indicate a balanced mixer, but rather suggests balancing a differential amplifier in a controller circuit (column 7, lines 15-20). The rest of the column 7 explains the controller in Fig. 2. Specifically, in figure 2, the mixer is unbalanced, and therefore such a circuit is irrelevant as a reference against the present invention.

It is therefore respectfully requested that the rejection of claims 1-4, and 7-10 under 35 USC 102(b) be withdrawn.

B



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6. Since Durec and Chevallier also fail to disclose the above concepts, the rejection of claims 5, 11, and 12 on Granfield in view of either of these references should be withdrawn.

Reconsideration and allowance are requested.

Respectfully submitted,

Henry I. Steckler

May 30, 2001

Henry I. Steckler (Reg. No. 24,139) Date

PERMAN & GREEN, LLP
425 Post Road
Fairfield, CT 06430
(203) 259-1800

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5/30/01

Date

Name of Person Making Deposit



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000545

| PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a) (Large Entity) | Docket No. 297-008576-US (PAR) |
|---|---|

In Re Application Of: **Murtojarvi**

| Serial No. | Filing Date | Examiner | Group Art Unit |
|---|---|---|---|
| 09/292,301 | 04/15/99 | West, L. | 2681 |

Invention: **METHOD AND ATTENUATING SPURIOUS SIGNALS AND RECEIVER**

OIPE JUN 01 2001 PATENT & TRADEMARK OFFICE

RECEIVED JUN 08 2001 Technology Center 2600

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a response to the Office Action of 01/31/01 (Date) in the above-identified application.

The requested extension is as follows (check time period desired):

☒ One month ☐ Two months ☐ Three months ☐ Four months ☐ Five months

from: 04/30/01 (Date) until: 05/30/01 (Date)

The fee for the extension of time is $110 and is to be paid as follows:

☒ A check in the amount of the fee is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account No. 16-1350
A duplicate copy of this sheet is enclosed.

☒ If an additional extension of time is required, please consider this a petition therefor and charge any additional fees which may be required to Deposit Account No. 16-1350
A duplicate copy of this sheet is enclosed.

Henry I. Steckler (Signature) Dated: May 30, 2001

Henry I. Steckler, Reg. No. 24,139
Perman & Green, LLP
425 Post Road
Fairfield, CT 06430
(203) 259-1800
Customer No.: 2512

06/04/2001 MABDI1 00000038 09292301
01 FC:115 110.00 OP

CC:

I certify that this document and fee is being deposited on May 30, 2001 with the U.S. Postal Service as first class mail under 37 C.F.R. 1.8 and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Carm Marsh
*Signature of Person Mailing Correspondence*

Carm Marsh
*Typed or Printed Name of Person Mailing Correspondence*

P12LARGE/REV08



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UNITED STATES DEPARTMENT OF COMMERCE
Patent and Trademark Office
Address: COMMISSIONER OF PATENTS AND TRADEMARKS
Washington, D.C. 20231

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
|---|---|---|---|
| 09/292,301 | 04/15/99 | MURTOJARVI S | 297-008576-U |

WM01/0711

CLARENCE A GREEN
PERMAN & GREEN LLP
425 POST ROAD
FAIRIELD CT 06430

| EXAMINER | |
|---|---|
| WEST, L | |
| **ART UNIT** | **PAPER NUMBER** |
| 2681 | 9 |

**DATE MAILED:** 07/11/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

PTO-90C (Rev. 2/95)
*U.S. GPO: 2000-473-000/44602

1- File Copy

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/292,301 | MURTOJARVI ET AL. | |
| | Examiner | Art Unit | |
| | Lewis G. West | 2681 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *01 June 2001* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .



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***Response to Arguments***

Applicant's arguments filed June 1, 2001 have been fully considered but they are not persuasive.

1. Applicant makes multiple statements regarding different types of balanced and unbalanced mixers, none of which relate to the claims as applicant claims a method for balancing an unspecified type of mixer.

2. In claim 1, applicant does not claim that the oscillator is adjusted, what is claimed is the transistor bias is adjusted, which is exactly what is disclosed in Grandfield et al.

3. In claim 7, the entirety of column 7 refers to figure 2, which relates to a mixer, which is being brought into a balanced condition, as is claimed by the applicant, note specifically that a specific bias is indicated necessary on lines 16-19 and the rest of the column goes on to explain how the circuit is formed and used to obtain that proper bias to achieve balance.

4. The statutory bar rejection under U.S.C. 102(b) therefore remains on claims 1-4 and 7-10.

5. The rejections under U.S.C. 103(a) also remain since applicant's arguments fail to overcome the prior art.

***Final Rejection***

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –



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(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-4, 7-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Grandfield et al.

Regarding claim 1, Grandfield discloses a method for eliminating error (unwanted signals) in a receiver in which radio signals are mixed, characterized in that the mixing is balanced by adjusting bias currents in transistors of the mixing circuit. (col. 7 lines 1-67)

Regarding claim 2, Grandfield discloses the method characterized in that the bias currents are adjusted in an input circuit of a radio frequency signal. (col. 3 lines 59-62)

Regarding claim 3, Grandfield discloses the method characterized in that the bias currents are adjusted in an input circuit of a local oscillator. (Fig. 1; col. 3 lines 59-68)

Regarding claim 4, Grandfield discloses the method characterized in that the bias currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit. (col. 5 lines 16-56).

Regarding claim 7, Grandfield discloses a means for eliminating error (unwanted signals) in a receiver in which radio signals are mixed, characterized in that the mixing is balanced by adjusting bias currents in transistors of the mixing circuit. (col. 7 lines 1-67)

Regarding claim 8, Grandfield discloses the receiver characterized in that the bias currents are adjusted in an input circuit of a radio frequency signal. (col. 3 lines 59-62)



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Regarding claim 9, Grandfield discloses the receiver characterized in that the bias currents are adjusted in an input circuit of a local oscillator. (Fig. 1; col. 3 lines 59-68)

Regarding claim 10, Grandfield discloses the receiver characterized in that the bias currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit. (col. 5 lines 16-56)

***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 5, 11 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grandfield in view of Durec et al.

Regarding claim 5, Grandfield does not expressly disclose the adjustment of the bias is performed using a D/A converter to adjust a current for the signal line across parallel resistors. Durec however discloses a receiver with adjustment means that comprises a digital to analog converter with a digital controller that adjusts power to the mixer to eliminate unwanted signals. (col. 3 lines 8-65), and discloses a control signal across resistors in parallel from the D/A converter. (col. 6 lines 8-26) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a signal from a D/A to control current across parallel resistors in a receiver in order to eliminate unwanted signal components.



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Regarding claim 11, Grandfield does not expressly disclose the use of a digital to analog converter to adjust bias with a digital controller. Durec however discloses a receiver with adjustment means that comprises a digital to analog converter with a digital controller that adjusts power to the mixer to eliminate unwanted signals. (col. 3 lines 8-65) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use a digital to analog converter and a digital controller to eliminate unwanted signals in a mixer circuit in order to improve signal quality in the receiver.

Regarding claim 12, Grandfield does not expressly disclose the use of D/A and A/D converters or a processor with memory for bias adjustments. However Durec discloses an analog to digital converter that take measurements from a mixer and a digital to analog converter that controls power to the mixer to adjust for unwanted signals. Also disclosed is a "table look-up" which means memory is inherent in the circuit. (col. 3 lines 8-65) Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use A/D and D/A converters in conjunction with a processor with memory in order to adjust settings based on stored information.

10. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grandfield in view of Chevallier.

Regarding claim 6, Grandfield does not expressly disclose that the bias currents or voltages are adjusted by tuning the receiver by measuring the balance from the receiver outputs and empirically adjusting the bias. However, Chevallier discloses adjusting the bias according to feedback from the outputs. (col. 6) Therefore it would



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have been obvious to one of ordinary skill in the art at the time of the invention to empirically adjust the bias to correct the balance in tuning a receiver in order to eliminate unwanted signal components.

***Conclusion***

**THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lewis G. West whose telephone number is 703-308-9298. The examiner can normally be reached on Monday-Thursday 5:30-4:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 703-305-4778. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9314 for regular communications and 703-872-9314 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-305-4700.

Lewis West
(703) 308-9298
July 3, 2001

NAY MAUNG
PRIMARY EXAMINER



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OIPE JC87 AUG 15 2001 PATENT & TRADEMARK OFFICE

RECEIVED AUG 20 2001 Technology Center 2600

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Murtojarvi et al.

SERIAL NO.: 09/292,301 ART UNIT: 2681

FILED: 4/15/99 EXAMINER: West, L.

TITLE: METHOD AND ATTENUATING SPURIOUS SIGNALS AND RECEIVER

ATTORNEY DOCKET NO.: 297-008576-US (PAR)

Commissioner of Patents and Trademarks
Washington, D.C. 20231

AMENDMENT UNDER 37 CFR 1.116

Sir:

This is in response to the Office Action dated 7/11/01. Please amend the Application as follows:

IN THE CLAIMS:

1. (Amended) A method for attenuating spurious signals in a transmitter and/or receiver in which radio signals are mixed to a second frequency, said method comprising the mixing is balanced by adjusting bias voltages and/or currents in transistors of the mixer circuit, and

said adjusting step comprises tuning the receiver by measuring the balance from the receiver outputs and empirically adjusting the bias voltages and/or currents on the basis of measurements.



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2. (Amended) The method of claim 1, wherein the bias voltages and/or currents are adjusted in an input circuit of a radio-frequency signal.

3. (Amended) The method of claim 1, wherein the bias voltages and/or currents are adjusted in an input circuit of a local oscillator.

4. (Amended) The method of claim 1, wherein the bias voltages and/or currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit.

5. (Amended) The method of claim 1, wherein the adjustment of the bias voltages and/or currents is performed using a digital-to-analog converter to adjust current for the signal line across parallel resistors.

---

7. (Amended) A receiver comprising a mixer for mixing radio signals to a second frequency, means for attenuating spurious signals when receiving radio signals, and balance adjustment means in the mixer circuit to adjust the circuit's balance by adjusting bias voltages and/or currents in transistors of the mixer circuit.

8. (Amended) The receiver of claim 7, wherein the adjustment means comprises an input circuit for a radio-frequency signal to adjust bias voltages and/or currents of an adjustment circuit.



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9. (Amended) The receiver of claim 7, wherein the adjustment means comprises a local oscillator input circuit to adjust bias voltages and/or currents of an adjustment circuit.

10. (Amended) The receiver of claim 7, wherein the adjustment means comprises an adjustment circuit separately for both transistors of a transistor pair of a signal line of the mixer circuit to adjust bias voltages and/or currents.

11. (Amended) The receiver of claim 7, wherein the adjustment means comprises a digital-to-analog converter to adjust bias voltages and/or currents with a digital controller.

12. (Amended) The receiver of claim 7, wherein it further comprises

- an A/D converter to measure the balance,

- a D/A converter to adjust bias voltages and/or currents, and

- an oscillator, a processor and memory to carry out balance measurement routines as well as bias voltage and/or current adjustment routines.

Cancel Claim 6.

REMARKS



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Claim 1 has been amended to incorporate claim 6. Also all claims have been amended to conform to US practice.

The present invention is a method and an apparatus for attenuating spurious signals. To achieve this, it features balancing the mixing by adjusting the bias currents and/or voltages in transistors of the mixer circuit.

Grandfield discloses in Col. 7, lines 1-67, a circuit for adjusting the level of oscillator injection by controlling the bias on oscillator transistor Q3 (see col. 4, lines 13 and 14, and 27-36). The bias on mixer transistor Q4 is determined by resistor R2 (see col. 5, line 68, to col. 6, line 1) and is apparently fixed by the value of this resistor and that of the B+ supply.

Claim 7 recites "...balance adjustment means in the mixer circuit to adjust the circuit's balance by adjusting bias voltages and/or currents in transistors of the mixer circuit". This is totally missing from Grandfield.

It is therefore respectfully requested that the rejection of claims 7-10 under 35 USC 102(b) on Grandfield be withdrawn.

Amended claim 1 also recites the above limitations. It is noted that in Chevallier it is the bias of transistor 102 which is made equal to that of 101 (see Col. 5, lines 63-66). However, these transistors are not the mixer transistors, which are 221, 222, 231, 232, and 233. Since the above limitations are not found in Chevallier, the rejection of this



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claim under 35 USC 103 on Grandfield in view of Chevallier should be withdrawn.

In addition, claim 1 recites adjusting the balance by tuning the receiver by measuring the balance and adjusting the bias voltages and/or currents on the basis of the measurements. As the Examiner correctly states, Chevallier does not expressly disclose this concept. While it does disclose adjusting bias by a feedback loop, this is totally different from adjusting bias by tuning. Thus for this additional reason, claim 1 is patentable.

An entry and allowance are requested, or at least an entry for appeal purposes.

Respectfully submitted,

Henry I. Steckler (Reg. No. 24,139) Date: Aug 13, 2001

PERMAN & GREEN, LLP
425 Post Road
Fairfield, CT 06430
(203) 259-1800
Customer No. 2512

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August 13, 2001
Date

Name of Person Making Deposit



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000559

Application No.: 09/292,301

Marked Up Claims

1. (Amended) A method for attenuating spurious signals in a transmitter and/or receiver in which radio signals are mixed to a second frequency [which may also be the baseband frequency], said method comprising [characterized in that] the mixing is balanced by adjusting bias voltages [(3)] and/or currents in transistors of the mixer circuit[.], and

said adjusting step comprises tuning the receiver by measuring the balance from the receiver outputs and empirically adjusting the bias voltages and/or currents on the basis of measurements.

2. (Amended) The method of claim 1, [characterized in that] wherein the bias voltages [(3)] and/or currents are adjusted in an input circuit of a radio-frequency signal.

3. (Amended) The method of claim 1, [characterized in that] wherein the bias voltages [(3)] and/or currents are adjusted in an input circuit of a local oscillator.

4. (Amended) The method of claim 1, [characterized in that] wherein the bias voltages [(3)] and/or currents are adjusted separately for both transistors of a transistor pair of a signal line in the mixer circuit.

5. (Amended) The method of claim 1, [characterized in that] wherein the adjustment of the bias voltages [(3)] and/or



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currents is performed using a digital-to-analog converter to adjust current [$I_{BIAS}$] for the signal line across parallel resistors.

7. (Amended) A receiver comprising a mixer [(10)] for mixing radio signals to a second frequency [which may also be the baseband frequency], [and] means for attenuating spurious signals when receiving radio signals, [characterized in that it comprises] and balance adjustment means [(12)] in the mixer circuit [(10)] to adjust the circuit's balance by adjusting bias voltages and/or currents in transistors [(Q10, Q11, Q12, Q13, Q14, Q15)] of the mixer circuit.

8. (Amended) The receiver of claim 7, [characterized in that] wherein the adjustment means [(12)] comprises an input circuit [($V_{RF+}$, $V_{RF-}$, C3, C4)] for a radio-frequency signal to adjust bias voltages and/or currents of an adjustment circuit [(BRF+, BRF−, $R_{B5}$, $R_{B6}$, $R_{B7}$, $R_{B8}$)].

9. (Amended) The receiver of claim 7, [characterized in that] wherein the adjustment means [(12)] comprises a local oscillator input circuit [($V_{LO+}$, $V_{LO-}$, C1, C2)] to adjust bias voltages and/or currents of an adjustment circuit [(BLO+, BLO−, $R_{B1}$, $R_{B2}$, $R_{B3}$, $R_{B4}$)].

10. (Amended) The receiver of claim 7, [characterized in that] wherein the adjustment means [(12)] comprises an adjustment circuit separately for both transistors of a transistor pair [(Q10, Q14,; Q11, Q13)] of a signal line [($V_{LO+}$, $V_{LO-}$)] of the mixer circuit [(10)] to adjust bias voltages and/or currents.



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11. (Amended) The receiver of claim 7, [characterized in that] wherein the adjustment means comprises a digital-to-analog converter [(19)] to adjust bias voltages and/or currents with a digital controller [(12)].

12. (Amended) The receiver of claim 7, [characterized in that] wherein it further comprises

- an A/D converter [(18)] to measure the balance,

- a D/A converter [(19)] to adjust bias voltages and/or currents, and

- an oscillator [(15)], a processor [(16)] and memory [(17)] to carry out balance measurement routines as well as bias voltage and/or current adjustment routines.



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Washington, D.C. 20231

ME

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. |
|---|---|---|---|
| 09/292,301 | 04/15/99 | MURTOJARVI S | 297-008576-U |

WM01/0912

CLARENCE A GREEN
PERMAN & GREEN LLP
425 POST ROAD
FAIRIELD CT 06430

| EXAMINER | |
|---|---|
| WEST, L | |
| ART UNIT | PAPER NUMBER |
| 2681 | 11 |

DATE MAILED: 09/12/01

**Please find below and/or attached an Office communication concerning this application or proceeding.**

**Commissioner of Patents and Trademarks**

PTO-90C (Rev.11/00)

1- File Copy



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| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 09/292,301 | MURTOJARVI ET AL. | |
| | Examiner | Art Unit | |
| | Lewis G. West | 2681 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *15 August 2001* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-12* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 April 1999* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

13)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

1)☒ Notice of References Cited (PTO-892)
2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3)☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4)☐ Interview Summary (PTO-413) Paper No(s). _____
5)☐ Notice of Informal Patent Application (PTO-152)
6)☐ Other:



NOKITC-005932

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Applicant's request for reconsideration of the finality of the rejection of the last Office action is persuasive and, therefore, the finality of that action is withdrawn.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 1, the use of "and/or" makes the scope of the claim improperly defined as the scope would encompass a method applied to not only a transmitter or receiver, but also to both a transmitter and receiver simultaneously.

Regarding claims 1-12, the use of "and/or" in reference to applied bias voltage and current is improper, while either may be applied, one would not apply both simultaneously.

The "mixer circuit" referred to in the claims was also previously equated with the "mixer" by the use of reference numerals. When these reference numerals were removed to conform to U. S. practice, the scope of the claim was broadened. Because of the difference in terminology, a mixer circuit could be read as encompassing more than just the frequency converter, for example the oscillator. To properly define the "mixer" and "mixer circuit" as the same device one term should be used consistently throughout all the claims.



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### *Claim Rejections - 35 USC § 102*

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

Claim 7 is rejected under 35 U.S.C. 102(b) as being anticipated by Tanabe et al.

Tanabe discloses a receiver comprising a mixer for mixing radio signal to a second frequency, means for attenuating spurious signal when receiving radio signals, and balance adjustment mans in the mixer circuit to adjust the circuit's balance by adjusting bias voltages in transistors of the mixer circuit. (Figure 1, col. 3 lines 1-16)

### *Allowable Subject Matter*

Claim 1 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action.

Claims 2-6 and 8-12 would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

### *Conclusion*

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Navid et al. also shows and RF mixer with balance adjustment means.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lewis G. West whose telephone number is 703-308-9298. The examiner can normally be reached on Monday-Thursday 5:30-4:00.

OPAP AKIMA-18
SEP 0 8 2014
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Proposed Constructions for Claim Terms of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824, and U.S. Patent No. 7,366,529[1], Complainants Nokia Corporation And Nokia Inc.'s



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Proposed Claim Constructions and Identification of Extrinsic Evidence, HTC Corporation, HTC America, Inc., and Google Inc.'s Initial Claim Construction Brief for U.S. Patent No. 6,035,189; U.S. Patent No. 6,711,211; and U.S. Patent No. 8,140,650, and Respondents' Initial Markman Brief Regarding Disputed Claim Terms In U.S. Patent Nos. 6,373,345, 7,187,945, 8,363,824, and 7,366,529.

The opinions included in Proposed Constructions for Claim Terms of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824, and U.S. Patent No. 7,366,529[1], HTC Corporation, HTC America, Inc., and Google Inc.'s Initial Claim Construction Brief for U.S. Patent No. 6,035,189; U.S. Patent No. 6,711,211; and U.S. Patent No. 8,140,650, and Respondents' Initial Markman Brief Regarding Disputed Claim Terms In U.S. Patent Nos. 6,373,345, 7,187,945, 8,363,824, and 7,366,529 are not the opinions of the Applicant or Applicant's Attorney. Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

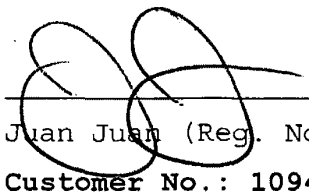
The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R.



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§1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



9/4/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

9.4.2014 Jessica Cooper

Date Name of Person Making Deposit



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

OPAP AKIMA-18 SEP 0 8 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Proposed Constructions for Claim Terms of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824, and U.S. Patent No. 7,366,529[1] (Paul C. Goulet et al.) [including Declaration of Iain Richardson (with Exhibits A, B) and Certificate of Service], Investigation No. 337-TA-885, September 9, 2013 (35 pages) |
| | Complainants Nokia Corporation And Nokia Inc.'s Proposed Claim Constructions and Identification of Extrinsic Evidence (Jonas R. McDavit et al.) [including Proposed Claim Constructions and Identification of Extrinsic Evidence and Certificate of Service], Investigation No. 337-TA-885, September 9, 2013 (12 pages) |
| | Joint Claim Construction Chart (Jonas R. McDavit et al.) [including Joint Claim Construction Chart and Certificate of Service], Investigation No. 337-TA-885, September 13, 2013 (15 pages) |
| | HTC Corporation, HTC America, Inc., and Google Inc.'s Initial Claim Construction Brief for U.S. Patent No. 6,035,189; U.S. Patent No. 6,711,211; and U.S. Patent No. 8,140,650 (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-11 and Certificate of Service], Investigation No. 337-TA-885, January 8, 2013 (255 pages) |
| | Respondents' Initial Markman Brief Regarding Disputed Claim Terms In U.S. Patent Nos. 6,373,345, 7,187,945, 8,363,824, and 7,366,529 (Paul C. Goulet et al.) [including Exhibits 1-24 and Certificate of Service], Investigation No. 337-TA-885, September 16, 2013 (400 pages) |
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-847 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Google Inc.'s Initial Claim Construction Brief, Respondents HTC Corp. and HTC America, Inc's, Opening Claim Construction Brief, Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation, Opening Claim Construction Brief, Google Inc.'s Reply Brief on Construction of Disputed



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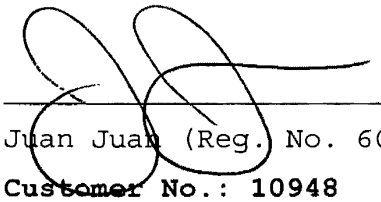
Terms of U.S. Patent No. 6,141,664, U.S. Patent No. 7,209,911, U.S. Patent No. 5,884,190, and U.S. Patent No. 7,366,529, and Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation Responsive Claim Construction Brief. The opinions included in Google Inc.'s Initial Claim Construction Brief, Respondents HTC Corp. and HTC America, Inc's, Opening Claim Construction Brief, and Google Inc.'s Reply Brief on Construction of Disputed Terms of U.S. Patent No. 6,141,664, U.S. Patent No. 7,209,911, U.S. Patent No. 5,884,190, and U.S. Patent No. 7,366,529. are not the opinions of the Applicant or Applicant's Attorney. Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

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Respectfully submitted,



9/4/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Google Inc.'s Initial Claim Construction Brief (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-32 and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (690 pages) |
| | Respondents HTC Corp. and HTC America, Inc's, Opening Claim Construction Brief (Blair M. Jacobs et al.) [including Exhibits 1-19 and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (371 pages) |
| | Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation, Opening Claim Construction Brief (Jason Berrebi et al.) [including Exhibits A-D and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (106 pages) |
| | Google Inc.'s Reply Brief on Construction of Disputed Terms of U.S. Patent No. 6,141,664, U.S. Patent No. 7,209,911, U.S. Patent No. 5,884,190, and U.S. Patent No. 7,366,529 (Shamita D. Etienne-Cummings et al.) [including Exhibits 33-37 and Certificate of Service], Investigation No. 337-TA-847, January 8, 2013 (151 pages) |
| | Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation Responsive Claim Construction Brief (Jason Berrebi et al.) [including Certificate of Service], Investigation No. 337-TA-847, January 8, 2013 (48 pages) |
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Complainants' Nokia Corporation, Nokia Inc.'s Opening Claim Construction Brief [including Exhibits 1-29 and Certificate of Service].



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Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

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Respectfully submitted,



9/4/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

9.4.2014 Jessica Cooper

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Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000576

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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OPA SEP 0 8 2014 AKIMA-18 PATENT & TRADEMARK OFFICE

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Complainants' Nokia Corporation, Nokia Inc.'s Opening Claim Construction Brief (Jonas R. McDavit et al.) [including Exhibits 1-29 and Certificate of Service], Investigation No. 337-TA-885, September 16, 2013 (787 pages) |
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TAW




IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

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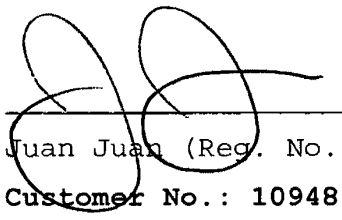
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Respectfully submitted,



9/5/2014

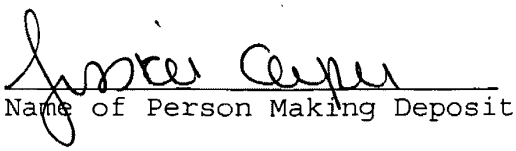
Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
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203-925-9400

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9.5.2014
Date



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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OPAP AKIMA-16 SEP 10 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

| | |
|---|---|
| | Complainants Nokia Corporation and Nokia Inc.'s Responsive Claim Construction Brief (M. Scott Stevens et al.) [including Exhibits 1-36 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (983 pages) |
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| Examiner's Signature: | Date Considered: |
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TFW




IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

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Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Respondents' Rebuttal Markman Brief Regarding Disputed Claim Terms in U.S. Patent Nos. 6,373,345; 7,187,945; 8,363,824; and 7,366,529, and HTC Corp., HTC America, Inc., and Google Inc.'s Rebuttal Claim Construction Brief for U.S. Patent No. 6,035,189, U.S. Patent No. 6,711,211, and U.S.



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Patent No. 8,140,650, and Proposed Terms for Claim Construction of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824 and U.S. Patent No. 7,366,529[1]. Applicant's Attorney notes that Exhibits 12-15 of HTC Corp., HTC America, Inc., and Google Inc.'s Rebuttal Claim Construction Brief for U.S. Patent No. 6,035,189, U.S. Patent No. 6,711,211, and U.S. Patent No. 8,140,650 do not appear to have been used in their brief and thus Exhibits 12-15 are not provided (and do not appear to be available).

The opinions included in Respondents' Rebuttal Markman Brief Regarding Disputed Claim Terms in U.S. Patent Nos. 6,373,345; 7,187,945; 8,363,824; and 7,366,529, and HTC Corp., HTC America, Inc., and Google Inc.'s Rebuttal Claim Construction Brief for U.S. Patent No. 6,035,189, U.S. Patent No. 6,711,211, and U.S. Patent No. 8,140,650, and Proposed Terms for Claim Construction of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824 and U.S. Patent No. 7,366,529[1] are not the opinions of the Applicant or Applicant's Attorney.

Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

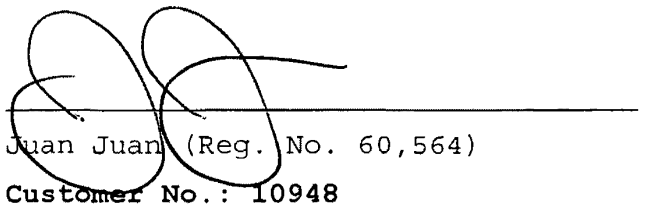
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possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



9/5/2014

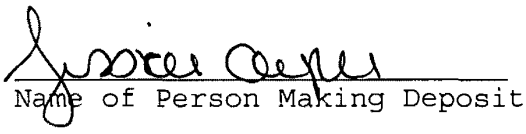
Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Respondents' Rebuttal Markman Brief Regarding Disputed Claim Terms in U.S. Patent Nos. 6,373,345; 7,187,945; 8,363,824; and 7,366,529 (Paul C. Goulet et al.) [including Exhibits 1-34 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (548 pages) |
| | HTC Corp., HTC America, Inc., and Google Inc.'s Rebuttal Claim Construction Brief for U.S. Patent No. 6,035,189, U.S. Patent No. 6,711,211, and U.S. Patent No. 8,140,650 529 (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-11, 16-19 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (281 pages) |
| | Proposed Terms for Claim Construction of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824 and U.S. Patent No. 7,366,529[1] (Paul C. Goulet et al.) [including Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (7 pages) |
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PATENT & TRADEMARK OFFICE

IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record documents submitted to Applicant during the discovery process. In particular, Exhibits C-1 through C-8 are invalidity charts prepared by HTC Corp. and HTC America, Inc., which were served on Applicant on October 11, 2013.



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The opinions included in Exhibits C-1 through C-8 are not the opinions of the Applicant or Applicant's Attorney.

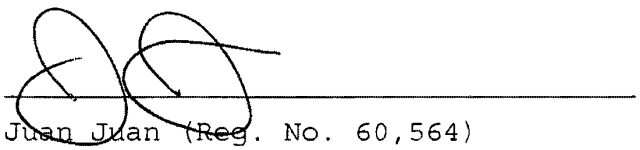
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Respectfully submitted,



Juan Juan (~~Reg~~. No. 60,564)

9/8/14

Date

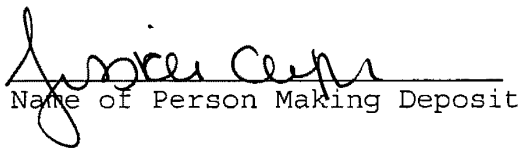
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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US- | | | | |
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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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|---|---|
| | Exhibit C-1: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent No. 7,515,431 to Stephen P. Zadesky, et al. ("Zadesky"), HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-2: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent No. 7,336,228 to Lin Lu, et al. ("Lu") , HTC Corp. and HTC America, Inc., October 11, 2013, 8 pages |
| | Exhibit C-3: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent Application Publication No. US 2005/0282593 to Michael F. Spence, et al. ("Spence"), HTC Corp. and HTC America, Inc., October 11, 2013, 8 pages |
| | Exhibit C-4: Invalidity of U.S. Patent No. 8,363,824 in light of PalmOne Zire 31 and U.S. Patent No. 7,366,228 to Lu, HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-5: Invalidity of U.S. Patent No. 8,363,824 in light of Apple iPod Nano (1st Generation), HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-6: Invalidity of U.S. Patent No. 8,363,824 in light of Apple iPod Mini (1st Generation), HTC Corp. and HTC America, Inc., October 11, 2013, 9 pages |
| | Exhibit C-7: Invalidity of U.S. Patent No. 8,363,824 in light of Nokia 9300, HTC Corp. and HTC America, Inc., October 11, 2013, 13 pages |
| | Exhibit C-8: Invalidity of U.S. Patent No. 8,363,824 in light of Blackberry 857, HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
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| Examiner's Signature: | Date Considered: |
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IFW

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Google Inc.'s Notice of Prior Art.

The opinions included in Google Inc.'s Notice of Prior Art are not the opinions of the Applicant or Applicant's Attorney.

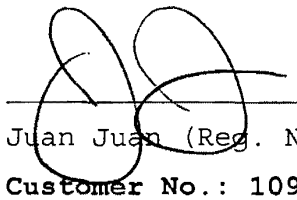


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Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



9/8/2014

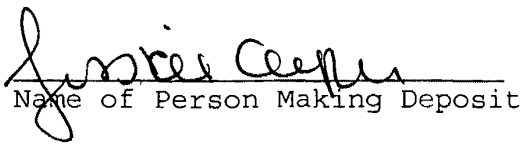
Juan Juan (Reg. No. 60,564) Date

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Attorneys At Law, LLC
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203-925-9400

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US- | | | | |
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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| | Google Inc.'s Notice of Prior Art (Shamita D. Etienne-Cummings et al.) [including Certificate of Service], Investigation No. 337-TA-885, December 24, 2013 (38 pages) |
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

An office action issued in regard to Chinese Patent Application No. 201210281567.1, which is a counterpart application to the present U.S. application. Enclosed is a copy of the office action (along with a translation of the office action). Applicant notes that the primary reference in the office action (US 2005/0282593) has been previously cited. Also enclosed is Form PTO-1449 which lists the art not previously cited in the present U.S. Application. Copies of

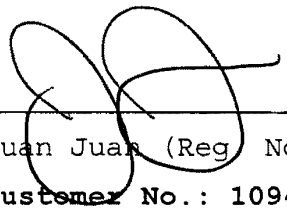


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any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

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Respectfully submitted,



9/12/14

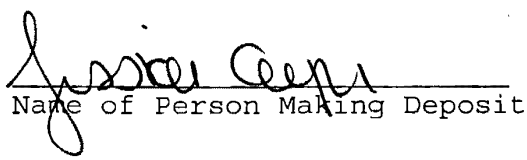
Juan Juan (Reg. No. 60,564) Date

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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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OPAP AKIMA-11 SEP 16 2014 PATENT & TRADEMARK OFFICE

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | CN2750587(Y) | 01/04/2006 | Konka Group Co. | Abstract |

**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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The PTO did not receive the following listed item(s) page 1 of 2

Espacenet

# Bibliographic data: CN2750587 (Y) — 2006-01-04

## A flip lid mechanism for handset


| | |
|---|---|
| **Inventor(s):** | XIE RUI YAO [CN] ± (RUI,YAO XIE) |
| **Applicant(s):** | KONKA GROUP CO [CN] ± (KONKA GROUP CO) |



| | |
|---|---|
| **Classification:** | **- international:** ***H04M1/02*** |
| | **- cooperative:** |
| **Application number:** | CN2004288781U 20040923 |
| **Priority number(s):** | CN2004288781U 20040923 |


### Abstract of CN2750587 (Y)


The utility model relates to a turnover lip mechanism for a turnover lip handset. The utility model is characterized in that a locking mechanism is arranged on a main casing of the handset and a turnover lip casing of the handset, mounting holes of elastically controlled rotating shaft on the main casing of the handset and the turnover lip casing of the handset are staggered with a shaft line in the arrangement of an angle of 5 to 20 DEG. mode, and thus, the elastically controlled rotating shaft is in an elastically compressed state when the main casing of the handset and the turnover lip casing of the handset are closed; when the turnover lip casing of the handset needs to be opened, the locking mechanism is opened. The turnover lip casing of the handset is separated from the main casing of the handset by the turnover lip casing through the elastic recovery of the elastically controlled rotating shaft. A turnover lip of the handseat can be opened, the utility model can realize the aims that users independently and quickly operate by one hand, and use is convenient.

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
*H04M 1/02 (2006.01)*

[12] 实用新型专利说明书

专利号 ZL 200420088781.6

[45] 授权公告日 2006 年 1 月 4 日

[11] 授权公告号 CN 2750587Y

[22] 申请日 2004.9.23
[21] 申请号 200420088781.6
[73] 专利权人 康佳集团股份有限公司
地址 518053 广东省深圳市南山区华侨城康佳集团股份有限公司
[72] 设计人 谢 睿 姚 恒

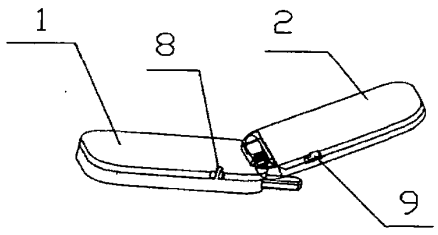
[74] 专利代理机构 深圳市智科友专利商标事务所
代理人 曲家彬
权利要求书 1 页 说明书 3 页 附图 1 页

[54] 实用新型名称

一种手机翻盖机构

[57] 摘要

一种翻盖手机的手机翻盖机构，它是在手机主壳体与手机翻盖壳体上设置有锁紧机构，手机主壳体和手机翻盖壳体上的弹性控制转轴安装孔同轴线错位 5－20°角度设置，使手机主壳体与手机翻盖壳体闭合时，弹性控制转轴呈弹性压缩状态，需打开手机翻盖壳体时，打开锁紧机构，手机翻盖壳体靠弹性控制转轴的弹性恢复将手机翻盖壳体与手机主壳体离开，打开手机翻盖，实现操作者一只手独立快速操作，方便使用的目的。




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1.一种手机翻盖机构，包括有手机主壳体、手机翻盖壳体、弹性控制转轴，其特征在于：

a.所述的手机主壳体（1）上和手机翻盖壳体（2）上，设有可使手机主壳体（1）与手机翻盖（2）相互锁紧的可控锁紧机构，

b.所述的手机主壳体（1）上的弹性控制转轴固定套（3）的固定孔（4）与手机翻盖壳体（2）上的弹性控制转轴弹性控制转轴（5）的转轴孔（6）在手机主壳体（1）与手机翻盖壳体（2）呈闭合状态时，沿弹性控制转轴的轴线方向，错位 5—20° 角度设置。

2.根据权利要求 1 所述的一种手机翻盖机构，其特征在于：所述的可控锁紧机构，由手机主壳体（1）上的弹性卡勾（8）和手机翻盖壳体（2）上的卡勾槽（9）构成。



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# 一种手机翻盖机构

## 所属技术领域

本实用新型涉及一种通讯用手机，特别是一种翻盖手机的手机翻盖机构。

## 背景技术

目前，公知的手机翻盖机构，手机主壳体与手机翻盖是通过手机主壳体与手机翻盖连接弹性控制转轴控制，当手机主壳体与手机翻盖呈闭合状态时，弹性控制转轴弹簧使手机翻盖紧紧压在手机主壳体上，当需要打开手机翻盖时，操作者控制手机翻盖去克服弹性控制转轴的弹力，使手机翻盖打开，现有技术的缺点是，操作者使用一只手时，有时很难将手机翻盖打开，特别是当操作者不能使用双手或无法使用双手操作时，现有技术给使用带来困难。

## 发明内容

为克服现有技术使用时，操作者一只手使用困难的技术不足，本实用新型提供一种操作者一只手即可方便使用的手机翻盖机构。

本实用新型解决其技术问题所采用的技术方案是：一种手机翻盖机构，包括有手机主壳体、手机翻盖壳体、弹性控制转轴，手机主壳体上和手机翻盖壳体上，设有可使手机主壳体与手机翻盖相互锁紧的可控锁紧机构，手机主壳体上的弹性控制转轴固定套的固定孔与手机翻盖壳体上的弹性控制转轴弹性控制转轴的转轴孔，在手机主壳体与



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手机翻盖壳体呈闭合状态时，沿弹性控制转轴的轴线方向，错位 5—20° 角度设置。可控锁紧机构，由手机主壳体上的弹性卡勾和手机翻盖壳体上的卡勾槽构成。

本实用新型的有益效果是，操作者、使用时只须一只手即可方便、快捷打开手机翻盖，而且使用完毕后手机翻盖与手机主壳体接触牢固，本实用新型具有结构简单使用方便等优点。

附图说明

下面结合附图和实施例对本实用新型近一步说明

附图 1 为本实用新型闭合状态示意图

附图 2 为本实用新型打开状态示意图

附图 3 为手机主壳体示意图

附图 4 为手机翻盖壳体示意图

图中 1.手机主壳体，2.手机翻盖壳体，3.转轴固定套，4.固定套孔，5.弹性转轴，6.弹性转轴孔，，7.弹性卡勾，8.卡勾槽，

具体实施方式

参看附图，在手机主壳体 1 与手机翻盖壳体 2 呈闭合状态时，由于手机主壳体 1 的弹性控制转轴的转轴固定套 3 的固定套孔 4 与手机翻盖壳体 2 上的弹性控制转轴的轴线方向错位 5—20 度角度设置，此时，弹性控制转轴的弹性转轴 5 处于弹性压缩状态，手机翻盖壳体 2 与手机主壳体 1 的闭合，是靠操作者使用的外力，将手机翻盖壳体 2 与手机主壳体 1 的闭合，手机翻盖壳体 2 与手机主壳体 1 毕合后的固定靠手机主壳体 1 上的弹性卡勾 8 卡死在手机翻盖壳体 2 的卡勾槽 9



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内实现，当需打开手机翻盖壳体 2 时，操作者一只手搬动卡勾 8，使卡勾 8 离开卡勾槽 9，手机翻盖壳体 2 靠弹性转轴 5 的弹性恢复，使手机翻盖壳体 2 离开手机主壳体 1，打开手机翻盖壳体 2。



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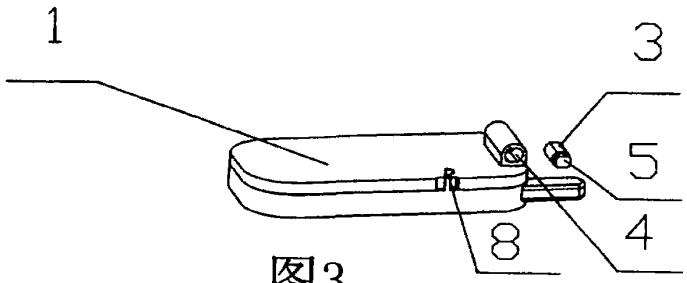



图3

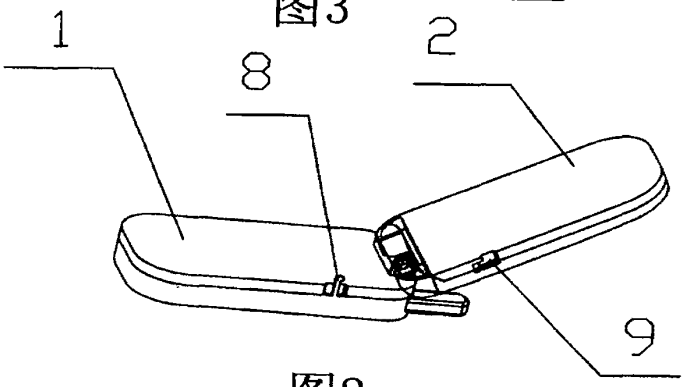



图2



图1

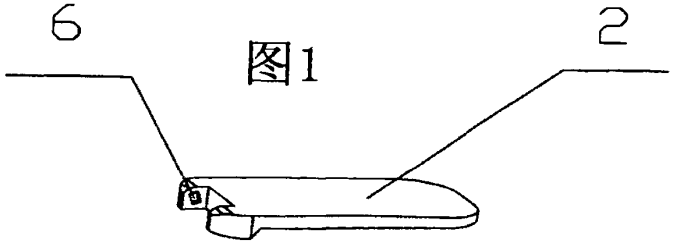



图4



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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

## Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56).



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Applicant's Attorney notes that a redacted copy is being submitted as the original copy includes confidential business information.

The opinions included in Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56) are not the opinions of the Applicant or Applicant's Attorney.

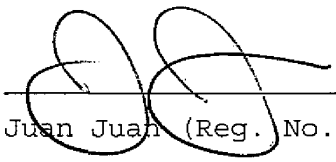
Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.



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Respectfully submitted,



9/18/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US- | | | | |
| | US- | | | | |
| | US- | | | | |
| | US- | | | | |
| | US- | | | | |
| | US- | | | | |
| | US- | | | | |

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | - - | | | |
| | - - | | | |
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

| | |
|---|---|
| | Redacted copy of Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56) (Paul C. Goulet et al.) [including Certificate of Service], Investigation No. 337-TA-885, October 11, 2013 (11 pages) |
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| Examiner's Signature: | Date Considered: |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

# Electronic Acknowledgement Receipt

| | |
|---|---|
| **EFS ID:** | 20178533 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Mark F. Harrington/Jessica Capra |
| **Filer Authorized By:** | Mark F. Harrington |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 18-SEP-2014 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 15:17:51 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

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| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
|---|---|---|---|---|---|
| 1 | Information Disclosure Statement (IDS) Form (SB08) | IDS.pdf | 74653<br>f3a33e9d24654503bda25b8d681b654a1dba49fa | no | 4 |

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| **Warnings:** | |
| **Information:** | |

| This is not an USPTO supplied IDS fillable form | | | | | |
|---|---|---|---|---|---|
| 2 | Other Reference-Patent/App/Search documents | Reference.pdf | 299195<br>04307e27e77e7cf271af08166ed75d71ededc9f8 | no | 11 |
| **Warnings:** | | | | | |
| **Information:** | | | | | |
| | | | **Total Files Size (in bytes):** | 373848 | |

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**National Stage of an International Application under 35 U.S.C. 371**
**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**
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# NOTICE OF ALLOWANCE AND FEE(S) DUE

10948 7590 10/01/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER |
|---|
| NGUYEN, TUAN DUC |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 10/01/2014

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 01/02/2015 |

**THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.**

**THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.**

**HOW TO REPLY TO THIS NOTICE:**

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

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For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

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| (Signature) |
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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 01/02/2015 |

| EXAMINER | ART UNIT | CLASS-SUBCLASS |
|---|---|---|
| NGUYEN, TUAN DUC | 2656 | 379-433080 |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
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(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
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3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. The following fee(s) are submitted:
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- ❑ Publication Fee (No small entity discount permitted)
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- ❑ Applicant certifying micro entity status. See 37 CFR 1.29 — NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ❑ Applicant asserting small entity status. See 37 CFR 1.27 — NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
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PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
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| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

10948 7590 10/01/2014

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER | |
|---|---|
| NGUYEN, TUAN DUC | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

DATE MAILED: 10/01/2014

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.



PTOL-85 (Rev. 02/11)

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000610

## OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

## Privacy Act Statement

**The Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

| Notice of Allowability | Application No. 14/067,249 | Applicant(s) JORGENSEN, CLAUS H. | |
|---|---|---|---|
| | Examiner TUAN D. NGUYEN | Art Unit 2656 | AIA (First Inventor to File) Status No |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *08/28/2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-42 and renumbered as 1-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   **Certified copies:**

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date See Continuation Sheet
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☒ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TUAN D NGUYEN/
Primary Examiner, Art Unit 2656



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000612

Continuation of Attachment(s) 2. Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date: 09/18/2014,09/12/2014,09/11/2014,09/10/2014,09/08/201408/28/2014.



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000613

The present application is being examined under the pre-AIA first to invent provisions.

## Office Action

### Examiner's Statement of Reasons for Allowance

1. Claims 25-42 are allowed.

The following is an examiner's statement of reasons for allowance: The prior art of record teaches various portable electronic devices thereon, for example US 2001/0034242. However, the prior art of record fails to show claim 25, a portable electronic device comprising: a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing; a camera located in said housing and extending to said cut out at said rear side; an engine section comprising a printed circuit board, a transceiver, a processor and a memory; a user input section located above the engine section and a battery, wherein the user input section is located adjacent the battery and the engine section; wherein the battery and engine section are housed in the housing and the user input is located in a hole through a front side of the housing; and claim 36, a housing for a portable electronic device comprising; a one piece housing forming enclosed exterior lateral sides and a rear side; a cut out in the rear side of said housing, said cut out configured to receive at least part of a camera; wherein the housing is configured to receive a

battery and an engine section, wherein the battery and engine section are housed in the housing, and wherein a user input is located in a hole through a front side of the housing.

2. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

3. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Tuan D. Nguyen whose telephone number is (571) 272-8163. The examiner can normally be reached on M-F 6:30-3:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Curt Kuntz can be reached on (571) 272-7499. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

TDN

9/19/14

/TUAN D NGUYEN/

Primary Examiner, Art Unit 2656

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

OPA SEP 0 8 2014 AKIMA-18 PATENT & TRADEMARK OFFICE

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | - -<br>- -<br>- -<br>- - | | | |

## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

| | |
|---|---|
| /T.N./ | Complainants' Nokia Corporation, Nokia Inc.'s Opening Claim Construction Brief (Jonas R. McDavit et al.) [including Exhibits 1-29 and Certificate of Service], Investigation No. 337-TA-885, September 16, 2013 (787 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

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UNITED STATES DEPARTMENT OF COMMERCE
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P.O. Box 1450
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www.uspto.gov

# BIB DATA SHEET

**CONFIRMATION NO. 7955**

| SERIAL NUMBER | FILING or 371(c) DATE<br>RULE | CLASS | GROUP ART UNIT | ATTORNEY DOCKET NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | 379 | 2656 | 891.0013.U4(US) |

**APPLICANTS**

Nokia Corporation, Espoo, FINLAND, Assignee (with 37 CFR 1.172 Interest);

**INVENTORS**

Claus H. Jorgensen, Bronshoj, DENMARK;

**** CONTINUING DATA ***************************

This application is a CON of 13/741,781 01/15/2013 PAT 8615077
and is a CON of 12/860,234 08/20/2010 PAT 8363824
and is a CON of 11/393,510 03/29/2006 PAT 7787618

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

11/13/2013

| Foreign Priority claimed ☐ Yes ☑ No<br>35 USC 119(a-d) conditions met ☐ Yes ☑ No<br>Verified and Acknowledged /TUAN DUC NGUYEN/ Examiner's Signature | ☐ Met after Allowance<br>Initials | STATE OR COUNTRY | SHEETS DRAWINGS | TOTAL CLAIMS | INDEPENDENT CLAIMS |
|---|---|---|---|---|---|
| | | DENMARK | 6 | 18 | 2 |

**ADDRESS**

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484
UNITED STATES

**TITLE**

PORTABLE ELECTRONIC DEVICE

| FILING FEE RECEIVED | | |
|---|---|---|
| 1900 | FEES: Authority has been given in Paper<br>No._____ to charge/credit DEPOSIT ACCOUNT<br>No._____ for following: | ☐ All Fees<br>☐ 1.16 Fees (Filing)<br>☐ 1.17 Fees (Processing Ext. of time)<br>☐ 1.18 Fees (Issue)<br>☐ Other _____<br>☐ Credit |



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| Index of Claims | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

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| ✓ | Rejected | - | Cancelled | N | Non-Elected | A | Appeal |
| = | Allowed | ÷ | Restricted | I | Interference | O | Objected |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| CLAIM | | DATE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Final | Original | 02/04/2014 | 05/27/2014 | 09/19/2014 | | | | | | |
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| 18 | 42 | = | = | = | | | | | | |

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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OPAP AKMA-11 SEP 11 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

| | |
|---|---|
| | Exhibit C-1: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent No. 7,515,431 to Stephen P. Zadesky, et al. ("Zadesky"), HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-2: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent No. 7,336,228 to Lin Lu, et al. ("Lu") , HTC Corp. and HTC America, Inc., October 11, 2013, 8 pages |
| | Exhibit C-3: Invalidity of U.S. Patent No. 8,363,824 in light of United States Patent Application Publication No. US 2005/0282593 to Michael F. Spence, et al. ("Spence"), HTC Corp. and HTC America, Inc., October 11, 2013, 8 pages |
| | Exhibit C-4: Invalidity of U.S. Patent No. 8,363,824 in light of PalmOne Zire 31 and U.S. Patent No. 7,366,228 to Lu, HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-5: Invalidity of U.S. Patent No. 8,363,824 in light of Apple iPod Nano (1st Generation), HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
| | Exhibit C-6: Invalidity of U.S. Patent No. 8,363,824 in light of Apple iPod Mini (1st Generation), HTC Corp. and HTC America, Inc., October 11, 2013, 9 pages |
| | Exhibit C-7: Invalidity of U.S. Patent No. 8,363,824 in light of Nokia 9300, HTC Corp. and HTC America, Inc., October 11, 2013, 13 pages |
| | Exhibit C-8: Invalidity of U.S. Patent No. 8,363,824 in light of Blackberry 857, HTC Corp. and HTC America, Inc., October 11, 2013, 11 pages |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citationif not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

OPAP AKIMA-18 SEP 0 8 2014 PATENT & TRADEMARK OFFICE

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

| | |
|---|---|
| /T.N./ | Proposed Constructions for Claim Terms of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824, and U.S. Patent No. 7,366,529[1] (Paul C. Goulet et al.) [including Declaration of Iain Richardson (with Exhibits A, B) and Certificate of Service], Investigation No. 337-TA-885, September 9, 2013 (35 pages) |
| /T.N./ | Complainants Nokia Corporation And Nokia Inc.'s Proposed Claim Constructions and Identification of Extrinsic Evidence (Jonas R. McDavit et al.) [including Proposed Claim Constructions and Identification of Extrinsic Evidence and Certificate of Service], Investigation No. 337-TA-885, September 9, 2013 (12 pages) |
| /T.N./ | Joint Claim Construction Chart (Jonas R. McDavit et al.) [including Joint Claim Construction Chart and Certificate of Service], Investigation No. 337-TA-885, September 13, 2013 (15 pages) |
| /T.N./ | HTC Corporation, HTC America, Inc., and Google Inc.'s Initial Claim Construction Brief for U.S. Patent No. 6,035,189; U.S. Patent No. 6,711,211; and U.S. Patent No. 8,140,650 (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-11 and Certificate of Service], Investigation No. 337-TA-885, January 8, 2013 (255 pages) |
| /T.N./ | Respondents' Initial Markman Brief Regarding Disputed Claim Terms In U.S. Patent Nos. 6,373,345, 7,187,945, 8,363,824, and 7,366,529 (Paul C. Goulet et al.) [including Exhibits 1-24 and Certificate of Service], Investigation No. 337-TA-885, September 16, 2013 (400 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-885 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56).



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Applicant's Attorney notes that a redacted copy is being submitted as the original copy includes confidential business information.

The opinions included in Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56) are not the opinions of the Applicant or Applicant's Attorney.

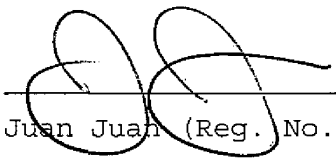
Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.



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Respectfully submitted,



9/18/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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|---|---|
| /T.N./ | Redacted copy of Respondents HTC Corporation's and HTC America, Inc.'s (1) Initial Supplemental Responses To Complainants' Contention Interrogatories To HTC (Nos. 9, 11, 12, 14, 52, and 53) and (2) Initial Objections and Responses To Complainants' Contention Interrogatories to HTC (Nos. 54-56) (Paul C. Goulet et al.) [including Certificate of Service], Investigation No. 337-TA-885, October 11, 2013 (11 pages) |
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Examiner's Signature: /Tuan Nguyen/ Date Considered: 09/19/2014

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

| | |
|---|---|
| | Google Inc.'s Initial Claim Construction Brief (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-32 and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (690 pages) |
| | Respondents HTC Corp. and HTC America, Inc's, Opening Claim Construction Brief (Blair M. Jacobs et al.) [including Exhibits 1-19 and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (371 pages) |
| | Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation, Opening Claim Construction Brief (Jason Berrebi et al.) [including Exhibits A-D and Certificate of Service], Investigation No. 337-TA-847, December 20, 2012 (106 pages) |
| | Google Inc.'s Reply Brief on Construction of Disputed Terms of U.S. Patent No. 6,141,664, U.S. Patent No. 7,209,911, U.S. Patent No. 5,884,190, and U.S. Patent No. 7,366,529 (Shamita D. Etienne-Cummings et al.) [including Exhibits 33-37 and Certificate of Service], Investigation No. 337-TA-847, January 8, 2013 (151 pages) |
| | Complainants' Nokia Corporation, Nokia Inc., and Intellisync Corporation Responsive Claim Construction Brief (Jason Berrebi et al.) [including Certificate of Service], Investigation No. 337-TA-847, January 8, 2013 (48 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /T.N./

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H. Filed: October 30, 2013
Art Unit: 2656 Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)

VIA EFS

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

Applicant was involved in Investigation 337-TA-847 before the United States International Trade Commission. Applicant's Attorney is filing this information disclosure statement to make of record a Responsive Claim Construction Brief (including Exhibits 1-34) that was filed in the United States International Trade Commission for Investigation 337-TA-847. The opinions included in the Responsive Claim Construction Brief are not the opinions of the Applicant or Applicant's Attorney. Applicant's Attorney is aware of the art listed on the enclosed Form PTO-1449. Copies of any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

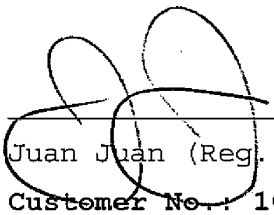


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Applicant's Attorney notes that due to the large number of pages for this Responsive Claim Construction Brief, this IDS may require more than one EFW-Web submission to include all of the submitted material.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



8/28/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000628

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US- | | | | |
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**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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|---|---|
| /T.N./ | Respondents HTC Corp. and HTC America, Inc.'s Responsive Claim Construction Brief(Blair M. Jacobs et al.), Investigation No. 337-TA-847, executed Jan. 8, 2013 (17793 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

OPAP AKIMA-11 SEP 12 2014 PATENT & TRADEMARK OFFICE

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US- | | | | |
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## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

| | |
|---|---|
| /T.N./ | Google Inc.'s Notice of Prior Art (Shamita D. Etienne-Cummings et al.) [including Certificate of Service], Investigation No. 337-TA-885, December 24, 2013 (38 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
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## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
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| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

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OPAP AKIMA-16 SEP 10 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
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## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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|---|---|
| /T.N./ | Respondents' Rebuttal Markman Brief Regarding Disputed Claim Terms in U.S. Patent Nos. 6,373,345; 7,187,945; 8,363,824; and 7,366,529 (Paul C. Goulet et al.) [including Exhibits 1-34 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (548 pages) |
| /T.N./ | HTC Corp., HTC America, Inc., and Google Inc.'s Rebuttal Claim Construction Brief for U.S. Patent No. 6,035,189, U.S. Patent No. 6,711,211, and U.S. Patent No. 8,140,650 529 (Shamita D. Etienne-Cummings et al.) [including Exhibits 1-11, 16-19 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (281 pages) |
| /T.N./ | Proposed Terms for Claim Construction of U.S. Patent No. 6,035,189, U.S. Patent No. 6,373,345, U.S. Patent No. 6,711,211, U.S. Patent No. 7,187,945, U.S. Patent No. 8,140,650, U.S. Patent No. 8,363,824 and U.S. Patent No. 7,366,529[1] (Paul C. Goulet et al.) [including Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (7 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Markthrough citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

| Search Notes | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | Examiner | Art Unit |
| | TUAN D NGUYEN | 2656 |

| CPC- SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
| H04M1/0262, H04M1/0214, H04M1/0216, H04M1/0264, H04M1/0277 | 5/27/14 | TN |

| CPC COMBINATION SETS - SEARCHED | | |
|---|---|---|
| Symbol | Date | Examiner |
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| US CLASSIFICATION SEARCHED | | | |
|---|---|---|---|
| Class | Subclass | Date | Examiner |
| 379 | 433.01,433.08,433.11,433.13 | 1/30/14 | TN |
| 455 | 90.3,575.1,575.3,572,573,574 | 2/3/14 | TN |
| 361 | 679.23 | 2/4/14 | TN |
| 348 | 374,376 | 2/4/14 | TN |
| | updated same as above | 5/27/14 | TN |
| | updated same as above | 9/17/18 | TN |

| SEARCH NOTES | | |
|---|---|---|
| Search Notes | Date | Examiner |
| PLUS and inventor search | 2/3/14 | TN |

| INTERFERENCE SEARCH | | | |
|---|---|---|---|
| US Class/ CPC Symbol | US Subclass / CPC Group | Date | Examiner |
| | updated same as above | 2/4/14 | TN |
| | updated same as above | 5/27/14 | TN |
| | updated same as above | 9/19/14 | TN |

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| | /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 |

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| CPC | | | | | | |
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| **Symbol** | | | | | **Type** | **Version** |
| H04M | | 1 | / | 0214 | F | 2013-01-01 |
| H04M | | 1 | / | 0262 | I | 2013-01-01 |
| H04M | | 1 | / | 0277 | I | 2013-01-01 |
| H04M | | 1 | / | 0216 | A | 2013-01-01 |
| H04M | | 1 | / | 0264 | A | 2013-01-01 |
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| **Symbol** | | | | **Type** | **Set** | **Ranking** | **Version** |
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| NONE | | **Total Claims Allowed:** | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 9/19/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |



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| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

| US ORIGINAL CLASSIFICATION | | INTERNATIONAL CLASSIFICATION | |
|---|---|---|---|
| CLASS | SUBCLASS | CLAIMED | NON-CLAIMED |
| 379 | 433.08 | H 0 4 M 1 / 00 (2006.01.01) | |
| | | H 0 4 M 9 / 00 (2006.01.01) | |

| CROSS REFERENCE(S) | | | | | |
|---|---|---|---|---|---|
| CLASS | SUBCLASS (ONE SUBCLASS PER BLOCK) | | | | |
| 379 | 433.01 | 433.13 | | | |
| 455 | 575.3 | | | | |

| NONE | | Total Claims Allowed: | |
|---|---|---|---|
| (Assistant Examiner) | (Date) | 18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656 | 9/19/14 | O.G. Print Claim(s) | O.G. Print Figure |
| (Primary Examiner) | (Date) | 25 | 7 |

| Issue Classification | Application/Control No. | Applicant(s)/Patent Under Reexamination |
|---|---|---|
| | 14067249 | JORGENSEN, CLAUS H. |
| | **Examiner** | **Art Unit** |
| | TUAN D NGUYEN | 2656 |

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

| Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original | Final | Original |
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| 16 | 40 | | | | | | | | | | | | | | |

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|---|---|---|---|
| NONE<br><br>(Assistant Examiner) | (Date) | **Total Claims Allowed:**<br>18 | |
| /TUAN D NGUYEN/<br>Primary Examiner.Art Unit 2656<br><br>(Primary Examiner) | 9/19/14<br><br>(Date) | O.G. Print Claim(s)<br>25 | O.G. Print Figure<br>7 |



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Best Available Copy



| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) Serial No.: 14/067,249<br>Applicant(s): Claus H. Jorgensen<br>Filing Date: October 30, 2013 Group: 2656 |
|---|---|

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | US-<br>US-<br>US-<br>US-<br>US-<br>US-<br>US- | | | | |

OPAP AKIMA-16 SEP 10 2014 PATENT & TRADEMARK OFFICE

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
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**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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|---|---|
| /T.N./ | Complainants Nokia Corporation and Nokia Inc.'s Responsive Claim Construction Brief (M. Scott Stevens et al.) [including Exhibits 1-36 and Certificate of Service], Investigation No. 337-TA-885, September 23, 2013 (983 pages) |
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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 09/19/2014 |
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Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Request for Paper

Sir:

This is in response to the Notice of Allowance mailed 10/01/2014. Please note that an Information Disclosure Statement (IDS) was filed on 9/12/2014 with the USPTO. A copy of this IDS can be found in the PAIR database (see entry for mail room date of 9/16/2014). A copy of this IDS is also attached for the examiner's reference. The examiner has not returned the PTO-1449 indicating that the art cited in that IDS has been considered. The examiner is requested to return a copy of the PTO-1449 indicating that the art has been considered.

Applicant notes that the header on the top of the submitted form PTO-1449 included a typographical error. In particular, the header indicated "Page No.: 2 of 2". However, the header should have indicated "Page No.: 1 of 1".

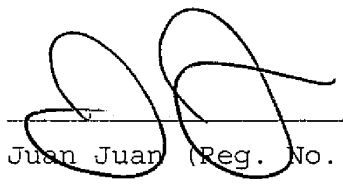
The examiner is directed to MPEP §609.05(a) which states that "[i]f an item of information in an IDS fails to comply with all the requirements of 37 CFR 1.97 and 37 CFR 1.98, that item of information in the IDS will not be considered and a line should be drawn through the citation to show that it has not been considered. **However, other items of information that do comply with all the requirements of 37 CFR 1.97 and 37 CFR 1.98 will be considered by the examiner**" [emphasis added].

Applicant submits that the citation of "CN2750587(Y), 01/04/2006, Konka Group Co." in the "Foreign Patent Documents" section of the form PTO-1449 complied with 37 CFR 1.97 and 37 CFR 1.98 and thus should be considered by the examiner.

The examiner is respectfully requested to return a copy of the PTO-1449 indicating that the art has been considered.

Should any unresolved issue remain, the examiner is invited to call applicant's attorney at the telephone number indicated below.

Respectfully submitted,



12/29/2014

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000638

OPAP AKIMA-11
SEP 16 2014
PATENT & TRADEMARK OFFICE

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

An office action issued in regard to Chinese Patent Application No. 201210281567.1, which is a counterpart application to the present U.S. application. Enclosed is a copy of the office action (along with a translation of the office action). Applicant notes that the primary reference in the office action (US 2005/0282593) has been previously cited. Also enclosed is Form PTO-1449 which lists the art not previously cited in the present U.S. Application. Copies of

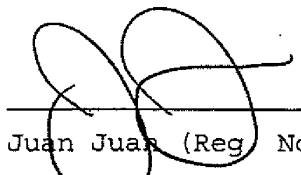


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any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



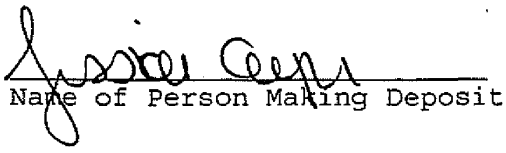
Juan Juan (Reg. No. 60,564) 9/12/14
Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

9.12.2014
Date



Name of Person Making Deposit



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

## U.S. PATENT DOCUMENTS

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | | | | | |

USPTO PAP AKIMA-11 SEP 16 2014 PATENT & TRADEMARK OFFICE

## FOREIGN PATENT DOCUMENTS

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| | CN2750587(Y) | 01/04/2006 | Konka Group Co. | Abstract |

## OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)

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| Examiner's Signature: | Date Considered: |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

The PTO did not receive the following listed item(s) page 1 of 2

Espacenet

# Bibliographic data: CN2750587 (Y) — 2006-01-04

## A flip lid mechanism for handset


| | |
|---|---|
| **Inventor(s):** | XIE RUI YAO [CN] ± (RUI,YAO XIE) |
| **Applicant(s):** | KONKA GROUP CO [CN] ± (KONKA GROUP CO) |



| | |
|---|---|
| **Classification:** | **- international:** ***H04M1/02*** |
| | **- cooperative:** |
| **Application number:** | CN2004288781U 20040923 |
| **Priority number(s):** | CN2004288781U 20040923 |


### Abstract of CN2750587 (Y)


The utility model relates to a turnover lip mechanism for a turnover lip handset. The utility model is characterized in that a locking mechanism is arranged on a main casing of the handset and a turnover lip casing of the handset, mounting holes of elastically controlled rotating shaft on the main casing of the handset and the turnover lip casing of the handset are staggered with a shaft line in the arrangement of an angle of 5 to 20 DEG. mode, and thus, the elastically controlled rotating shaft is in an elastically compressed state when the main casing of the handset and the turnover lip casing of the handset are closed; when the turnover lip casing of the handset needs to be opened, the locking mechanism is opened. The turnover lip casing of the handset is separated from the main casing of the handset by the turnover lip casing through the elastic recovery of the elastically controlled rotating shaft. A turnover lip of the handseat can be opened, the utility model can realize the aims that users independently and quickly operate by one hand, and use is convenient.

[19] 中华人民共和国国家知识产权局

[51] Int. Cl.
*H04M 1/02* (2006.01)

[12] 实用新型专利说明书

专利号 ZL 200420088781.6

[45] 授权公告日 2006 年 1 月 4 日

[11] 授权公告号 CN 2750587Y

[22] 申请日 2004.9.23
[21] 申请号 200420088781.6
[73] 专利权人 康佳集团股份有限公司
地址 518053 广东省深圳市南山区华侨城康佳集团股份有限公司
[72] 设计人 谢 睿 姚 恒

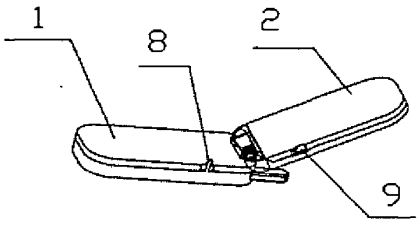
[74] 专利代理机构 深圳市智科友专利商标事务所
代理人 曲家彬
权利要求书 1 页 说明书 3 页 附图 1 页

[54] 实用新型名称

一种手机翻盖机构

[57] 摘要

一种翻盖手机的手机翻盖机构，它是在手机主壳体与手机翻盖壳体上设置有锁紧机构，手机主壳体和手机翻盖壳体上的弹性控制转轴安装孔同轴线错位 5－20°角度设置，使手机主壳体与手机翻盖壳体闭合时，弹性控制转轴呈弹性压缩状态，需打开手机翻盖壳体时，打开锁紧机构，手机翻盖壳体靠弹性控制转轴的弹性恢复将手机翻盖壳体与手机主壳体离开，打开手机翻盖，实现操作者一只手独立快速操作，方便使用的目的。




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1.一种手机翻盖机构，包括有手机主壳体、手机翻盖壳体、弹性控制转轴，其特征在于：

a.所述的手机主壳体（1）上和手机翻盖壳体（2）上，设有可使手机主壳体（1）与手机翻盖（2）相互锁紧的可控锁紧机构，

b.所述的手机主壳体（1）上的弹性控制转轴固定套（3）的固定孔（4）与手机翻盖壳体（2）上的弹性控制转轴弹性控制转轴（5）的转轴孔（6）在手机主壳体（1）与手机翻盖壳体（2）呈闭合状态时，沿弹性控制转轴的轴线方向，错位5—20°角度设置。

2.根据权利要求1所述的一种手机翻盖机构，其特征在于：所述的可控锁紧机构，由手机主壳体（1）上的弹性卡勾（8）和手机翻盖壳体（2）上的卡勾槽（9）构成。



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# 一种手机翻盖机构

## 所属技术领域

本实用新型涉及一种通讯用手机，特别是一种翻盖手机的手机翻盖机构。

## 背景技术

目前，公知的手机翻盖机构，手机主壳体与手机翻盖是通过手机主壳体与手机翻盖连接弹性控制转轴控制，当手机主壳体与手机翻盖呈闭合状态时，弹性控制转轴弹簧使手机翻盖紧紧压在手机主壳体上，当需要打开手机翻盖时，操作者控制手机翻盖去克服弹性控制转轴的弹力，使手机翻盖打开，现有技术的缺点是，操作者使用一只手时，有时很难将手机翻盖打开，特别是当操作者不能使用双手或无法使用双手操作时，现有技术给使用带来困难。

## 发明内容

为克服现有技术使用时，操作者一只手使用困难的技术不足，本实用新型提供一种操作者一只手即可方便使用的手机翻盖机构。

本实用新型解决其技术问题所采用的技术方案是：一种手机翻盖机构，包括有手机主壳体、手机翻盖壳体、弹性控制转轴，手机主壳体上和手机翻盖壳体上，设有可使手机主壳体与手机翻盖相互锁紧的可控锁紧机构，手机主壳体上的弹性控制转轴固定套的固定孔与手机翻盖壳体上的弹性控制转轴弹性控制转轴的转轴孔，在手机主壳体与



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手机翻盖壳体呈闭合状态时，沿弹性控制转轴的轴线方向，错位 5—20° 角度设置。可控锁紧机构，由手机主壳体上的弹性卡勾和手机翻盖壳体上的卡勾槽构成。

本实用新型的有益效果是，操作者、使用时只须一只手即可方便、快捷打开手机翻盖，而且使用完毕后手机翻盖与手机主壳体接触牢固，本实用新型具有结构简单使用方便等优点。

附图说明

下面结合附图和实施例对本实用新型近一步说明

附图 1 为本实用新型闭合状态示意图

附图 2 为本实用新型打开状态示意图

附图 3 为手机主壳体示意图

附图 4 为手机翻盖壳体示意图

图中 1.手机主壳体，2.手机翻盖壳体，3.转轴固定套，4.固定套孔，5.弹性转轴，6.弹性转轴孔，，7.弹性卡勾，8.卡勾槽，

具体实施方式

参看附图，在手机主壳体 1 与手机翻盖壳体 2 呈闭合状态时，由于手机主壳体 1 的弹性控制转轴的转轴固定套 3 的固定套孔 4 与手机翻盖壳体 2 上的弹性控制转轴的轴线方向错位 5—20 度角度设置，此时，弹性控制转轴的弹性转轴 5 处于弹性压缩状态，手机翻盖壳体 2 与手机主壳体 1 的闭合，是靠操作者使用的外力，将手机翻盖壳体 2 与手机主壳体 1 的闭合，手机翻盖壳体 2 与手机主壳体 1 毕合后的固定靠手机主壳体 1 上的弹性卡勾 8 卡死在手机翻盖壳体 2 的卡勾槽 9



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内实现，当需打开手机翻盖壳体 2 时，操作者一只手搬动卡勾 8，使卡勾 8 离开卡勾槽 9，手机翻盖壳体 2 靠弹性转轴 5 的弹性恢复，使手机翻盖壳体 2 离开手机主壳体 1，打开手机翻盖壳体 2。



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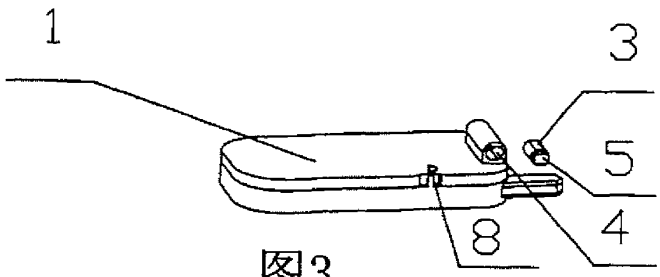



图3

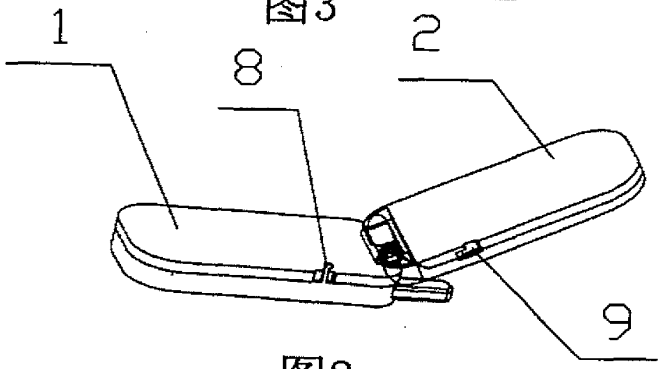



图2



图1

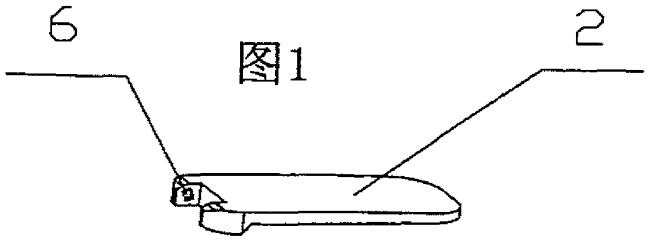



图4



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THE STATE INTELLECTUAL PROPERTY OFFICE OF THE PEOPLE'S REPUBLIC OF CHINA

Address: 6 Xi Tu Cheng Lu, Haidian, Beijing Post Code: 100088

| | | |
|---|---|---|
| Applicant: | NOKIA CORPORATION | |
| Attorney: | Maohua Wang | Date of Notification: |
| Application No.: | 201210281567.1 | Date: 27 Month: 05 Year: 2014 |
| Title of the Invention: | PORTABLE ELECTRONIC DEVICE | |

## Notification of the First Office Action

1. ☒ The applicant requested examination as to substance on March 29, 2007 and examination has been carried out on the above-identified patent application for invention under Article 35(1) of the Patent Law of the People's Republic of China(hereinafter referred to as "the Patent Law").
   ☐ The Chinese Patent Office has decided to examine the application on its own initiative under Article 35(2) of the Patent Law.

2. ☒ The applicant claimed priority/priorities based on the application(s):
   filed in US on March 29, 2006, filed in _____ on _____,
   filed in _____ on _____, filed in _____ on _____,
   filed in _____ on _____, filed in _____ on _____,
   ☒ The applicant has provided the priority documents certified by the Patent Office where the priority application(s) was/were filed.
   ☐ The applicant has not provided the priority documents certified by the Patent Office where the priority application(s) was/were filed and therefore the priority claim(s) is/are deemed not to have been made under Article 30 of the Patent Law.
   ☐ The application is a PCT continuation.

3. ☐ The applicant submitted amendments to the application on _____ and on _____, wherein the amended _____ submitted on _____ and the amended _____ submitted on _____ are not acceptable, because said amendments do not comply with ☐Article 33 of the Patent Law. ☐Rule 51 of the Implementing Regulations of the Patent Law.
   The specific reasons why the amendments are not allowable are set forth in the text portion of this Notification.

4. ☐ Examination as to substance was directed to the initial application documents as filed.
   ☒ Examination as to substance was directed to the documents as specified below:
   Application documents filed on the date of filing of the divisional application.

5. ☐ This Notification is issued without search reports.
   ☒ This Notification is issued with consideration of the search results.
   ☒ Below is/are the reference document(s) cited in this Office Action(the reference number(s) will be used throughout the examination procedure):

| No. | Number(s) or Title(s) of Reference(s) | Date of Publication (or the filing date of conflicting application) |
|---|---|---|
| 1 | US 2005/0282593A1 | Date: 22 Month: 12 Year: 2005 |

6. Conclusions of the Action:
   ☐ On the Specification:
   ☐ The subject matter contained in the application is not patentable under Article 5 of the Patent Law.
   ☐ The description does not comply with Article 26 paragraph 3 of the Patent Law.



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☐ The description does not comply with Article 33 of the Patent Law.
☐ The draft of the description does not comply with Rule 18 of the Implementing Regulations.
☐ The draft of the description does not comply with Rule 19 of the Implementing Regulations

☒ On the Claims:

☒ Claim(s) 1-5, 8, 10-11 does/do not possess the novelty as required by Article 22 paragraph 2 of the Patent Law.

☒ Claim(s) 6-7, 9, 12 does/do not possess the inventiveness as required by Article 22 paragraph 3 of the Patent Law.

☐ Claim(s) _____ does/do not possess the practical applicability as required by Article 22 paragraph 4 of the Patent Law.

☐ Claim(s) _____ is/are not patentable under Article 25 of the Patent Law.

☐ Claim(s) _____ does/do not comply with Article 26 paragraph 4 of the Patent Law.

☐ Claim(s) _____ does/do not comply with Article 31 paragraph 1 of the Patent Law.

☐ Claim(s) _____ does/do not comply with Article 33 of the Patent Law.

☐ Claim(s) _____ does/do not comply with the definition of inventions prescribed by Rule 2 paragraph 1 of the Implementing Regulations.

☐ Claim(s) _____ does/do not comply with the provisions of Rule 13 paragraph 1 of the Implementing Regulations.

☐ Claim(s) _____ does/do not comply with the provisions of Rule 20 of the Implementing Regulations.

☐ Claim(s) _____ does/do not comply with the provisions of Rule 21 of the Implementing Regulations.

☐ Claim(s) _____ does/do not comply with the provisions of Rule 22 of the Implementing Regulations.

☐ Claim(s) _____ does/do not comply with the provisions of Rule 23 of the Implementing Regulations.

☐ Claim(s) _____ does not comply with the provisions of Rule 43 paragraph 1 of the Implementing Regulations.

☐ The divisional application does not comply with the provisions of Rule 43 paragraph 1 of the Implementing Regulations.

7. In view of the conclusions set forth above, the Examiner is of the opinion that:

☐ The applicant should make amendments as directed in the text portion of the Notification.

☐ The applicant should expound in the response reasons why the application is patentable and make amendments to the application where there are deficiencies as pointed out in the text portion of the Notification, otherwise, the application will not be allowed.

☒ The application contains no allowable invention, and therefore, if the applicant fails to submit sufficient reasons to prove that the application does have merits, it will be rejected.

☐

8. The followings should be taken into consideration by the applicant in making the response:

(1) Under Article 37 of the Patent Law, the applicant should respond to the office action within 4 months counting from the date of receipt of the Notification. If, without any justified reason, the time limit is not met, the application shall be deemed to have been withdrawn.

(2) Any amendments to the application should be in conformity with the provisions of Article 33 of the Patent Law. Substitution pages should be in duplicate and the format of the substitution should be in conformity with the relevant provision contained in "The Examination Guidelines".

(3) The response to the Notification and/or revision of the application should be mailed to or handed over to the "Reception Division" of the Patent Office, and documents not mailed or handed over to the Reception Divisions have no legal effect.

(4) Without an appointment, the applicant and/or his agent shall not interview with the Examiner in the Patent Office.

9. This Notification contains a text portion of 3 pages and the following attachments:

☐ __ cited reference(s), totaling __ pages.

☐

Examination Dept. _____ Examiner:_____ Seal of the Examination Department



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# Summary of First Office Action

Application No.: 201210281567.1

In this outstanding Office Action, the Examiner has rejected Claims 1-5, 8, and 10-11 under Article 22.2 of the Chinese Patent Law as lacking novelty in view of D1 (US2005/0282593A1), and also rejected Claims 6-7, 9 and 12 under Article 22.3 of the Chinese Patent Law as lacking inventiveness over D1 in view of common knowledge in the art.

In particular, the Examiner has indicated that D1 discloses a clamshell phone (equivalent to a portable electronic device) and specifically discloses (see paragraphs [0016]-[0032] and Figs. 1-7 of D1): the device 100 comprises an upper part also known as a flip 102, and a lower part 104; the flip 102 and the lower part 104 are coupled by a rotational coupling, in particular a hinge 106; the flip 102 comprise a first inside surface 110, and a first outside surface 202; the lower part 104 comprises a second inside surface 112, and 1 second outside surface; the hinge 106 allows the flip 102 to be rotated from the first configuration in which the flip 102 extends upward away from the lower part 104, i.e. opened position, to the second configuration in which the flip 102 overlies the lower part 104, i.e. closed position; as shown in Fig. 3, the lower part 104 of the device 100 comprises a lower part inner housing part 330 and a lower part outer housing part 332 (equivalent to a one piece housing forming enclosed exterior lateral sides and a rear side and at least a portion of the front face), which are coupled together by screws; keypad 124 is located on the inside surface of the lower part 112 (equivalent to a user input section located above the engine section and the battery, and the user input is configured to be located in a hole through the front side of the housing and substantially form part of the front face of the portable electronic device); a battery compartment 336 is defined between the lower part inner housing part 330, and a battery compartment cover 338; the battery compartment 336 is located proximate a top end 340 of the lower part 104; a populated printed circuit board 348 (equivalent to a printed circuit board) that includes communication and control circuits of the device 100 is located between the bottom end 346 and the battery compartment 336 (equivalent to an engine section comprising a printed circuit board; a battery located adjacent the engine section; wherein the battery and the



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engine section are housed in the housing and the user input section is located directly opposite the battery without a portion of the engine section therebetween); referring to Fig. 7, the device 100 comprises a transceiver 402, a processor 404, an analog-to-digital converter (A/D) 406, the flip position sensor 352, a camera interface 408, a digital-to-analog converter (D/A) 410, a display driver 412, a button interface decoder 414, a program memory 416, and a workspace memory 418 coupled together through a system bus 420 (equivalent to an engine section comprising a printed circuit board, a transceiver, a processor and a memory). Therefore, D1 discloses all technical features of Claim 1 and thus Claim 1 lacks novelty in view of D1.

D1, particularly in paragraphs [0016]-[0032] and Figs. 1-7, discloses the additional technical features of dependent Claims 2-5 and 8, 10, and 11. Thus, these dependent claims also lack novelty in view of D1.

Dependent Claim 6 and Claim 7 differ from D1 in that the battery is located between two portions of the engine section. Based on this distinguishing technical feature, the technical problem to be solved is how to arrange the position relationship between the battery and the engine. However, it is commonly used technical means for a person skilled in the art to arrange the battery between two portions of the engine section. Therefore, the technical solutions of Claims 6 and 7 are obvious based on D1 and in view of common knowledge in the art, and thus lack inventiveness.

Claim 9 differs from D1 (see paragraphs 16-32, Figs. 1-7) in that the camera is housed at an exterior side of the portable electronic device by a junction of a portion of the second hinge member and a portion of a one-piece second tubular housing member of the second section. However, this technical feature belongs to common knowledge in the art. Therefore, the technical solution of Claim 9 is obvious based on D1 and in view of common knowledge in the art, and thus lacks inventiveness.

Claim 12 differs from D1 in that the one piece housing member is made from metal. However, in order to enhance sturdiness of the housing, using the metal material to make the housing member is commonly used technical means in the art, belonging to common knowledge in the art. Therefore, the technical solution of Claim 12 is obvious based on D1 and in view of common knowledge in the art, and thus lacks inventiveness.



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# 中华人民共和国国家知识产权局 P14121069

100020

北京市朝阳区东三环中路1号环球金融中心办公楼东楼20层 北京市
金杜律师事务所
王茂华 杨移

发文日：

2014年05月27日

申请号或专利号：201210281567.1　　发文序号：2014052201028550

申请人或专利权人：诺基亚公司

发明创造名称：便携式电子设备

## 第一次审查意见通知书

1. ☒应申请人提出的实质审查请求，根据专利法第35条第1款的规定，国家知识产权局对上述发明专利申请进行实质审查。
☐根据专利法第35条第2款的规定，国家知识产权局决定自行对上述发明专利申请进行审查。
2. ☒申请人要求以其在：
US专利局的申请日2006年03月29日为优先权日。
☒申请人已经提交了经原受理机构证明的第一次提出的在先申请文件的副本。
☐申请人尚未提交经原受理机构证明的第一次提出的在先申请文件的副本，根据专利法第30条的规定视为未要求优先权要求。
3. ☐经审查，申请人于_____提交的修改文件，不符合专利法实施细则第51条第1款的规定，不予接受。
4. 审查针对的申请文件：
☐原始申请文件。☒分案申请递交日提交的文件。☐下列申请文件：

5. ☐本通知书是在未进行检索的情况下作出的。
☒本通知书是在进行了检索的情况下作出的。
☒本通知书引用下列对比文件(其编号在今后的审查过程中继续沿用)：

| 编号 | 文件号或名称 | 公开日期（或抵触申请的申请日） |
|---|---|---|
| 1 | US 2005/0282593A1 | 20051222 |

6. 审查的结论性意见：
关于说明书：
☐申请的内容属于专利法第5条规定的不授予专利权的范围。
☐说明书不符合专利法第26条第3款的规定。
☐说明书不符合专利法第33条的规定。
☐说明书的撰写不符合专利法实施细则第17条的规定。
☐_____


纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路6号 国家知识产权局专利局受理处收
电子申请，应当通过电子专利申请系统以电子文件形式提交相关文件。除另有规定外，以纸件等其他形式提交的文件视为未提交。

Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000653

关于权利要求书：

☐权利要求_____不符合专利法第 2 条第 2 款的规定。
☐权利要求_____不符合专利法第 9 条第 1 款的规定。
☒权利要求 1-5，8，10-11 不具备专利法第 22 条第 2 款规定的新颖性。
☒权利要求 6-7，9，12 不具备专利法第 22 条第 3 款规定的创造性。
☐权利要求_____不具备专利法第 22 条第 4 款规定的实用性。
☐权利要求_____属于专利法第 25 条规定的不授予专利权的范围。
☐权利要求_____不符合专利法第 26 条第 4 款的规定。
☐权利要求_____不符合专利法第 31 条第 1 款的规定。
☐权利要求_____不符合专利法第 33 条的规定。
☐权利要求_____不符合专利法实施细则第 19 条的规定。
☐权利要求_____不符合专利法实施细则第 20 条的规定。
☐权利要求_____不符合专利法实施细则第 21 条的规定。
☐权利要求_____不符合专利法实施细则第 22 条的规定。
☐_____

☐申请不符合专利法第 26 条第 5 款或者实施细则第 26 条的规定。
☐申请不符合专利法第 20 条第 1 款的规定。
☐分案申请不符合专利法实施细则第 43 条第 1 款的规定。
上述结论性意见的具体分析见本通知书的正文部分。

7. 基于上述结论性意见，审查员认为：

☐申请人应当按照通知书正文部分提出的要求，对申请文件进行修改。
☐申请人应当在意见陈述书中论述其专利申请可以被授予专利权的理由，并对通知书正文部分中指出的不符合规定之处进行修改，否则将不能授予专利权。
☒专利申请中没有可以被授予专利权的实质性内容，如果申请人没有陈述理由或者陈述理由不充分，其申请将被驳回。
☐_____

8. 申请人应注意下列事项：

(1) 根据专利法第 37 条的规定，申请人应在收到本通知之日起的 4 个月内陈述意见，如果申请人无正当理由逾期不答复，其申请将被视为撤回。

(2) 申请人对其申请的修改应当符合专利法第 33 条的规定，不得超出原说明书和权利要求书记载的范围，同时申请人对专利申请文件进行的修改应当符合专利法实施细则第 51 条第 3 款的规定，按照本通知书的要求进行修改。

(3) 申请人的意见陈述书和/或修改文本应邮寄或递交国家知识产权局专利局受理处，凡未邮寄或递交给受理处的文件不具备法律效力。

(4) 未经预约，申请人和/或代理人不得前来国家知识产权局专利局与审查员举行会晤。

9. 本通知书正文部分共有 3 页，并附有下述附件：

☐引用的对比文件的复印件共_____份_____页。
☐_____

审查员：王萌　　联系电话：0512-88996079　　审查部门：专利审查协作江苏中心通信发明审查部



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# 中华人民共和国国家知识产权局

## 第一次审查意见通知书

申请号:2012102815671

本申请涉及便携式电子设备，现提出如下的审查意见。

权利要求 1 不具备专利法第二十二条第二款规定的新颖性。

权利要求 1 要求保护一种便携式电子设备，对比文件 1（US2005/0282593A1）公开了一种蛤壳式电话（相当于便携式电子设备），并具体公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 1-2，装置 100 包括也被称为翻盖的上部 102 和下部 104，翻盖 102 和下部 104 通过旋转接合件相接合，具体为铰链 106；翻盖 102 包括第一内表面 110 和第一外表面 202；下部 104 包括第二内表面 112 和第二外表面；铰链 106 允许翻盖 102 从第一构型旋转到第二构型，第一构型中翻盖 102 远离下部 104 向上展开，即打开位置，第二构型中翻盖 102 叠放在下部 104 上，即闭合位置；如图 3 所示，装置 100 的下部 104 包括下部内机壳部分 330 和下部外机壳部分 332（相当于一体壳，形成封闭的外部侧面和后侧以及前面的至少一部分），其用螺钉接合在一起；键盘 124 位于下部的内表面 112 上（相当于用户输入部分，位于所述引擎部分和所述电池之上，并且所述用户输入被配置成位于通过所述壳的前侧的孔中，并且基本上形成所述便携式电子设备的所述前面的一部分），电池室 336 限定在下部内机壳部分 330 和位于邻近下部外机壳部分 332 的电池室盖 338 之间，电池室 336 位于紧接着下部分 104 的顶端 340，电池 342 基本上布置在电池室 336 中，天线 344 位于紧接着下部 104 的底端 346，包括装置 100 的通信和控制电路的组装印刷电路板 348（相当于印刷电路板）位于底端 346 和电池室 336 之间（相当于引擎部分包括印刷电路板，电池与所述引擎部分相邻设置，其中所述电池和所述引擎部分容纳在所述壳中，所述用户输入部分直接位于所述电池的对面，而所述引擎部分的一部分不在这两者之间）；参见附图 7，是在图 1-3 中所示的手持式通信装置 100 的方框图，装置 100 包括通过系统总线 420 接合在一起的收发器 402、处理器 404、模数转换器(A/D) 406、翻盖位置传感器 352、照相机接口 408、数模转换器(D/A) 410、显示装置驱动器 412、按钮输入解码器 414、程序存储器 416 和工作区存储器 418（相当于引擎部分包括收发器、处理器和存储器）。

由此可见，该权利要求所要求保护的技术方案与该对比文件 1 所公开的内容实质上是相同的，且均属于移动终端领域，都是为了解决翻盖手机内部元件的形成配置的技术问题，并产生了相同的技术效果，因此该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 2 不具备专利法第二十二条第二款规定的新颖性。

权利要求 2 是对权利要求 1 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 1-2，装置 100 包括也被称为翻盖的上部 102 和下部 104，翻盖 102 和下部 104 通过旋转接合件相接合（相当于便携式电子设备包括第一部分和可移动地连接至所述第一部分的第二部分），具体为铰链 106；电池室 336 位于紧接着下部分 104 的顶端 340，电池 342 基本上布置在电池室 336 中，天线 344 位于紧接着下部 104 的底端 346，包括装置 100 的通信和控制电路的组装印刷电路板 348 位于底端 346 和电池室 336 之间（相当于引擎部分位于所述第一部分中）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 3 不具备专利法第二十二条第二款规定的新颖性。

权利要求 3 是对权利要求 2 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 1-3，装置 100 具有显示器以及照相机，且设置在翻盖 102 中（相当于第二部分具有显示器和/或照相机）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 4 不具备专利法第二十二条第二款规定的新颖性。

权利要求 4 是对权利要求 1 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 4，电池 342 与印刷电路板 348 处于同一水平平面内（相当于电池位于所述引擎部分的侧面）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 5 不具备专利法第二十二条第二款规定的新颖性。

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纸件申请，回函请寄：100088 北京市海淀区蓟门桥西土城路 6 号 国家知识产权局专利局受理处收
电子申请，应当通过电子专利申请系统以电子文件形式提交相关文件，除另有规定外，以纸件等其他形式提交的文件视为未提交。

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权利要求 5 是对权利要求 1 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 4，电池 342 与印刷电路板 348 处于同一水平平面内（相当于引擎部分位于所述电池的相对侧）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 6 不具备专利法第二十二条第三款规定的创造性。

权利要求 6 是对权利要求 5 的进一步限定，该权利要求所保护的技术方案与对比文件 1 所公开的内容相比，其区别为：电池位于所述引擎部分的两个部分之间。基于上述区别特征可以确定，权利要求 6 所要求保护的技术方案实际要解决的技术问题是如何布置电池和引擎的位置关系。对于本领域技术人员而言，将电池设置于引擎的两个部分之间是本领域的惯用手段，属于公知常识。因此，在对比文件 1 的基础上结合公知常识以获得该权利要求所要求保护的技术方案，对所属技术领域的技术人员来说是显而易见的，因此该权利要求所要求保护的技术方案不具备突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

权利要求 7 不具备专利法第二十二条第三款规定的创造性。

权利要求 7 是对权利要求 5 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 4，电池 342 与印刷电路板 348 处于同一水平平面内（相当于电池与引擎部分并排布置）。该权利要求所保护的技术方案与对比文件 1 所公开的内容相比，其区别为：电池位于所述引擎部分的两个部分之间。基于上述区别特征可以确定，权利要求 7 所要求保护的技术方案实际要解决的技术问题是如何布置电池和引擎的位置关系。对于本领域技术人员而言，将电池设置于引擎的两个部分之间是本领域的惯用手段，属于公知常识。因此，在对比文件 1 的基础上结合公知常识以获得该权利要求所要求保护的技术方案，对所属技术领域的技术人员来说是显而易见的，因此该权利要求所要求保护的技术方案不具备突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

权利要求 8 不具备专利法第二十二条第二款规定的新颖性。

权利要求 8 是对权利要求 1 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 1-2，装置 100 包括也被称为翻盖的上部 102 和下部 104，翻盖 102 和下部 104 通过旋转接合件相接合（相当于便携式电子设备包括枢转地连接至第一部分的第二部分），具体为铰链 106；翻盖 102 包括第一内表面 110 和第一外表面 202（相当于第二部分包括具有一般管状形状并且形成所述第二部分的相对外部侧面的第二一体壳部件）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。

权利要求 9 不具备专利法第二十二条第三款规定的创造性。

权利要求 9 是对权利要求 1 的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7）：参见附图 1-2，装置 100 包括也被称为翻盖的上部 102 和下部 104，翻盖 102 和下部 104 通过旋转接合件相接合（相当于便携式电子设备包括第一部分，该第一部分通过铰链枢转地连接至第二部分），具体为铰链 106；参见附图 3，铰链 106 包括分别连接于翻盖 102 和下部 104 的两部分（相当于所述铰链包括连接至所述第一部分的第一铰链部件以及连接至所述第二部分的第二铰链部件）；装置 100 具有照相机，且被设置在翻盖 102 的第一外表面 202（相当于第二管状壳部件，形成所述第二部分的相对外部侧面）上（相当于便携式电子设备进一步包括照相机，该照相机连接至所述第二部分，其中所述照相机被容纳于所述便携式电子设备的外侧）。该权利要求所保护的技术方案与对比文件 1 所公开的内容相比，其区别为：照相机通过所述第二铰链部件的一部分和所述第二部分的一体第二管状壳部件的一部分的接合被容纳于所述便携式电子设备的外侧。基于上述区别特征可以确定，权利要求 9 所要求保护的技术方案实际要解决的技术问题是如何设置照相机的位置。对于本领域技术人员而言，将照相机设置在第二铰链部件的一部分与所述第二部分的一体第二管状壳部件的一部分的接合处是本领域的惯用手段，属于公知常识。因此，在对比文件 1 的基础上结合公知常识以获得该权利要求所要求保护的技术方案，对所属技术领域的技术人员来说是显而易见的，因此该权利要求所要求保护的技术方案不具备突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

权利要求 10 不具备专利法第二十二条第二款规定的新颖性。

权利要求 10 是对前述权利要求中任一项的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附



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图 1-7)：键盘 124 位于下部的内表面 112 上（相当于用户输入部分包括小键盘）。因此，在其引用的权利要求不具备新颖性的情况下，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。而在其引用的权利要求不具备创造性的情况下，该权利要求所要求保护的技术方案不具有突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

权利要求 11 不具备专利法第二十二条第二款规定的新颖性。

权利要求 11 是对前述权利要求中任一项的进一步限定，对比文件 1 公开了（参见说明书第 16-32 段，附图 1-7)：装置 100 为蛤壳式电话（相当于便携式电子设备是移动电话)。而 PDA、游戏机是本领域常见便携式电子设备。因此，在其引用的权利要求不具备新颖性的情况下，且特征为“便携式电子设备是移动电话”时，该权利要求所要求保护的技术方案不符合专利法第 22 条第 2 款新颖性的规定。而在其引用的权利要求不具备创造性的情况下，该权利要求所要求保护的技术方案不具有突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

权利要求 12 不具备专利法第二十二条第三款规定的创造性。

权利要求 12 是对前述权利要求中任一项的进一步限定，该权利要求所保护的技术方案与对比文件 1 所公开的内容相比，其区别为：一体壳部件由金属制成。基于上述区别特征可以确定，权利要求 12 所要求保护的技术方案实际要解决的技术问题是采用何种材料制作壳体。对于本领域技术人员而言，为了增加壳体的坚固性从而采用金属材料制作壳体部分是本领域的惯用手段，属于公知常识。因此，在对比文件 1 的基础上结合公知常识以获得该权利要求所要求保护的技术方案，对所属技术领域的技术人员来说是显而易见的，因此该权利要求所要求保护的技术方案不具备突出的实质性特点和显著的进步，不符合专利法第 22 条第 3 款有关创造性的规定。

基于上述理由，本申请的权利要求不具备新颖性或者创造性，说明书中也没有可以被授予专利权的实质性内容，因而本申请不具备被授予专利权的前景。如果申请人不能在本通知书规定的答复期限内提出表明本申请具有新颖性或者创造性的充分理由，本申请将被驳回。

在答复意见中陈述的理由或对原申请文件进行的修改，申请人应具体指出所做的陈述或修改可以从说明书记载的哪些部分得到，申请人应特别注意，对申请文件的修改应当符合专利法第三十三条的规定，不得超出原说明书和权利要求书记载的范围。申请人提交的修改文件应当包括：修改涉及部分的原文复印件，采用明显标记该复印件注出所作的增加、删除或替换；重新打印的替换页（一式两份），用于替换相应的原文。申请人应当确保上述两部分在内容上的一致性。

审查员姓名:王萌
审查员代码:501535



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# 检索报告

| | | |
|---|---|---|
| 申请号：2012102815671 | 申请日：20070329 | 首次检索 |
| 申请人：诺基亚公司 | 最早的优先权日：20060329 | |
| 权利要求项数：12 | 说明书段数：40+13 | |
| 审查员确定的 IPC 分类号：H04M1/02 | | |
| 检索记录信息：CNABS，CNTXT，VEN，CNKI：翻盖，折叠，蛤壳，手机，移动，便携，电池，电路板，处理器，存储器，键盘，照相机，镜头，管状，壳，盖，flip，clam lw shell，phone，battery，circuit，processor，engine，memory，key lw board，camera，housing；IPC：H04M1/02，H04M1/00，H04B1/00 | | |

相关专利文献

| 类型 | 国别以及代码[11]给出的文献号 | 代码[43]或[45]给出的日期 | IPC 分类号 | 相关的段落和/或图号 | 涉及的权利要求 |
|---|---|---|---|---|---|
| X | US2005/0282593A1 | 20051222 | H04B1/00 | 说明书第16-32段，附图1-7 | 1-12 |
| A | CN2750587Y | 20060104 | H04M1/02 | 全文 | 1-12 |



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| 相关非专利文献 | | | | | |
|---|---|---|---|---|---|
| 类型 | 书名(包括版本号和卷号) | 出版日期 | 作者姓名和出版者名称 | 相关页数 | 涉及的权利要求 |
| 类型 | 期刊或文摘名称<br>(包括卷号和期号) | 发行日期 | 作者姓名和文章标题 | 相关页数 | 涉及的权利要求 |

表格填写说明事项：

1. 审查员实际检索领域的 IPC 分类号应当填写到大组和 / 或小组所在的分类位置。
2. 期刊或其它定期出版物的名称可以使用符合一般公认的国际惯例的缩写名称。
3. 相关文件的类型说明：

X：一篇文件影响新颖性或创造性；

Y：与本报告中的另外的 Y 类文件组合而影响创造性；

A：背景技术文件；

R：任何单位或个人在申请日向专利局提交的、属于同样的发明创造的专利或专利申请文件。

P：中间文件，其公开日在申请的申请日与所要求的优先权日之间的文件；

E：抵触申请。

审 查 员：王萌　　审查部门：专利审查协作江苏中心通信发明审查部

2014 年 05 月 18 日



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000659

# Electronic Acknowledgement Receipt

| | |
|---|---|
| **EFS ID:** | 21076002 |
| **Application Number:** | 14067249 |
| **International Application Number:** | |
| **Confirmation Number:** | 7955 |
| **Title of Invention:** | PORTABLE ELECTRONIC DEVICE |
| **First Named Inventor/Applicant Name:** | Claus H. Jorgensen |
| **Customer Number:** | 10948 |
| **Filer:** | Mark F. Harrington/Cathy Sturmer |
| **Filer Authorized By:** | Mark F. Harrington |
| **Attorney Docket Number:** | 891.0013.U4(US) |
| **Receipt Date:** | 29-DEC-2014 |
| **Filing Date:** | 30-OCT-2013 |
| **Time Stamp:** | 15:07:50 |
| **Application Type:** | Utility under 35 USC 111(a) |

## Payment information:

| | |
|---|---|
| Submitted with Payment | no |

## File Listing:

| Document Number | Document Description | File Name | File Size(Bytes)/ Message Digest | Multi Part /.zip | Pages (if appl.) |
|---|---|---|---|---|---|
| 1 | Miscellaneous Incoming Letter | NC51996US_RequestforPaper_12-29-2014.pdf | 736779<br>2966119c53b37521842f1753a07b378bd6acbc48 | no | 23 |

| | |
|---|---|
| **Warnings:** | |
| **Information:** | |

| Total Files Size (in bytes): | 736779 |
|---|---|

**This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.**

**New Applications Under 35 U.S.C. 111**
**If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.**

**National Stage of an International Application under 35 U.S.C. 371**
**If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.**

**New International Application Filed with the USPTO as a Receiving Office**
**If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.**

IFW

## PART B - FEE(S) TRANSMITTAL

**Complete and send this form, together with applicable fee(s), to: Mail** Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
**or Fax** (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

OPAP MAIL ROOM
JAN 05 2015
PATENT & TRADEMARK OFFICE

10948 7590 10/01/2014
Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

01/06/2015 CCHAU2 00000007 501924 14067249
01 FC:1501 960.00 DA

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

**Certificate of Mailing or Transmission**
I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO (571) 273-2885, on the date indicated below.

| | |
|---|---|
| Jessica Capra | (Depositor's name) |
| | (Signature) |
| 12.30.2014 | (Date) |

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

TITLE OF INVENTION: PORTABLE ELECTRONIC DEVICE

| APPLN. TYPE | ENTITY STATUS | ISSUE FEE DUE | PUBLICATION FEE DUE | PREV. PAID ISSUE FEE | TOTAL FEE(S) DUE | DATE DUE |
|---|---|---|---|---|---|---|
| nonprovisional | UNDISCOUNTED | $960 | $0 | $0 | $960 | 01/02/2015 |

| EXAMINER | ART UNIT | CLASS-SUBCLASS |
|---|---|---|
| NGUYEN, TUAN DUC | 2656 | 379-433080 |

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).
- ☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.
- ☒ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively.
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Harrington & Smith
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Nokia Corporation

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Espoo, Finland

Please check the appropriate assignee category or categories (will not be printed on the patent): ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. The following fee(s) are submitted:
- ☒ Issue Fee
- ☐ Publication Fee (No small entity discount permitted)
- ☐ Advance Order - # of Copies _____

4b. Payment of Fee(s): **(Please first reapply any previously paid issue fee shown above)**
- ☐ A check is enclosed.
- ☐ Payment by credit card. Form PTO-2038 is attached.
- ☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credits any overpayment, to Deposit Account Number 50-1924 (enclose an extra copy of this form).

5. **Change in Entity Status** (from status indicated above)
- ☐ Applicant certifying micro entity status. See 37 CFR 1.29
  NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
- ☐ Applicant asserting small entity status. See 37 CFR 1.27
  NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
- ☐ Applicant changing to regular undiscounted fee status.
  NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date 12/30/2014

Typed or printed name Juan Juan Registration No. 60,564



PTOL-85 Part B (10-13) Approved for use through 10/31/2013. OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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OPAP AKIMA-11
JAN 0 5 2015
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PTO/SB/47 (03-09)
Approved for use through 05/31/2015. OMB 0651-0016
U.S. Patent and Trademark Office; U. S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

# "FEE ADDRESS" INDICATION FORM

**Address to:**
**Mail Stop M Correspondence**
**Commissioner for Patents**
**P.O. Box 1450**
**Alexandria, VA 22313-1450**

**- OR -**

**Fax to:**
**571-273-6500**

**INSTRUCTIONS:** The issue fee must have been paid for application(s) listed on this form. In addition, only an address represented by a Customer Number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. **When to check the first box below**: If you have a Customer Number to represent the fee address. **When to check the second box below**: If you have no Customer Number representing the desired fee address, in which case a completed Request for Customer Number (PTO/SB/125) must be attached to this form. For more information on Customer Numbers, see the Manual of Patent Examining Procedure (MPEP) § 403.

For the following listed application(s), please recognize as the "Fee Address" under the provisions of 37 CFR 1.363 the address associated with:

☑ Customer Number: 00197

***OR***

☐ The attached Request for Customer Number (PTO/SB/125) form.

| PATENT NUMBER (if known) | APPLICATION NUMBER |
|---|---|
| | 14/067,249 |

Completed by (check one):

☐ Applicant/Inventor

☑ Attorney or Agent of record 60,564 (Reg. No.)

☐ Assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

☐ Assignee recorded at Reel _____ Frame _____

Signature

Juan Juan
Typed or printed name

(203) 925-9400
Requester's telephone number

12/30/2014
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more that one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.363. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1. 11 and 1.14. This collection is estimated to take 5 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313- 1450. DO NOT SEND COMPLETED FORMS TO THIS ADDRESS.
**SEND TO: Mail Stop M Correspondence, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**
*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 10/30/2013 | Claus H. Jorgensen | 891.0013.U4(US) | 7955 |

10948 7590 01/09/2015

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

| EXAMINER | |
|---|---|
| NGUYEN, TUAN DUC | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2656 | |

| NOTIFICATION DATE | DELIVERY MODE |
|---|---|
| 01/09/2015 | ELECTRONIC |

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@hspatent.com
Nokia.IPR@nokia.com



Amazon.com, Inc., Amazon.com Services LLC - Ex. 1011, Page 000664

| **Supplemental Notice of Allowability** | **Application No.** 14/067,249 | **Applicant(s)** JORGENSEN, CLAUS H. | |
|---|---|---|---|
| | **Examiner** TUAN D. NGUYEN | **Art Unit** 2656 | **AIA (First Inventor to File) Status** No |

***-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--***

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *12/29/2014*.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on_____.
2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.
3. ☒ The allowed claim(s) is/are *25-42 and renumbered as 1-18*. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov .
4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   **Certified copies:**

   a) ☐ All b) ☐ Some *c) ☐ None of the:
   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
**THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.**

5. ☐ CORRECTED DRAWINGS ( as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   **Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).**
6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

**Attachment(s)**

1. ☐ Notice of References Cited (PTO-892)
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 09/16/2014
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/TUAN D NGUYEN/
Primary Examiner, Art Unit 2656



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OPAP AKIMA-11
SEP 16 2014
PATENT & TRADEMARK OFFICE

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 14/067,249 Confirmation No.: 7955
Applicant(s): Jorgensen, Claus H.
Filed: October 30, 2013
Art Unit: 2656
Examiner: Nguyen, Tuan Duc
Title: Portable Electronic Device

Attorney Docket No.: 891.0013.U4(US)
Customer No.: 10,948

Commissioner For Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Information Disclosure Statement

(37 C.F.R. §1.97(b))

Sir:

The following information is being disclosed to the U.S. Patent and Trademark Office as information that may be material to the examination of the above-identified patent application.

An office action issued in regard to Chinese Patent Application No. 201210281567.1, which is a counterpart application to the present U.S. application. Enclosed is a copy of the office action (along with a translation of the office action). Applicant notes that the primary reference in the office action (US 2005/0282593) has been previously cited. Also enclosed is Form PTO-1449 which lists the art not previously cited in the present U.S. Application. Copies of

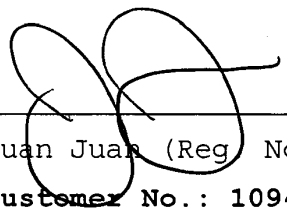


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any non-U.S. patent art is/are enclosed with the Form PTO-1449 for the Examiner's use.

The filing of this Statement is not to be construed as a representation that a search has been made regarding the claimed invention (37 C.F.R. §1.97(g)) or that no other possible material information exists. In addition, the filing of this Statement is not to be construed to be an admission that the information cited in the Statement is, or is considered to be, material to Patentability (37 C.F.R. §1.97(h)). Please charge any fee deficiency to deposit account 50-1924.

Respectfully submitted,



9/12/14

Juan Juan (Reg. No. 60,564) Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys At Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner For Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

9.12.2014
Date



Name of Person Making Deposit



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| INFORMATION DISCLOSURE CITATION FORM FOR PATENT APPLICATION (FORM PTO-1449) (Substitute) | Docket No. 891.0013.U4(US) | Serial No.: 14/067,249 |
|---|---|---|
| | Applicant(s): Claus H. Jorgensen | |
| | Filing Date: October 30, 2013 | Group: 2656 |

**U.S. PATENT DOCUMENTS**

| Examiner Initials | Document Number (Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name of Patentee or Applicant | Class | Sub-class |
|---|---|---|---|---|---|
| | | | | | |

OPAP AKUMA-11 SEP 16 2014 PATENT & TRADEMARK OFFICE

**FOREIGN PATENT DOCUMENTS**

| Examiner Initials | Document Number (Country Code-Number-Kind Code) | Publication Date (MM-DD-YYYY) | Name Of Patentee of Applicant | Translation? Yes/No/n/a |
|---|---|---|---|---|
| /T.N./ | CN2750587(Y) | 01/04/2006 | Konka Group Co. | Abstract |

**OTHER DOCUMENTS (Author (Capitalize), Title, Date, Pages, Etc., if known)**

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| Examiner's Signature: /Tuan Nguyen/ | Date Considered: 01/05/2015 |
|---|---|

Initial if reference was considered, whether or not citation is in conformance with MPEP. Mark through citation if not considered. Include a copy of this citation form with your next correspondence to the Applicant(s).

The PTO did not receive the following listed item(s) page 1 of 2

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | ISSUE DATE | PATENT NO. | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|---|---|---|---|---|
| 14/067,249 | 02/10/2015 | 8953780 | 891.0013.U4(US) | 7955 |

10948 7590 01/21/2015

Harrington & Smith, Attorneys At Law, LLC
4 Research Drive, Suite 202
Shelton, CT 06484

# ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

**Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)**
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Nokia Corporation, Espoo, FINLAND, Assignee (with 37 CFR 1.172 Interest);
Claus H. Jorgensen, Bronshoj, DENMARK;

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CFC

IN THE U.S. PATENT AND TRADEMARK OFFICE

In re U.S. Patent Application of:

APPLICANT: Jorgensen PATENT NO. 8,953,780 B2

SERIAL NO.: 14/067,249 ART UNIT: 2656

FILED: 10/30/2013 EXAMINER: Nguyen, Tuan Duc

TITLE: Portable Electronic Device

ATTORNEY DOCKET NO.: 891.0013.U4(US)

Customer No.: 10,948

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Attention: Certificate of Correction Branch

Request for Certificate of Correction
(Office Mistake)
35 U.S.C. §254 (37 C.F.R. §1.322)

Sir:

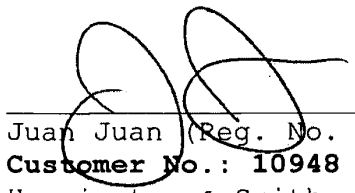
This is a request for a Certificate of Correction (MPEP 1480) in regard to the above-identified patent. Attached is a Form PTO-1050. The mistake(s), incurred through the fault of the Patent and Trademark Office, is clearly disclosed by the records of the Office as indicated by the following description:

In the claims:

Claim 15, col.7, line 10 "to" should be inserted in between "according" and "claim". Please refer to the application filed on October 30, 2013. Originally claim 39; renumbered upon issue as claim 15.

The Office is requested to issue a Certificate of Correction.

Respectfully submitted,



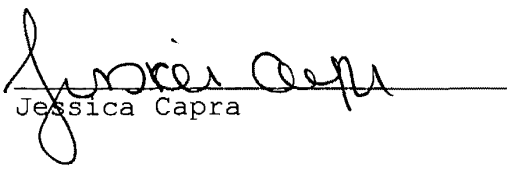
Juan Juan (Reg. No. 60,564) 3/13/15
Date

**Customer No.: 10948**
Harrington & Smith,
Attorneys at Law, LLC
4 Research Drive
Shelton, CT 06484-6212
203-925-9400

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail on the date shown below in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

3.13.205
Date



Jessica Capra



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PTO/SB/44 (09-07)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.
(Also Form PTO-1050)

# UNITED STATES PATENT AND TRADEMARK OFFICE
## CERTIFICATE OF CORRECTION



PATENT NO. : 8,953,780 B2

APPLICATION NO.: 14/067,249

ISSUE DATE : February 10, 2015

INVENTOR(S) : Jorgensen

It is certified that an error appears or errors appear in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Claim 15, col.7, line 10 "to" should be inserted in between "according" and "claim".

MAILING ADDRESS OF SENDER (Please do not use customer number below):

Harrington & Smith, Attorneys at Law, LLC
4 Research Drive
Shelton, CT 06484

This collection of information is required by 37 CFR 1.322, 1.323, and 1.324. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1.0 hour to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Attention Certificate of Corrections Branch, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

*If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.*

UNITED STATES PATENT AND TRADEMARK OFFICE

# CERTIFICATE OF CORRECTION



| | |
|---|---|
| PATENT NO. | : 8,953,780 B2 |
| APPLICATION NO. | : 14/067249 |
| DATED | : February 10, 2015 |
| INVENTOR(S) | : Jorgensen |

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the claims,

Claim 15, col. 7, line 10 --to-- should be inserted in between "according" and "claim".

Signed and Sealed this
Fifth Day of May, 2015

Michelle K. Lee

Michelle K. Lee
*Director of the United States Patent and Trademark Office*