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Sony Corporation

UNITED STATES DISTRICT COURT
CENTRAL DISTRICT OF CALIFORNIA

SONY CORPORATION, a Japanese
corporation,

Plaintiff,

v.

LG ELECTRONICS U.S.A., INC., a
Delaware corporation and LG
ELECTRONICS MOBILECOMM
U.S.A., INC., a California corporation,

Defendants.

Case No. CV10-09967 CAS (PJWx)

**FIRST AMENDED COMPLAINT
FOR PATENT INFRINGEMENT**

DEMAND FOR JURY TRIAL

1 Plaintiff Sony Corporation ("Sony") hereby amends its Complaint against
2 LG Electronics U.S.A., Inc. ("LGEUS"), and LG Electronics Mobilecomm U.S.A.,
3 Inc. ("LGEMU") (collectively "Defendants"), on personal knowledge as to its own
4 activities and on information and belief as to the activities of others, as follows:

5 **THE PARTIES**

6 1. Sony is a corporation organized and existing under the laws of Japan
7 with offices at 1-7-1 Konan, Minato-ku, Tokyo, 108-0075, Japan.

8 2. On information and belief, LGEUS is a corporation organized and
9 existing under the laws of Delaware with offices at 1000 Sylvan Avenue,
10 Englewood Cliffs, New Jersey 07632. Upon information and belief, LGEUS,
11 directly or indirectly through its wholly owned subsidiaries, imports into the United
12 States and distributes and sells and/or offers to sell throughout the United States,
13 including in the State of California, mobile telephone handsets. Such mobile
14 telephone handset products include, but are not limited to, Accolade (VX5600),
15 Cosmos (VN250), Encore (GT550), enV Touch (VX11000), Fathom (VS750),
16 Quantum (C900), Glance (VX7100), GU295, Lotus Elite (LX610), LX370, Neon
17 (GT365), Remarq (LN240), Rumor 2 (VM265), Rumor Touch (LN510), Vu Plus
18 (GR700), and Xenon (GR500).

19 3. On information and belief, LGEMU is a corporation organized and
20 existing under the laws of California with offices at 10101 Old Grove Road, San
21 Diego, California 92131. Upon information and belief, LGEMU is a wholly owned
22 subsidiary of LGEUS. Upon information and belief, LGEMU imports, markets,
23 distributes, and sells the LG mobile telephone handset products in the United
24 States, including in the State of California. Such mobile telephone handset
25 products include, but are not limited to, Accolade (VX5600), Cosmos (VN250),
26 Encore (GT550), enV Touch (VX11000), Fathom (VS750), Quantum (C900),
27 Glance (VX7100), GU295, Lotus Elite (LX610), LX370, Neon (GT365), Remarq
28 (LN240), Rumor 2 (VM265), Rumor Touch (LN510), Vu Plus (GR700), and

1 Xenon (GR500).

2 **JURISDICTION AND VENUE**

3 4. This is an action for patent infringement arising under the patent laws of
4 the United States, Title 35 of the United States Code. Accordingly, this Court has
5 subject matter jurisdiction pursuant to 28 U.S.C. §§ 1331 and 1338(a).

6 5. Personal jurisdiction is proper in this district pursuant to 28 U.S.C. §§
7 1391 and 1400 because, on information and belief, Defendants transact business in
8 this district, including the sale and offering for sale of their mobile telephone
9 handset products, and Defendants have sufficient contacts with this district to
10 subject themselves to the jurisdiction of this Court.

11 6. Venue is proper in this district pursuant to 28 U.S.C. §§ 1391(b), (c), and
12 (d), and 1400(b).

13 **CAUSES OF ACTION**

14 **COUNT I**

15 **Infringement of U.S. Patent No. 6,222,921**

16 7. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
17 this Complaint as if fully set forth herein.

18 8. United States Patent No. 6,222,921, entitled "Method and apparatus for
19 displaying an electronic phonebook" (the "'921 patent"), was duly and legally
20 issued on April 24, 2001 naming Katzuto Mugura, Bryan Lew Fong, and Chris Shi-
21 Chai Liu as inventors. A true and correct copy of the '921 patent is attached hereto
22 as Exhibit A.

23 9. Sony owns by assignment the entire right, title, and interest in and to the
24 '921 patent, including the right to sue for past, present, and future infringements
25 thereof.

26 10. Sony has provided and Defendants have received actual notice of the
27 '921 patent.

28 11. Defendants have and are directly infringing, and/or intentionally

1 inducing others to infringe, for example, through the instructions they provide to
2 their users who directly infringe, and/or committing acts of contributory
3 infringement of one or more claims of the '921 patent in violation of 35 U.S.C. §
4 271, *et seq.* Defendants have and are committing acts of infringement by making,
5 using, selling, and/or offering to sell products within the United States, and/or
6 importing products into the United States, including, but not limited to, the
7 following LG products: Lotus Elite (LX610), LX370, Neon (GT365), Remarq
8 (LN240), Rumor 2 (VM265), and Xenon (GR500).

9 12. Defendants' activities have been without express, or implied, license by
10 Sony.

11 13. Defendants will continue to infringe the '921 patent unless enjoined by
12 this Court. As a result of the infringing conduct of each Defendant, Sony has
13 suffered, and will continue to suffer, irreparable harm for which there is no
14 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
15 such infringement pursuant to 35 U.S.C. § 283.

16 14. As a result of the infringement of the '921 patent by each Defendant,
17 Sony has been damaged, and will be further damaged, and is entitled to be
18 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
19 presently cannot be ascertained, but that will be determined at trial.

20 15. Sony believes that each Defendant's past infringement and/or continuing
21 infringement has been deliberate and willful, and that this case is therefore an
22 exceptional case, which warrants an award of treble damages and attorneys' fees to
23 Sony in accordance with 35 U.S.C. § 285.

24 COUNT II

25 Infringement of U.S. Patent No. 7,580,006

26 16. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
27 this Complaint as if fully set forth herein.

28 17. United States Patent No. 7,580,006, entitled "Portable telephone" (the

1 “’006 patent”), was duly and legally issued on August 25, 2009 naming Ryosuke
2 Takeuchi as inventor. A true and correct copy of the ’006 patent is attached hereto
3 as Exhibit B.

4 18. Sony owns by assignment the entire right, title, and interest in and to the
5 ’006 patent, including the right to sue for past, present, and future infringements
6 thereof.

7 19. Sony has provided and Defendants have received actual notice of the
8 ’006 patent.

9 20. Defendants have and are directly infringing, and/or intentionally
10 inducing others to infringe, for example, through the instructions they provide to
11 their users who directly infringe, and/or committing acts of contributory
12 infringement of one or more claims of the ’006 patent in violation of 35 U.S.C. §
13 271, *et seq.* Defendants have and are committing acts of infringement by making,
14 using, selling, and/or offering to sell products within the United States, and/or
15 importing products into the United States, including, but not limited to, the
16 following LG products: Accolade (VX5600), Cosmos (VN250), Encore (GT550),
17 enV Touch (VX11000), Fathom (VS750), Glance (VX7100), GU295, Lotus Elite
18 (LX610), LX370, Neon (GT365), Remarq (LN240), Rumor 2 (VM265), Rumor
19 Touch (LN510), Vu Plus (GR700) and Xenon (GR500).

20 21. Defendants’ activities have been without express, or implied, license by
21 Sony.

22 22. Defendants will continue to infringe the ’006 patent unless enjoined by
23 this Court. As a result of the infringing conduct of each Defendant, Sony has
24 suffered, and will continue to suffer, irreparable harm for which there is no
25 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
26 such infringement pursuant to 35 U.S.C. § 283.

27 23. As a result of the infringement of the ’006 patent by each Defendant,
28 Sony has been damaged, and will be further damaged, and is entitled to be

1 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
2 presently cannot be ascertained, but that will be determined at trial.

3 24. Sony believes that each Defendant's past infringement and/or continuing
4 infringement has been deliberate and willful, and that this case is therefore an
5 exceptional case, which warrants an award of treble damages and attorneys' fees to
6 Sony in accordance with 35 U.S.C. § 285.

7 **COUNT III**

8 **Infringement of U.S. Patent No. RE40,568**

9 25. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
10 this Complaint as if fully set forth herein.

11 26. United States Patent No. RE40,568 entitled "Synchronization symbol
12 structure using OFDM based transmission method" (the "'568 patent"), was duly
13 and legally issued on November 11, 2008 naming Ralf Böhnke, Thomas Dölle, and
14 Tino Puch as inventors. A true and correct copy of the '568 patent is attached
15 hereto as Exhibit C.

16 27. Sony owns by assignment the entire right, title, and interest in and to the
17 '568 patent, including the right to sue for past, present, and future infringements
18 thereof.

19 28. Sony has provided and Defendants have received actual notice of the
20 '568 patent.

21 29. Defendants have and are directly infringing, and/or intentionally
22 inducing others to infringe, for example, through the instructions they provide to
23 their users who directly infringe, and/or committing acts of contributory
24 infringement of one or more claims of the '568 patent in violation of 35 U.S.C. §
25 271, *et seq.* Defendants have and are committing acts of infringement by making,
26 using, selling, and/or offering to sell products within the United States, and/or
27 importing products into the United States, including, but not limited to, the
28 following LG products: Fathom (VS750), and Quantum (C900).

1 30. Defendants' activities have been without express, or implied, license by
2 Sony.

3 31. Defendants will continue to infringe the '568 patent unless enjoined by
4 this Court. As a result of the infringing conduct of each Defendant, Sony has
5 suffered, and will continue to suffer, irreparable harm for which there is no
6 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
7 such infringement pursuant to 35 U.S.C. § 283.

8 32. As a result of the infringement of the '568 patent by each Defendant,
9 Sony has been damaged, and will be further damaged, and is entitled to be
10 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
11 presently cannot be ascertained, but that will be determined at trial.

12 33. Sony believes that each Defendant's past infringement and/or continuing
13 infringement has been deliberate and willful, and that this case is therefore an
14 exceptional case, which warrants an award of treble damages and attorneys' fees to
15 Sony in accordance with 35 U.S.C. § 285.

16 **COUNT IV**

17 **Infringement of U.S. Patent No. 7,120,137**

18 34. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
19 this Complaint as if fully set forth herein.

20 35. United States Patent No. 7,120,137 entitled "Method and apparatus for
21 assigning codes" (the "'137 patent"), was duly and legally issued on October 10,
22 2006 naming Keijiro Take as inventor. A true and correct copy of the '137 patent is
23 attached hereto as Exhibit D.

24 36. Sony owns by assignment the entire right, title, and interest in and to the
25 '137 patent, including the right to sue for past, present, and future infringements
26 thereof.

27 37. Sony has provided and Defendants have received actual notice of the
28 '137 patent.

1 38. Defendants have and are directly infringing, and/or intentionally
2 inducing others to infringe, for example, through the instructions they provide to
3 their users who directly infringe, and/or committing acts of contributory
4 infringement of one or more claims of the '137 patent in violation of 35 U.S.C. §
5 271, *et seq.* Defendants have and are committing acts of infringement by making,
6 using, selling, and/or offering to sell products within the United States, and/or
7 importing products into the United States, including, but not limited to, the
8 following LG products: Encore (GT550), Fathom (VS750), GU295, Vu Plus
9 (GR700), and Xenon (GR500).

10 39. Defendants' activities have been without express, or implied, license by
11 Sony.

12 40. Defendants will continue to infringe the '137 patent unless enjoined by
13 this Court. As a result of the infringing conduct of each Defendant, Sony has
14 suffered, and will continue to suffer, irreparable harm for which there is no
15 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
16 such infringement pursuant to 35 U.S.C. § 283.

17 41. As a result of the infringement of the '137 patent by each Defendant,
18 Sony has been damaged, and will be further damaged, and is entitled to be
19 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
20 presently cannot be ascertained, but that will be determined at trial.

21 42. Sony believes that each Defendant's past infringement and/or continuing
22 infringement has been deliberate and willful, and that this case is therefore an
23 exceptional case, which warrants an award of treble damages and attorneys' fees to
24 Sony in accordance with 35 U.S.C. § 285.

25 COUNT V

26 Infringement of U.S. Patent No. 6,829,489

27 43. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
28 this Complaint as if fully set forth herein.

1 44. United States Patent No. 6,829,489, entitled "Communication system,
2 transmitter, receiver, and communication method" (the "'489 patent"), was duly
3 and legally issued on December 7, 2004 naming Kazushi Yamamoto, Hideshi
4 Murai, and Yasuhiro Yano as inventors. A true and correct copy of the '489 patent
5 is attached hereto as Exhibit E.

6 45. Sony owns by assignment the entire right, title, and interest in and to the
7 '489 patent, including the right to sue for past, present, and future infringements
8 thereof.

9 46. Sony has provided and Defendants have received actual notice of the
10 '489 patent.

11 47. Defendants have and are directly infringing, and/or intentionally
12 inducing others to infringe, for example, through the instructions they provide to
13 their users who directly infringe, and/or committing acts of contributory
14 infringement of one or more claims of the '489 patent in violation of 35 U.S.C. §
15 271, *et seq.* Defendants have and are committing acts of infringement by making,
16 using, selling, and/or offering to sell products within the United States, and/or
17 importing products into the United States, including, but not limited to, the
18 following LG products: Encore (GT550), Fathom (VS750), GU295, Vu Plus
19 (GR700), and Xenon (GR500).

20 48. Defendants' activities have been without express, or implied, license by
21 Sony.

22 49. Defendants will continue to infringe the '489 patent unless enjoined by
23 this Court. As a result of the infringing conduct of each Defendant, Sony has
24 suffered, and will continue to suffer, irreparable harm for which there is no
25 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
26 such infringement pursuant to 35 U.S.C. § 283.

27 50. As a result of the infringement of the '489 patent by each Defendant,
28 Sony has been damaged, and will be further damaged, and is entitled to be

1 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
2 presently cannot be ascertained, but that will be determined at trial.

3 51. Sony believes that each Defendant's past infringement and/or continuing
4 infringement has been deliberate and willful, and that this case is therefore an
5 exceptional case, which warrants an award of treble damages and attorneys' fees to
6 Sony in accordance with 35 U.S.C. § 285.

7 **COUNT VI**

8 **Infringement of U.S. Patent No. 7,242,769**

9 52. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
10 this Complaint as if fully set forth herein.

11 53. United States Patent No. 7,242,769, entitled "Enciphering apparatus and
12 method, deciphering apparatus and method as well as information processing
13 apparatus and method" (the "'769 patent"), was duly and legally issued on July 10,
14 2007 naming Ryuji Ishiguro, Yoshitomo Osawa, Yoshio Osakabe, Makoto Sato,
15 Hisato Shima, and Tomoyuki Asano as inventors. A true and correct copy of the
16 '769 patent is attached hereto as Exhibit F.

17 54. Sony owns by assignment the entire right, title, and interest in and to the
18 '769 patent, including the right to sue for past, present, and future infringements
19 thereof.

20 55. Sony has provided and Defendants have received actual notice of the
21 '769 patent.

22 56. Defendants have and are directly infringing, and/or intentionally
23 inducing others to infringe, for example, through the instructions they provide to
24 their users who directly infringe, and/or committing acts of contributory
25 infringement of one or more claims of the '769 patent in violation of 35 U.S.C. §
26 271, *et seq.* Defendants have and are committing acts of infringement by making,
27 using, selling, and/or offering to sell products within the United States, and/or
28 importing products into the United States, including, but not limited to, the

1 following LG products: Encore (GT550), GU295, Vu Plus (GR700), and Xenon
2 (GR500).

3 57. Defendants' activities have been without express, or implied, license by
4 Sony.

5 58. Defendants will continue to infringe the '769 patent unless enjoined by
6 this Court. As a result of the infringing conduct of each Defendant, Sony has
7 suffered, and will continue to suffer, irreparable harm for which there is no
8 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
9 such infringement pursuant to 35 U.S.C. § 283.

10 59. As a result of the infringement of the '769 patent by each Defendant,
11 Sony has been damaged, and will be further damaged, and is entitled to be
12 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
13 presently cannot be ascertained, but that will be determined at trial.

14 60. Sony believes that each Defendant's past infringement and/or continuing
15 infringement has been deliberate and willful, and that this case is therefore an
16 exceptional case, which warrants an award of treble damages and attorneys' fees to
17 Sony in accordance with 35 U.S.C. § 285.

18 COUNT VII

19 Infringement of U.S. Patent No. 6,510,208

20 61. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of
21 this Complaint as if fully set forth herein.

22 62. United States Patent No. 6,510,208, entitled "Telephone apparatus with
23 audio recording function and audio recording method telephone apparatus with
24 audio recording function" (the "'208 patent"), was duly and legally issued on
25 January 21, 2003 naming Kozo Komiya as inventor. A true and correct copy of the
26 '208 patent is attached hereto as Exhibit G.

27 63. Sony owns by assignment the entire right, title, and interest in and to the
28 '208 patent, including the right to sue for past, present, and future infringements

1 thereof.

2 64. Sony has provided and Defendants have received actual notice of the
3 '208 patent.

4 65. Defendants have and are directly infringing, and/or intentionally
5 inducing others to infringe, for example, through the instructions they provide to
6 their users who directly infringe, and/or committing acts of contributory
7 infringement of one or more claims of the '208 patent in violation of 35 U.S.C. §
8 271, *et seq.* Defendants have and are committing acts of infringement by making,
9 using, selling, and/or offering to sell products within the United States, and/or
10 importing products into the United States, including, but not limited to, the
11 following LG products: Glance (VX7100), Accolade (VX5600), Cosmos (VN250),
12 enV Touch (VX11000), Lotus Elite (LX610), LX370, Remarq (LN240), and
13 Rumor Touch (LN510).

14 66. Defendants' activities have been without express, or implied, license by
15 Sony.

16 67. Defendants will continue to infringe the '208 patent unless enjoined by
17 this Court. As a result of the infringing conduct of each Defendant, Sony has
18 suffered, and will continue to suffer, irreparable harm for which there is no
19 adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against
20 such infringement pursuant to 35 U.S.C. § 283.

21 68. As a result of the infringement of the '208 patent by each Defendant,
22 Sony has been damaged, and will be further damaged, and is entitled to be
23 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
24 presently cannot be ascertained, but that will be determined at trial.

25 69. Sony believes that each Defendant's past infringement and/or continuing
26 infringement has been deliberate and willful, and that this case is therefore an
27 exceptional case, which warrants an award of treble damages and attorneys' fees to
28 Sony in accordance with 35 U.S.C. § 285.

COUNT VIII

Infringement of U.S. Patent No. 6,374,121

70. Sony repeats and re-alleges the allegations of paragraphs 1 through 6 of this Complaint as if fully set forth herein.

71. United States Patent No. 6,374,121, entitled "System and method for enabling automatic performance of instrument functions" (the "'121 patent"), was duly and legally issued on April 16, 2002 naming Kazuto Mugura, Eduardo Sciammarella, and Scott Kravitz as inventors. A true and correct copy of the '121 patent is attached hereto as Exhibit H.

72. Sony owns by assignment the entire right, title, and interest in and to the '121 patent, including the right to sue for past, present, and future infringements thereof.

73. Defendants have and are directly infringing, and/or are intentionally inducing others to infringe, for example, through the instructions they provide to their users who directly infringe, and/or are committing acts of contributory infringement of one or more claims of the '121 patent in violation of 35 U.S.C. § 271, *et seq.* Defendants have and are committing acts of infringement by making, using, selling, and/or offering to sell products within the United States, and/or importing products into the United States, including, but not limited to, the following LG products: Xenon (GR500) and Quantum (C900).

74. Defendants' activities have been without express, or implied, license by Sony.

75. Defendants will continue to infringe the '121 patent unless enjoined by this Court. As a result of the infringing conduct of each Defendant, Sony has suffered, and will continue to suffer, irreparable harm for which there is no adequate remedy at law. Accordingly, Sony is entitled to injunctive relief against such infringement pursuant to 35 U.S.C. § 283.

76. As a result of the infringement of the '121 patent by each Defendant,

1 Sony has been damaged, and will be further damaged, and is entitled to be
2 compensated for such damages pursuant to 35 U.S.C. § 284 in an amount that
3 presently cannot be ascertained, but that will be determined at trial.

4 **PRAYER FOR RELIEF**

5 WHEREFORE, Sony respectfully requests that the Court enter judgment:

6 (a) That each Defendant has infringed the '921 patent, '006 patent, '568
7 patent, '137 patent, '489 patent, '769 patent, '208 patent, and '121 patent under 35
8 U.S.C. §§ 271 *et seq.*;

9 (b) That injunctions be issued by this Court restraining each Defendant,
10 their respective officers, agents, servants, directors, and employees, and all persons
11 in active concert or participation with each, from directly or indirectly infringing, or
12 inducing or contributing to the infringement by others of the '921 patent, '006
13 patent, '568 patent, '137 patent, '489 patent, '769 patent, '208 patent, and '121
14 patent;

15 (c) That each Defendant be required to provide to Sony an accounting of
16 all gains, profits, and advantages derived by each Defendant's infringement of the
17 '921 patent, '006 patent, '568 patent, '137 patent, '489 patent, '769 patent, '208
18 patent, and '121 patent, and that Sony be awarded damages adequate to compensate
19 Sony for the wrongful infringing acts by each Defendant, in accordance with 35
20 U.S.C. § 284;

21 (d) That the damages awarded to Sony with regard to the '921 patent, '006
22 patent, '568 patent, '137 patent, '489 patent, '769 patent, and '208 patent be
23 increased up to three times, in view of Defendants' willful infringement, in
24 accordance with 35 U.S.C. § 284;

25 (e) That this case be declared to be exceptional in favor of Sony under 35
26 U.S.C. § 285, and that Sony be awarded its reasonable attorneys' fees and other
27 expenses incurred in connection with this action;

28 (f) That Sony be awarded its interest and costs of suit incurred in this

1 action; and

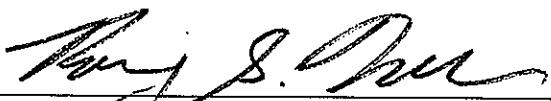
2 (g) That Sony be awarded such other and further relief as this Court deems
3 just and proper.
4

5
6 DATED: January 3, 2011

Respectfully submitted,

7 QUINN EMANUEL URQUHART &
8 SULLIVAN, LLP
9

10
11 By



Steven M. Anderson

12 Rory S. Miller

13 Attorneys for Plaintiff Sony Corporation

14 *Of Counsel:*

15 John Flock

16 Marcia H. Sundeen

Jeffrey S. Gerchick

Paul T. Qualey
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DEMAND FOR JURY TRIAL

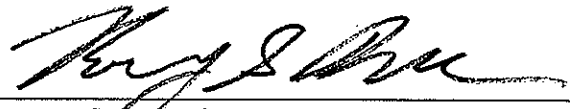
Pursuant to Rule 38 of the Federal Rules of Civil Procedure, Plaintiff hereby demands a trial by jury as to all issues so triable.

DATED: January 3, 2011

Respectfully submitted,

QUINN EMANUEL URQUHART &
SULLIVAN, LLP

By



Steven M. Anderson

Rory S. Miller

Attorneys for Plaintiff Sony Corporation

Of Counsel:

John Flock
Marcia H. Sundeen
Jeffrey S. Gerchick
Paul T. Qualey

EXHIBIT A



US006222921B1

(12) **United States Patent**
Mugura et al.

(10) Patent No.: **US 6,222,921 B1**
(45) Date of Patent: **Apr. 24, 2001**

(54) **METHOD AND APPARATUS FOR
DISPLAYING AN ELECTRONIC
PHONEBOOK**

(75) Inventors: **Katzuto Mugura, Kawasaki (JP);
Bryan Lew Fong, San Diego; Chris
Shi-Chai Liu, San Jose, both of CA
(US)**

(73) Assignees: **Sony Corporation, Tokyo (JP); Sony
Electronics Inc., Park Ridge, NJ (US)**

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/133,070**

(22) Filed: **Aug. 12, 1998**

(51) Int. Cl.⁷ **H04M 1/00**

(52) U.S. Cl. **379/354; 379/355; 379/356;
379/216**

(58) Field of Search **379/354, 355,
379/356, 216, 201, 202**

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,908,853 3/1990 Matsumoto 379/355

5,303,288 4/1994 Duffy et al. 379/59
5,349,629 9/1994 Kumano 379/58
5,371,788 12/1994 Baals et al. 379/396
5,483,591 1/1996 Koma 379/356
5,592,546 1/1997 Takahashi 379/355
5,724,410 3/1998 Parvulescu et al. 379/88
5,901,217 5/1999 Kanbar 379/355
6,041,325 * 3/2000 Shah et al. 707/10
6,047,054 * 4/2000 Bayless et al. 379/202

* cited by examiner

Primary Examiner—David Hudspeth

Assistant Examiner—Susan Wieland

(74) *Attorney, Agent, or Firm*—Crosby, Heafey, Roach &
May

(57) **ABSTRACT**

An apparatus and method for displaying a telephone direc-
tory. A main menu is used to display the names of a
telephone directory, and each of the names is associated with
a primary number. A sub menu is used to display the
numbers associated with each of the names in the main
menu. The primary number is denoted and automatically
selected in the second menu.

47 Claims, 5 Drawing Sheets

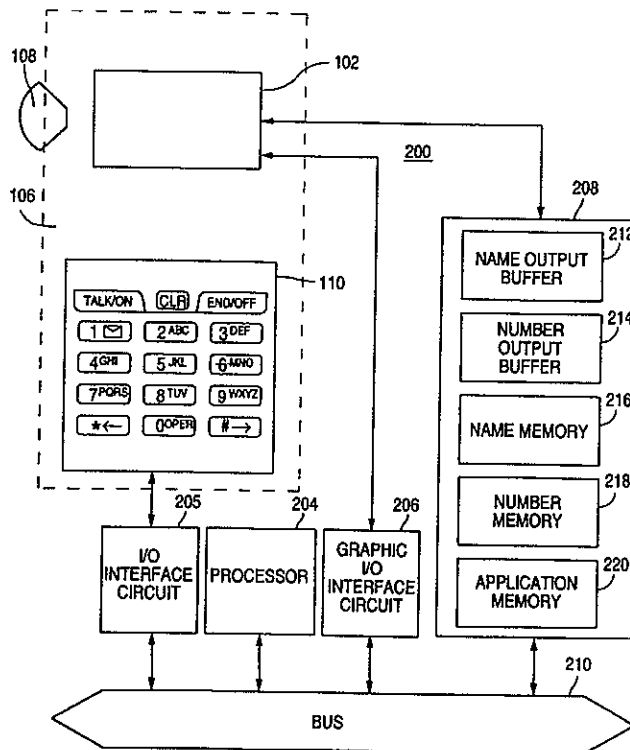


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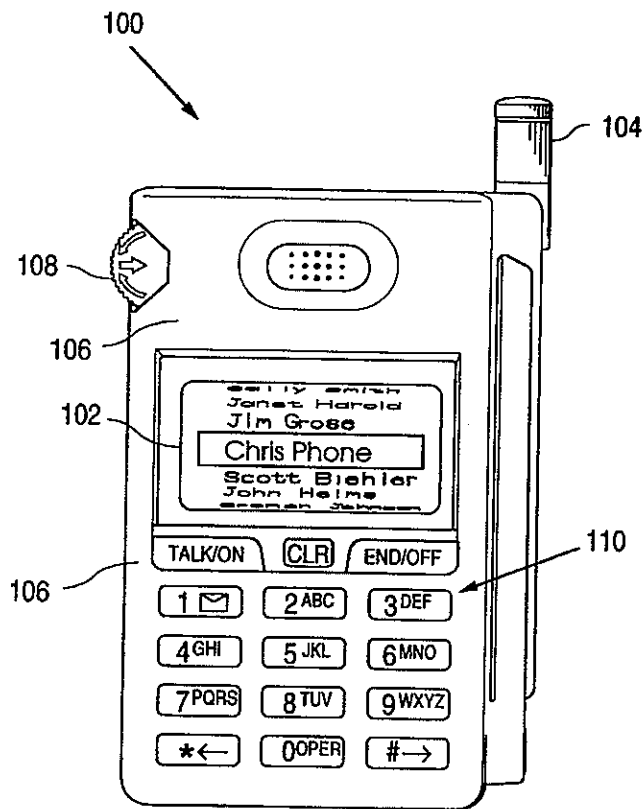


FIG. 1A

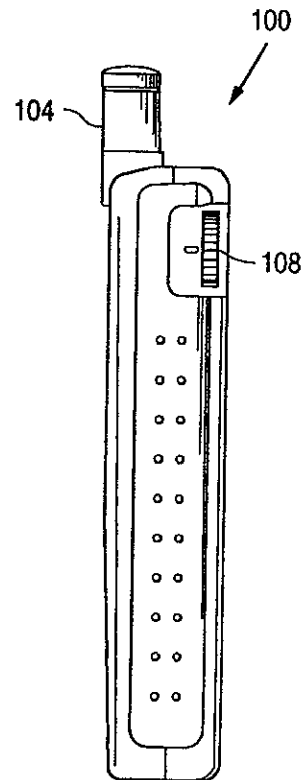


FIG. 1B

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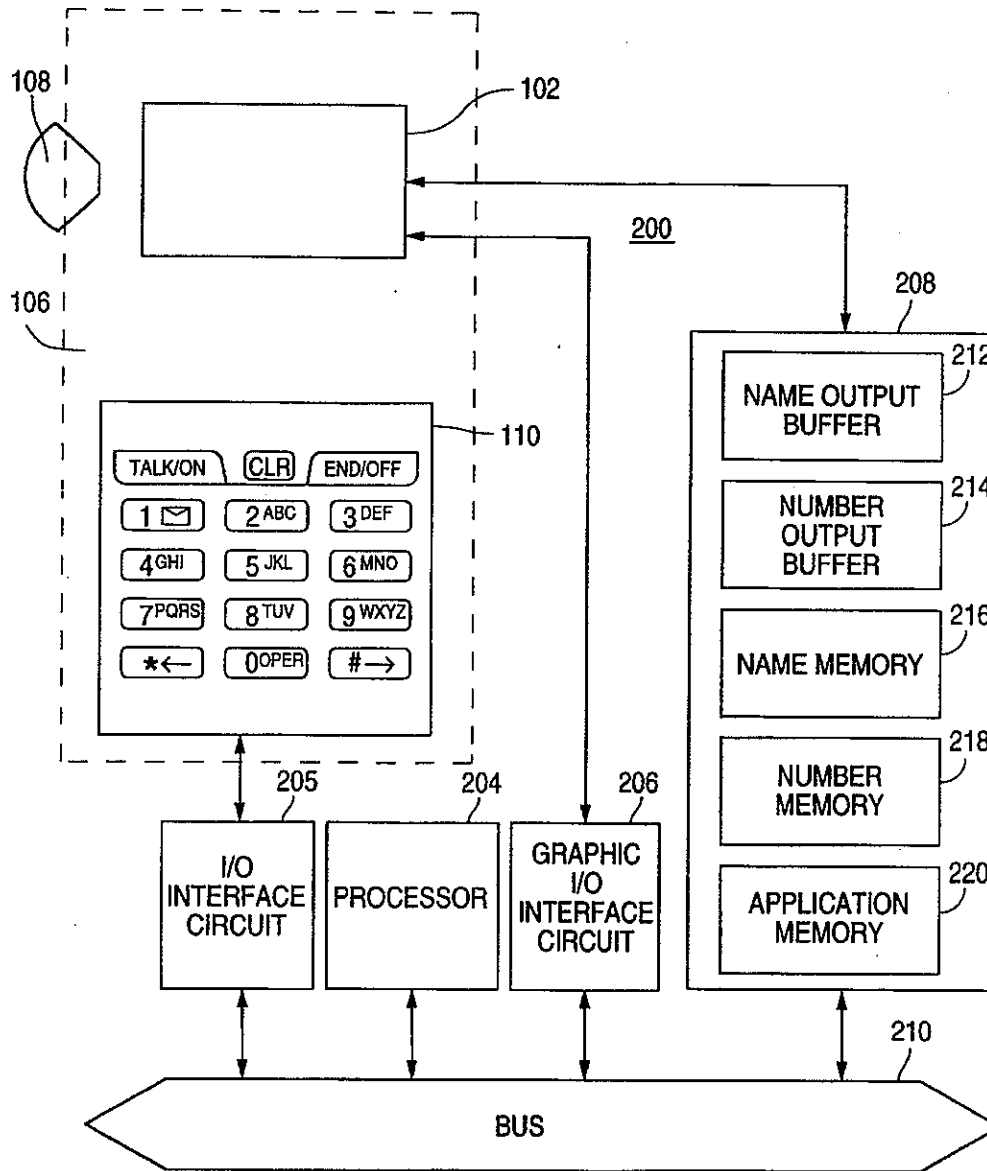


FIG. 2

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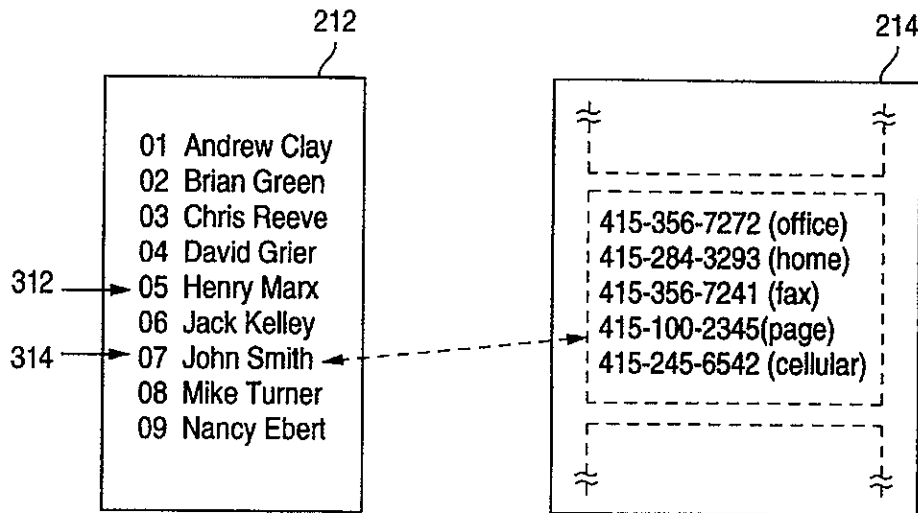


FIG. 3

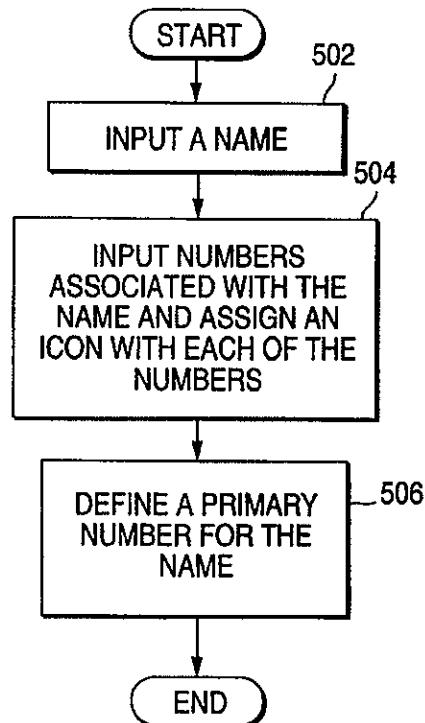


FIG. 5

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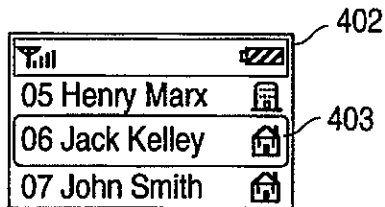


FIG. 4A

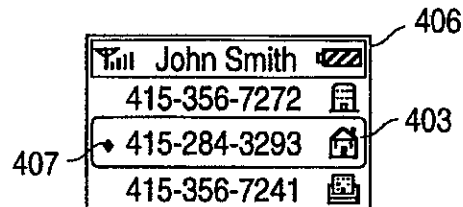


FIG. 4C

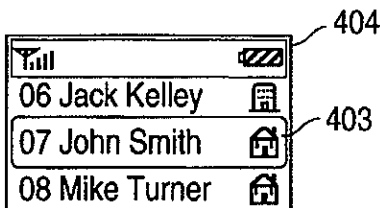


FIG. 4B

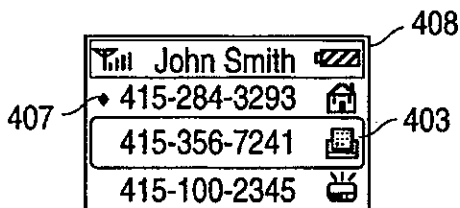


FIG. 4D

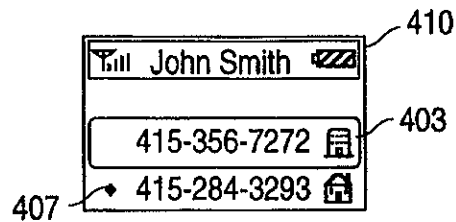


FIG. 4E

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FIG. 6

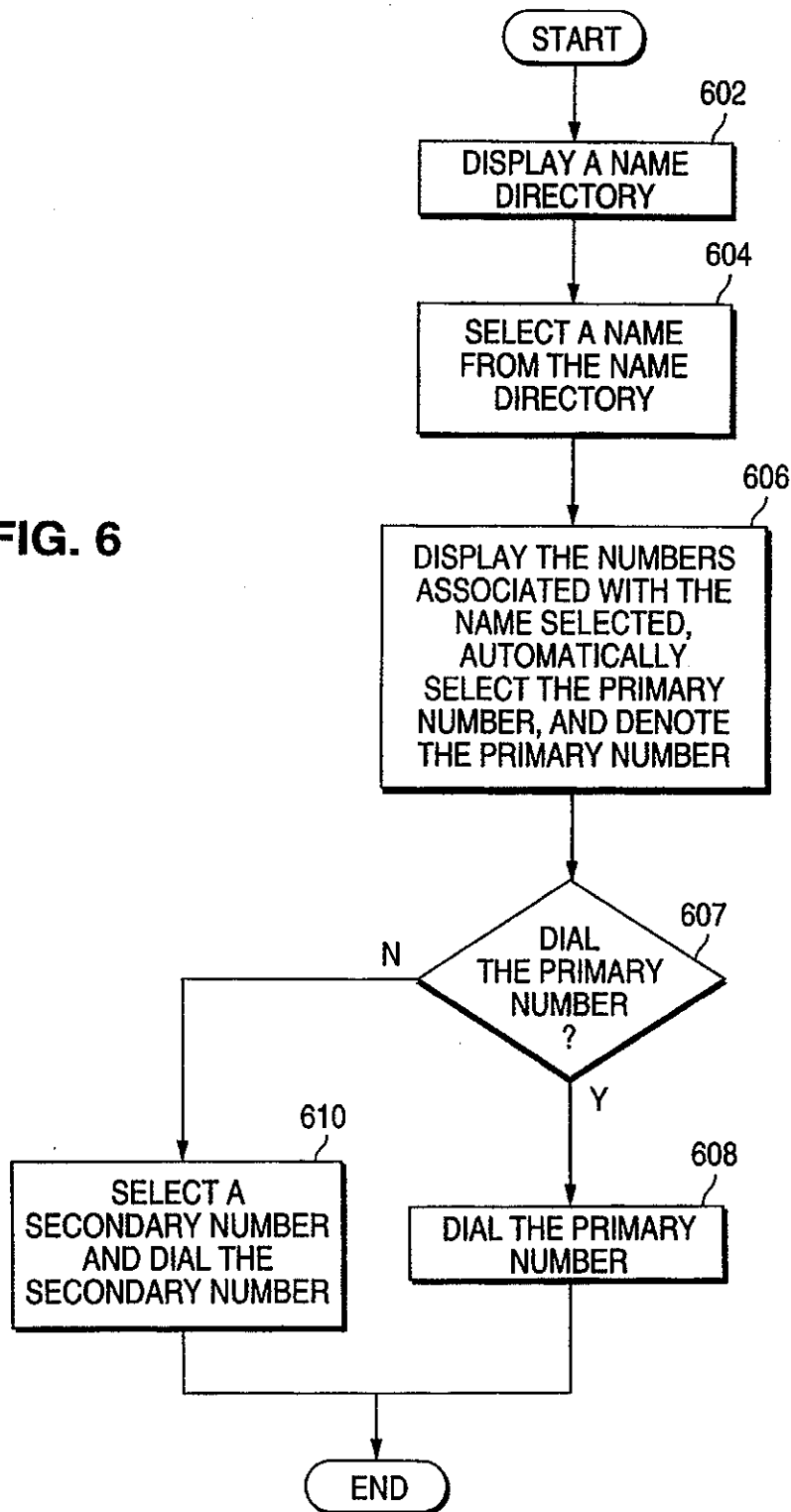


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METHOD AND APPARATUS FOR DISPLAYING AN ELECTRONIC PHONEBOOK

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to displaying a name directory on a screen, and, more specifically, to displaying a name directory containing a plurality of directory names with each of them being associated with a plurality of numbers.

2. Related Art

A state of art telephone has the capability of storing a telephone directory containing a plurality of names, and displaying these names on the display screen of the telephone. Frequently, a name in a telephone directory may contain several numbers (including a home number, an office number, a fax number, a page number, and a cellular number, for example). Using control buttons on the control panel of a telephone, a user can select a number from a telephone directory to dial the selected number.

Conventionally, a typical available telephone displays all names and the associated numbers of a telephone directory together on a display screen. Such an approach makes it difficult for a user to locate a number of interest from the display screen, because the user may see several numbers under an identical name. Furthermore, when a telephone directory is displayed on a relatively small region, such as an LCD screen on a cellular telephone, it is even more difficult for a user to locate a particular number of interest.

There is, therefore, a need for a method and apparatus to display a plurality of names, which facilitates a user to select a specific number from the multiple numbers associated with the names.

There is another need for a method and apparatus to display a plurality of names on a relatively small display region, which facilitates a user to select a specific number from the multiple numbers associated with the names.

The present invention provides a method to meet these two needs.

SUMMARY OF THE INVENTION

The present invention provides a novel method and a corresponding apparatus to display a telephone directory.

To address the shortcomings of the available art, the present invention provides a novel method for displaying a telephone directory. The method comprises the steps of: on a first display screen, displaying a plurality of names, each of the names being associated with a primary number; from the first display screen, selecting one of the names; on a second display screen, displaying a primary number associated with the selected name and at least one secondary number; and on the second display screen, automatically selecting the primary number.

The present invention also provides an apparatus capable of performing the steps in the method described above.

The foregoing and other features and advantages of the invention will be more readily understood upon consideration of the following detailed description of certain preferred embodiments of the invention, taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is the front view of a cellular telephone, which can be used to implement the present invention;

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FIG. 1B is the side view of the cellular telephone shown in FIG. 1A;

FIG. 2 is a block diagram illustrating some components of the cellular telephone shown in FIG. 1A;

FIG. 3 shows the steps illustrating a sequence of displays on a display region, in accordance with one embodiment of the present invention;

FIGS. 4A-E show the steps illustrating a sequence of displays on a display region, in accordance with another embodiment of the present invention;

FIG. 5 shows a flowchart illustrating the steps of entering a name and the numbers that are associated with the name into the cellular telephone, in accordance with the present invention; and

FIG. 6 shows a flowchart illustrating the steps of displaying the numbers that are associated with a name in a name directory, in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1A, there is shown the front view of a cellular telephone 100, which can be used to implement the present invention.

As shown in FIG. 1A, the cellular telephone 100 includes a display screen 102, an antenna 104, and a control panel 106. The control panel 106 includes a jog dial wheel 108 and a key panel 110 including twelve alpha/numeric keys (1, 2, 3, 4, 5, 6, 7, 8, 9, *, 0, and #). The jog dial wheel 108 can be moved in three directions (turn-up, turn-down, and press-in) as indicated by the three arrows. The menu items displayed on the display screen 102 can be scrolled up and down by turning the jog dial wheel 108 up and down, respectively. And a selected menu item displayed on the display screen 102 can be activated by pressing in the jog dial wheel 102.

Referring to FIG. 1B, there is shown the side view of the cellular telephone 100 to illustrate the side view of the jog dial wheel 108.

Referring to FIG. 2, there is shown a block diagram 200, illustrating some components of the cellular telephone 100 shown in FIG. 1A, in accordance with the present invention.

As shown in FIG. 2, the block diagram 200 includes a processor 204, an I/O (input and output) interface circuit 205, a graphic I/O interface circuit 206, a memory 208, and a bus 210.

The processor 204, the I/O interface circuit 205, the graphic I/O interface circuit 206, and the memory 208 are all coupled to the bus 210.

The memory 208 includes: (1) a name output buffer 212 for storing directory names to be displayed, (2) a number output buffer 214 for storing the numbers to be displayed, (3) a name memory 216 for storing the directory names, (4) a number memory 218 for storing the numbers associated with the directory names, and (5) an application memory 220 for storing an application that includes a data entry routine, a display routine, and a dialing routine.

The processor 204 controls the operations of the I/O interface circuit 205, the graphic I/O interface circuit 206, the memory 208, and the display region 102. More specifically, the processor 204 is able to: (1) get access to the data stored in the name output buffer 212, the number output buffer 214, the name memory 216, and the number memory 218, (2) execute the application stored in the application memory 220, (3) interact with the control panel 106 via the I/O interface circuit 205, and (4) display the data stored in

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the output buffers 212 and 214 on the display region 102 via the graphic I/O interface circuit 206. All these operations are performed in a conventional manner, except as otherwise described herein.

Since to the cellular system 100, the display screen 102 is an output mechanism, the name output buffer 212 and the number output buffer 214 are especially set to store the data to be displayed on the display screen 102.

Using the jog dial wheel 108, a user can invoke the data entry routine (stored in the application memory 20). And using the nine alpha/numeric keys on the key panel 110, a user can input names to the name memory 216 and numbers to the number memory 218. The names and numbers can then be loaded from the name memory 216 and the number memory 218 to the name output buffer 212 and the number output buffer 214, respectively. A name may associate with several numbers. Among the several numbers, the user can define a primary number for the name.

Referring to FIG. 3, there is shown a name directory stored in the name output buffer 212 and the number output buffer 214, in accordance with the present invention.

As shown in FIG. 3, the name output buffer 212 stores nine names. The number output buffer 214 stores the numbers associated with each of the nine names stored in the name output buffer 212. In particular, FIG. 3 shows that the number output buffer 214 stores five numbers that are associated with the seventh name (07 John Smith) stored in the name output buffer 212.

Since the display screen 102 has a relatively small area, not all the data items stored in the name output buffer 212 or the number output buffer 214 can be displayed on the display screen 102 at a certain point of time. Hence, a start pointer and an end pointer are set to mark an active section in the name output buffer 212 (or in the number output buffer 214). Even though all the data items stored in the name output buffer 212 (or in the number output buffer 214) are linked with the display screen 102, only the data items contained in the active section are being displayed on the display screen at a certain point of time. In the embodiment shown in FIG. 3, for the name output buffer 212, a start pointer 312 points to the fifth name (05 Henry Marx), and an end pointer 314 points to the seventh name (07 John Smith). Hence, the active region of the name output buffer 212 contains three names (05 Henry Marx, 06 Jack Kelley, and 07 John Smith). When the start and end pointers 312 and 314 are moved down or up by turning up or down the jog dial wheel 108, the active section of the name output buffer 212 is also being moved up or down, causing the names stored in the name output buffer 212 to scroll up or down on the displaying screen 102 accordingly.

Referring to FIGS. 4A-E, there are shown the screen displays on display screen 102, in accordance with the present invention.

FIG. 4A shows a screen display 402 on the display screen on 102, corresponding to the active region marked by the start pointer 312 and the end pointer 314 shown in FIG. 3. As shown in FIG. 4A, the screen display 402 includes three names (05 Henry Marx, 06 Jack Kelley, and 07 John Smith). An icon is displayed beside each of the names, denoting a primary number for a respective name. Specifically, the building icon beside "05 Henry Marx" denotes that the office number is the primary number for Henry Marx. The house icons beside "06 Jack Kelley" and "07 John Smith" denote that the home numbers are the primary numbers for Jack Kelley and John Smith. The rectangle in the middle of the display screen 102 indicates a selecting region 403, meaning

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that the name displayed in the selecting region 403 is currently selected. In FIG. 4A, the screen display 402 indicates that "06 Jack Kelley" is selected.

FIG. 4B shows a screen display 404 time sequentially to the screen display 402 of FIG. 4A. To select the name "07 John Smith", a user turns up the jog dial wheel 108 while the screen display 402 is being displayed on display screen 102. In response, the control panel 106 sends a request to the processor 204 via the I/O interface circuit 205. In response to the request, the processor 204 executes the display routine (stored in the application memory 220) to move the start pointer 312 from "05 Henry Marx" to "06 Jack Kelley", and the end pointer 314 from "07 John Smith" to "08 Mike Turner". Consequently, the name entry "05 Henry Marx" is moved out and the name entry "08 Mike Turner" is moved into the active section of the name output buffer 212. Via the graphic I/O interface circuit 206, the processor 204 then displays the names currently contained in the active section of the name output buffer 212, as shown in the display screen 404.

FIG. 4C shows a screen display 406 time sequentially to the screen display 404 of FIG. 4B. To retrieve the numbers associated with the name "07 John Smith", the user presses in the jog dial wheel 108 while the screen display 404 is being displayed on the display screen 102. In response, the control panel 106 sends a request to the processor 204 via the I/O interface circuit 205. In response to the request, the processor 204 executes the display routine (stored in the application memory 220) to retrieve the numbers associated with the name entry "07 John Smith" from number output memory 214. Since the home number of John Smith has been defined as a primary number, the processor 204 automatically displays the home telephone number (510-284-3292) in the selecting region 403 without requiring any interaction from the user. As shown in the screen display 406, a dot 407 denotes that the home telephone number is the primary number. To dial the primary number, the user simply presses in the jog dial wheel 108 on the control panel 106. In response, the processor 204 executes the dialing routine (stored in the application memory 220) to generate a dialing signal for the primary number.

FIG. 4D shows a screen display 408 time sequentially to the screen display 406 of FIG. 4C. To select the fax number "415-356-7241", a user turns up the jog dial wheel 108 while the screen display 406 is being displayed on display screen 102. In response, the control panel 106 sends a request to the processor 204 via the I/O interface circuit 205. In response to the request, the processor 204 executes the display routine (stored in the application memory 220) to move the fax number "415-356-7241" to the selecting region 403. To dial the fax number, the user then presses in the jog dial wheel 108 on the control panel 106. In response, the processor 204 executes the dialing routine (stored in the application memory 220) to generate a dialing signal for the fax number.

FIG. 4E shows a screen display 410 time sequentially to the screen display 406 of FIG. 4C. To select the office number "415-356-7272", a user turns down the jog dial wheel 108 while the screen display 406 is being displayed on the display screen 102. In response, the control panel 106 sends a request to the processor 204 via the I/O interface circuit 205. In response to the request, the processor 204 executes the display routine (stored in the application memory 220) to move the office number "415-356-7272" to the selecting region 403. To dial the office number, the user then presses in the jog dial wheel 108 on the control panel 106. In response, the processor 204 executes the dialing

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routine (stored in the application memory 220) to generate a dialing signal for the office number.

Referring to FIG. 5, there is shown a flowchart illustrating the steps of entering a name and the numbers that are associated with the name into the cellular telephone 100, in accordance with the present invention.

As shown in FIG. 5, at step 502, in response to a data entry menu selection from the display screen 102, the processor 204 executes the data entry routine (stored in the application memory 220) to display a prompt on the display screen 102, instructing a user to enter a name to the cellular telephone 100. Upon receiving the name entered by the user using the alpha/numeric keys on the key panel 110, the processor 204 stores the name to the name memory 216.

At step 504, the processor 204 executes the data entry routine (stored in the application memory 220) to display a prompt on the display screen 102, repeatedly instructing the user to input the numbers that are associated with the name. Upon receiving a number, the processor 204 also displays a prompt on the display screen 102, instructing the user to input the title for the number (such as home, office, fax, pager, or cellular). Upon receiving the title of the number, the processor 204 assigns a pre-designed icon (that matches the title) to the number. Upon receiving all the numbers that are associated with the name, the processor 204 stores the number into the number memory 218.

At step 506, in response to a display menu selection from the display screen 102, the processor 204 executes the data entry routine (stored in the application memory 220) to display a prompt on the display screen 102, instructing the user to define a primary number for the name. Upon receiving a definition input from the user, the processor 204 associates the primary number and the associated icon with the name.

Referring to FIG. 6, there is shown a flowchart illustrating the steps of displaying the numbers that are associated with a name in a name directory, in accordance with the present invention.

As shown in FIG. 6, at step 602, the processor 204 executes the display routine (stored in the application memory 220) to present a screen display for a name directory on the display screen 102. The screen display contains a selecting region and a plurality of name entries. As an exemplary screen display 404, FIG. 4B shows a name directory containing a selecting region 403 and three names (06 Jack Kelley, 07 John Smith, and 08 Mike Turner). The name "07 John Smith" is displayed within the selecting region 403.

At step 604, a user activates the name entry "07 John Smith" by pressing in the jog dial wheel 108.

At step 606, in response to the activation, the processor 204 executes the display routine (stored in the application memory 220) to retrieve the number entries associated with the name entry "07 John Smith" from the number output memory 214 and display them on a screen display. As an example, FIG. 4C shows the screen display 406 containing a selecting region 403 and three number entries (415-365-7272 (office), 415-284-3293 (home), and 415-327-7241 (fax)). Each of the three number entries is associated with an icon, and the dot 407 displayed beside the number entry "415-284-3293" denotes that the number entry is a primary number. Since the home number is defined as the primary number for the name entry "07 John Smith", the processor 204 automatically displays it in the selecting region 403 without requiring any interaction from the user. Following the step 606, the user has two options. If the user wishes to

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dial the primary number, the operation is led to step 608; if the user wishes to dial a secondary number, the operation is led to step 610.

At step 608, to dial the primary number, the user simply presses in the jog dial wheel 108 on the control panel 106, which in turn sends a request to the processor 204. In response to the request, the processor 204 executes the dialing routine (stored in the application memory 220) to generate a dialing signal for the primary number.

At step 610, to dial the fax number (415-356-7241), the user first turns up the jog dial wheel 108 to move the fax number into the selecting region 403 (as shown in FIG. 4D). The user then presses in the jog dial wheel 108, which in turn generates a request to the processor 204. In response to the request, the processor 204 executes the dialing routine (stored in the application memory 220) to generate a dialing signal for the fax number.

As an alternative, at step 610, to dial the office number (415-356-7272), the user first turns down the jog dial wheel 108 to move the office number into the selecting region 403 (as shown in FIG. 4E). The user then presses in the jog dial wheel 108, which in turn generates a request to the processor 204. In response to the request, the processor 204 executes the dialing routine (stored in the application memory 220) to generate a dialing signal for the office number.

Although the present invention has been shown and described with respect to preferred embodiments, various changes and modifications are deemed to lie within the spirit and scope of the invention as claimed.

What is claimed is:

1. A method for displaying a directory, comprising the steps of:

- (a) displaying a plurality of names on a first screen display, each of the names being associated with a primary number;
- (b) selecting one of the names from the first screen display;
- (c) displaying a primary number associated with the selected name and at least one secondary number on a second screen display; and
- (d) automatically selecting the primary number from the second screen display.

2. The method of claim 1, including the further step of:

displaying a primary number icon for each of the names.

3. The method of claim 1, including the further step of: highlighting the primary number.

4. The method of claim 1, including the further step of: activating the primary number to cause a dialing of the primary number.

5. The method of claim 1, including the further steps of: selecting the secondary number; and

activating the selected secondary number to cause a dialing of the secondary number.

6. The method of claim 1, the second screen display having a title region and a content region, the method further including the step

displaying the selected name in the title region, and displaying the primary number and the secondary number in the content region.

7. An apparatus for displaying a directory, comprising:

(a) means for displaying a plurality of names on a first screen display each of the names being associated with a primary number;

(b) means for selecting one of the names from the first screen display;

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(c) means for displaying on a second screen display a primary number associated with the selected name and at least one secondary number; and
(d) means for automatically selecting the primary number from the second screen display. 5
8. The apparatus of claim 7, further comprising:
means for displaying a primary number icon for each of the names.
9. The apparatus of claim 7, further comprising:
means for highlighting the primary number. 10
10. The apparatus of claim 7, further comprising:
means for activating the primary number to cause a dialing of the primary number.
11. The apparatus of claim 7, further comprising: 15
means for selecting the secondary number; and
means for activating the selected secondary number to cause a dialing of the secondary number.
12. The apparatus of claim 7, the second screen display having a title region and a content region, the apparatus 20 further including:
means for displaying the selected name in the title region, and displaying the primary number and the secondary number in the content region.
13. A storage device for storing a program, which is 25 readable and executable by a processing circuit to perform the steps of:
(a) displaying a plurality of names on a first screen display, each of the names having associated with it a primary number; 30
(b) selecting one of the names from the first screen display;
(c) displaying a primary number associated with the selected name and at least one secondary number on a 35 second screen display screen; and
(d) automatically selecting the primary number from the second screen display.
14. The memory device of claim 13, the codes capable of further performing the step of: 40 displaying a primary number icon for each of the names.
15. The memory device of claim 13, the codes capable of further performing the step of:
highlighting the primary number.
16. The memory device of claim 13, the codes capable of 45 further performing the step of:
activating the primary number to cause a dialing of the primary number.
17. The memory device of claim 13, the codes capable of 50 further performing the steps of:
selecting the secondary number; and
activating the selected secondary number to cause a dialing of the secondary number.
18. The memory device of claim 13, the second screen 55 display having a title region and a content region, the codes capable of further performing the step of:
displaying the selected name in the title region; and
displaying the primary number and the secondary number in the content region.
19. A method of operating a telephone, comprising the 60 steps of:
(a) displaying a plurality of names on a first screen display, each of the names having associated with a primary number; 65
(b) selecting one of the names from the first screen display;

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(c) displaying a primary number associated with the selected name and at least one secondary number on a second screen display; and
(d) automatically selecting the primary number from the second screen display.
20. The method of claim 19, including the further step of: displaying a primary number icon for each of the names.
21. The method of claim 19, including the further step of: highlighting the primary number.
22. The method of claim 19, including the further step of: activating the primary number to cause a dialing of the primary number.
23. The method of claim 19, including the further step of: selecting the secondary number; and
activating the selected secondary number to cause a dialing of the secondary number.
24. The method of claim 19, the second screen display having a title region and a content region, the method including the further step of:
displaying the selected name in the title region; and
displaying the primary number and the secondary number in the content region.
25. An apparatus for displaying a directory, comprising:
(a) a display screen for displaying a first screen display containing a plurality of names, each of the names having associated with it a primary number; and
(b) a processing circuit, in response to a first selection signal, for selecting one of the names from the first screen display;
wherein the displaying screen displays a second screen display containing a primary number associated with the selected name and at least one secondary number; and
wherein the processing circuit, in response to a second selection signal, automatically selects the primary number from the second screen display.
26. The apparatus of claim 25, the first screen display further containing:
a region for displaying a primary number icon for each of the names.
27. The apparatus of claim 25, wherein the processing circuit also highlights the primary number.
28. The apparatus of claim 25,
wherein the first and second screen displays are displayed on a telephone, and
wherein the processing circuit, in response to an activating signal activates the primary number to cause a dialing of the primary number.
29. The apparatus of claim 25,
wherein the first and second screen displays are displayed on a telephone;
wherein the processing circuit, in response to a third selection signal, selects the secondary number; and
wherein the processing circuit, in response to an activating signal, activates the selected secondary number to cause a dialing of the secondary number.
30. The apparatus of claim 25,
wherein the second screen display has a title region and a content region; and
wherein the processing circuit displays the selected name in the title region, and displays the primary number and the secondary number in the content region.
31. A method of operating a telephone that includes a screen for displaying a first screen display screen and a

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second screen display, and a processing circuit, the method comprising the steps of:

- (a) invoking the first screen display that displays a plurality of names, each of the names being associated with a primary number;
 - (b) generating a first selection signal to instruct the processing circuit to select one of the names from the first screen display;
 - (c) invoking the second screen display that displays a primary number associated with the selected name and at least one secondary number; and
 - (d) instructing the processing circuit to automatically select the primary number from the second screen display.
32. The method of claim 31, including the further step of: displaying a primary number icon for each of the names.
33. The method of claim 31, including the further step of: highlighting the primary number.
34. The method of claim 31, including the further step of: generating an activating signal to instruct the processing circuit to activate the primary number to cause a dialing of the primary number.
35. The method of claim 31, including the further steps of: generating a third signal to instruct the processing circuit to select the secondary number; and generating an activating signal to instruct the processing circuit to activate the selected secondary number to cause a dialing of the secondary number.
36. The method of claim 31, including the further step of: instructing the processing circuit to display the selected name in the title region, and displaying the primary number and the secondary number in the content region.
37. A telephone comprising:
means for storing a plurality of names;
means for storing a primary number and additional numbers for each of the names;
a display screen;
means for selecting and displaying a sub-set of the plurality of names;
means for selecting one of the sub-set names;
means for displaying the primary number and additional numbers; and
means for automatically selecting the primary number for dialing of the primary number.

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38. The telephone of claim 37, further comprising: means for displaying an icon with each of the primary number and with each of the additional number.
39. The telephone of claim 37, further comprising: means for highlighting the primary number when it is automatically selected.
40. The telephone of claim 37, further comprising: means for dialing the primary number when it is automatically selected.
41. The telephone of claim 37, further comprising: means for selecting one of the additional numbers instead of the primary one.
42. The telephone of claim 37, further comprising: means for dialing the additional number when it is selected.
43. A telephone comprising:
a display screen;
a memory to allow a user to enter names and associated numbers into the memory, including a primary number for each name;
a dial wheel to enable the user to display on the display screen a limited number of names entered into the memory; and
wherein the dial wheel is used to select a single name among the displayed names, the primary and additional numbers are displayed, and the primary number is automatically selected for dialing.
44. The telephone of 43, wherein the dial wheel is also used to select a number other than the primary one.
45. A telephone comprising:
a display screen;
a memory to allow a user to enter names and associated numbers into the memory, including a primary number for each name;
means to enable the user to display on the display screen a limited number of names entered into the memory;
means to select a signal name among the displayed names; and
means to display the primary and additional numbers and for automatically selecting the primary number for dialing.
46. The telephone of claim 45, further comprising: means to select a number other than the primary one.
47. The telephone of claim 46, further comprising: means to display an icon with each of the numbers.

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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,222,921 B1
DATED : April 24, 2001
INVENTOR(S) : Mugura et al.

Page 1 of 1

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

Column 5.

Line 31, delete "defme" and insert therefor -- define --.

Column 6.

Line 58, after "step", insert -- of: --.

Signed and Sealed this

Thirtieth Day of October, 2001

Attest:

Nicholas P. Godici

Attesting Officer

NICHOLAS P. GODICI
Acting Director of the United States Patent and Trademark Office

EXHIBIT
PAGE

A
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UNITED STATES PATENT AND TRADEMARK OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. : 6,222,921 B1
APPLICATION NO. : 09/133070
DATED : April 24, 2001
INVENTOR(S) : Mugura et al.

Page 1 of 1

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 14, column 7, line 39, delete "memory device" and insert --storage device--.
Claim 14, column 7, line 39, delete "codes" and insert --program--.
Claim 15, column 7, line 42, delete "memory device" and insert --storage device--.
Claim 15, column 7, line 42, delete "codes" and insert --program--.
Claim 16, column 7, line 45, delete "memory device" and insert --storage device--.
Claim 16, column 7, line 45, delete "codes" and insert --program--.
Claim 17, column 7, line 49, delete "memory device" and insert --storage device--.
Claim 17, column 7, line 49, delete "codes" and insert --program--.
Claim 18, column 7, line 54, delete "memory device" and insert --storage device--.
Claim 18, column 7, line 55, delete "codes" and insert --program--.
Claim 45, column 10, line 39, delete "signal" and insert --single--.

Signed and Sealed this

Twenty-ninth Day of June, 2010

David J. Kappos

David J. Kappos
Director of the United States Patent and Trademark Office

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EXHIBIT B



(12) **United States Patent**
Takeuchi

(10) Patent No.: **US 7,580,006 B2**
(45) Date of Patent: ***Aug. 25, 2009**

(54) **PORTABLE TELEPHONE**

(75) Inventor: **Ryosuke Takeuchi, Saitama (JP)**
(73) Assignee: **Sony Corporation, Tokyo (JP)**
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 101 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/788,439**

(22) Filed: **Apr. 20, 2007**

(65) **Prior Publication Data**
US 2007/0218943 A1 Sep. 20, 2007

Related U.S. Application Data

(63) Continuation of application No. 09/927,050, filed on Aug. 9, 2001, now Pat. No. 7,405,722.

(30) **Foreign Application Priority Data**
Aug. 11, 2000 (JP) 2000-245401

(51) Int. Cl.
G09G 5/00 (2006.01)
H04H 40/00 (2006.01)
(52) U.S. Cl. 345/2.1; 345/2.3; 345/184;
455/3.03; 455/78; 455/344
(58) Field of Classification Search 345/1.1-1.3,
345/2.1-2.3, 156, 157, 160, 161, 163, 168,
345/173, 184; 715/764, 810, 856-858, 861,
715/817, 819-824, 864; 455/575, 566, 90,
455/3.06, 78, 344

See application file for complete search history.

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* cited by examiner

Primary Examiner—Henry N Tran
(74) *Attorney, Agent, or Firm*—Frommer Lawrence & Haug LLP; William S. Frommer; Thomas F. Presson

(57) **ABSTRACT**

In a portable telephone according to the present invention, a display displays a block indicative of an operator, predetermined information and a pointer; the operator can be operated in directions opposite to each other; and the controller controls the display so as to shift the pointer to a desirable position within a predetermined information on a screen of the display in accordance with an operation of the operator and also display a mark indicative of a direction to which the pointer can be shifted and in which the predetermined information exists, adjacently to the block along a shift direction through the operator.

6 Claims, 22 Drawing Sheets

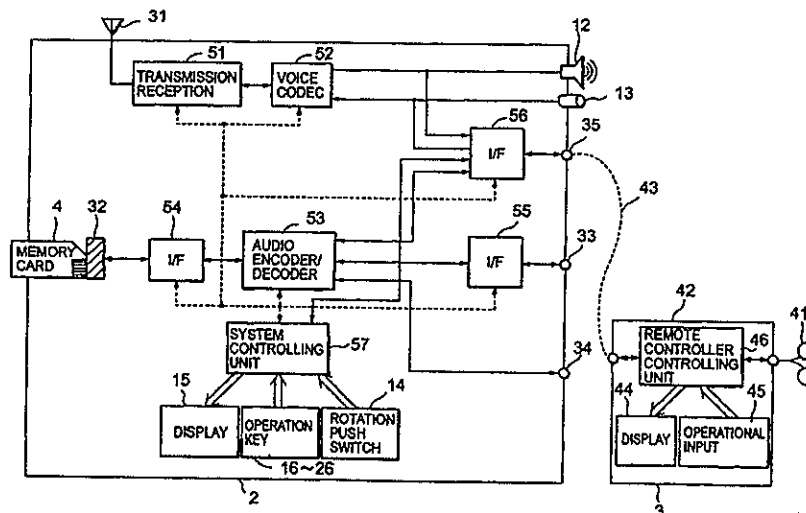


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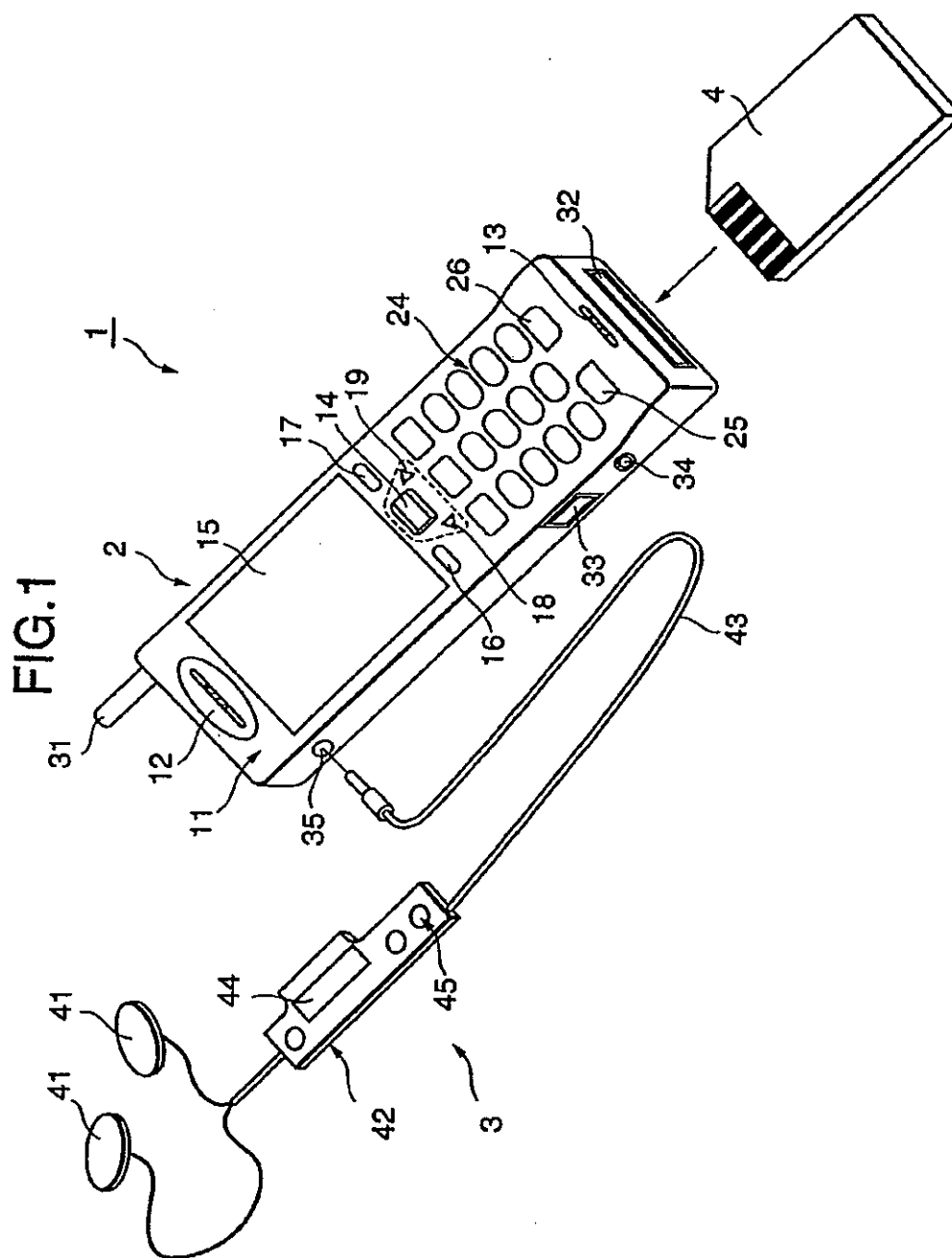


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FIG. 2

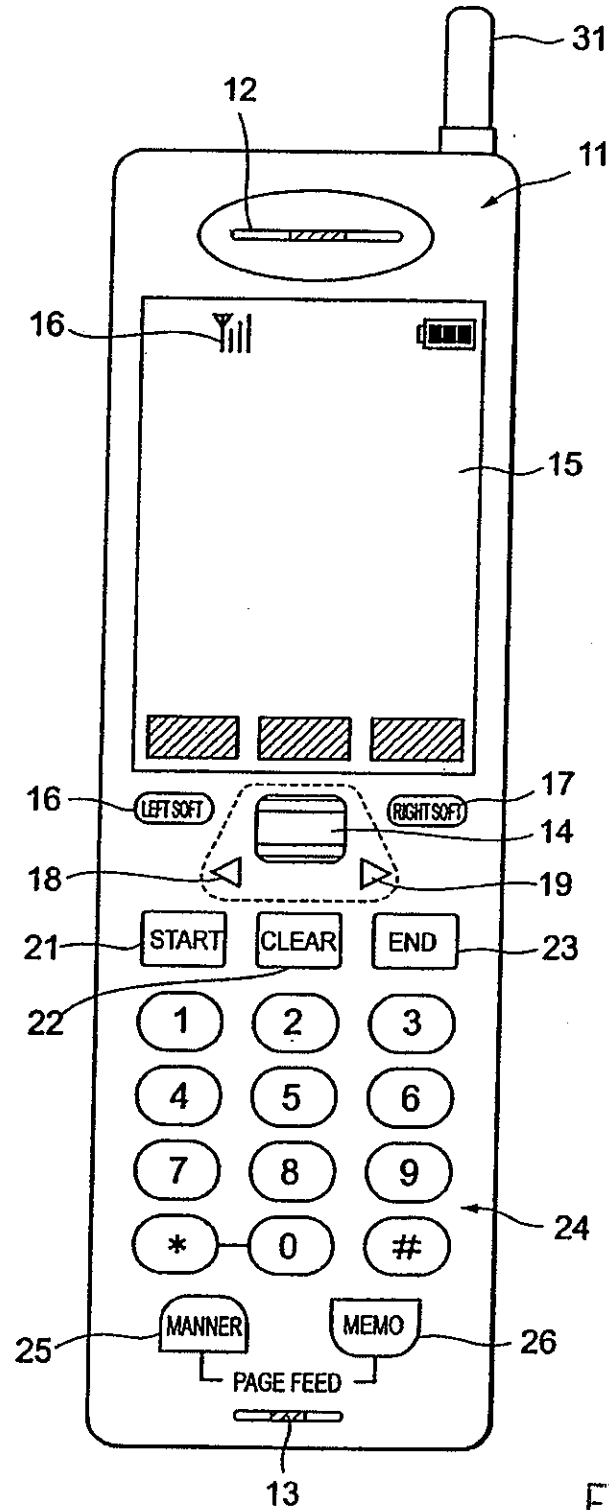


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FIG.3

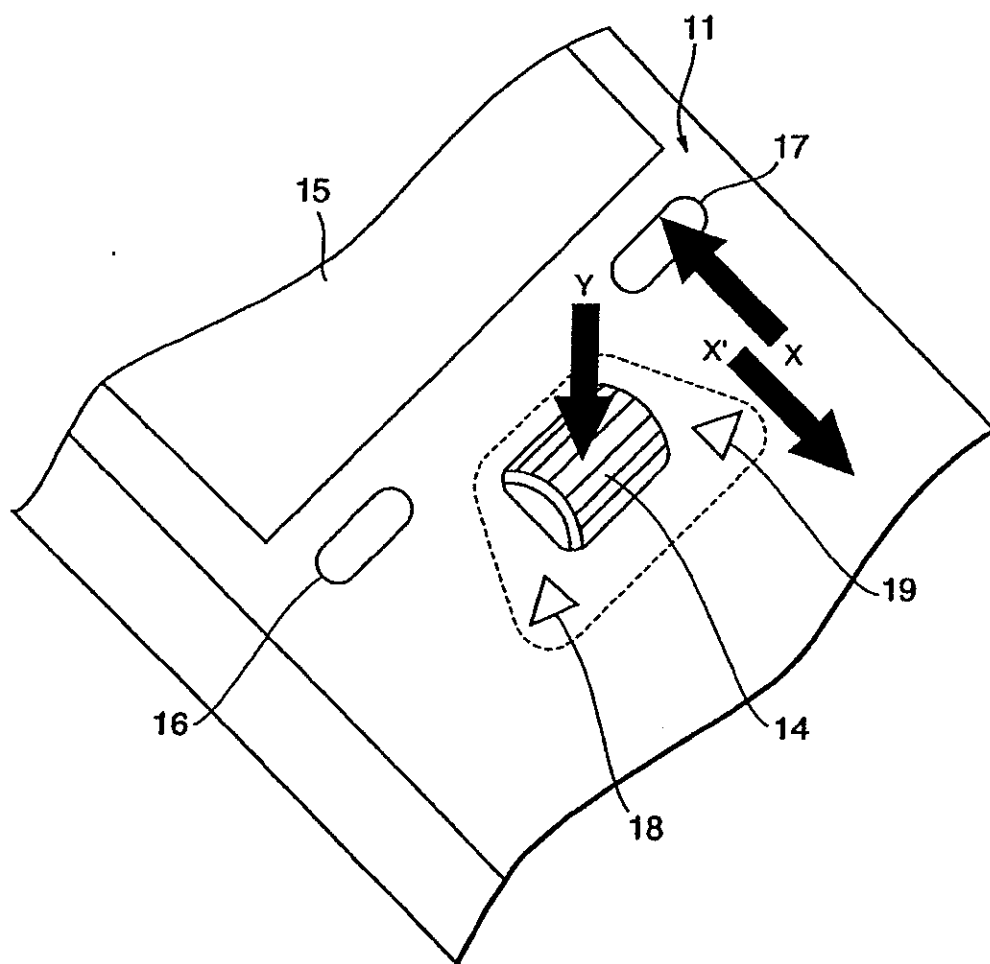


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FIG. 4

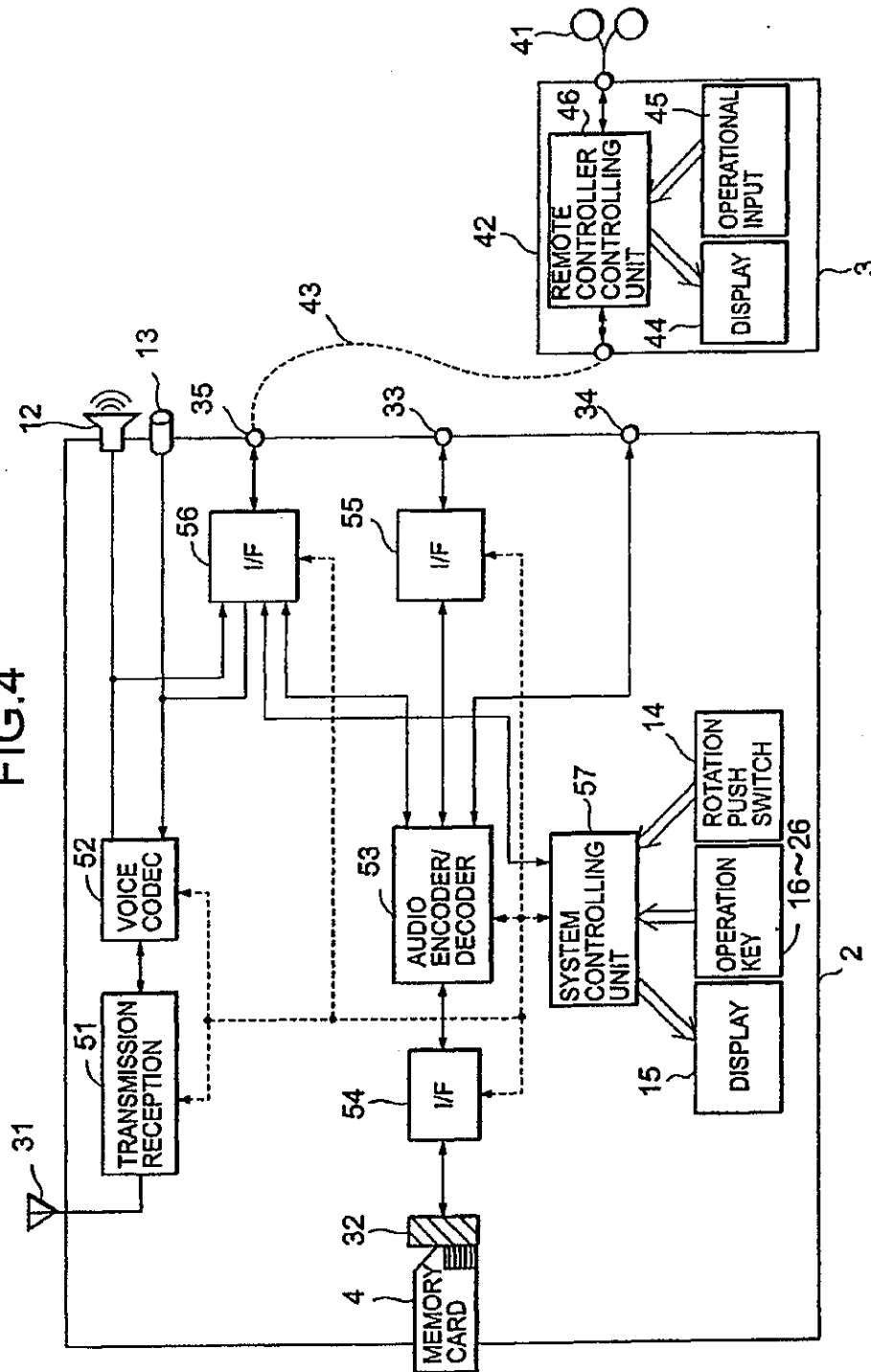


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FIG. 5

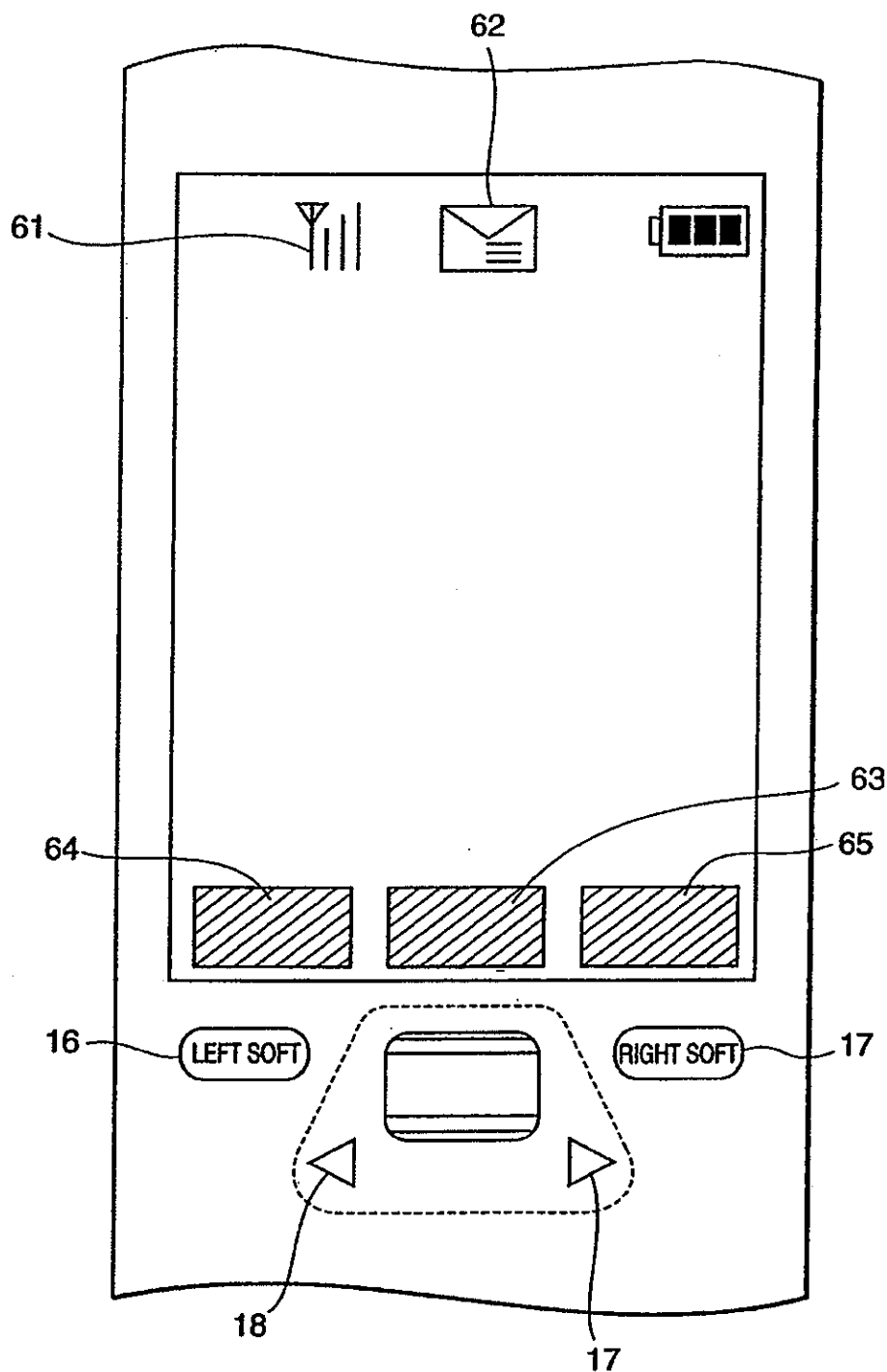


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FIG. 6A

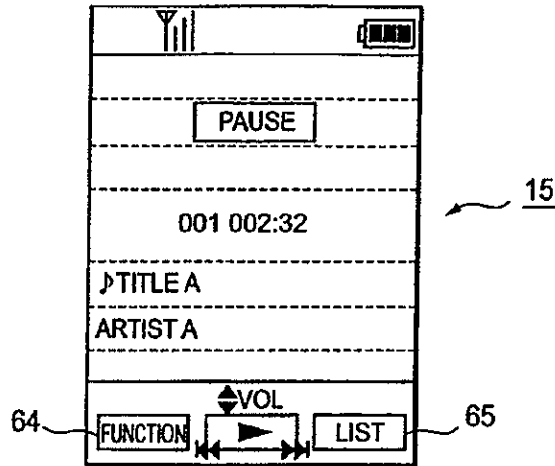


FIG. 6B

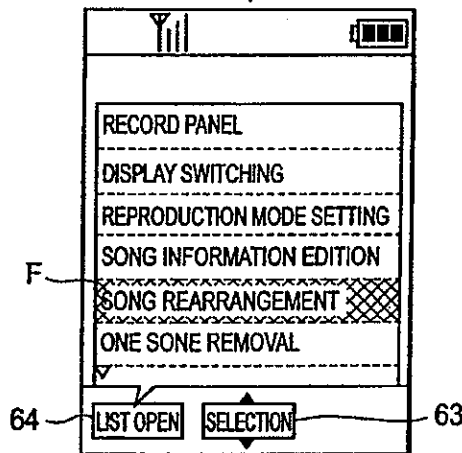


FIG. 6C

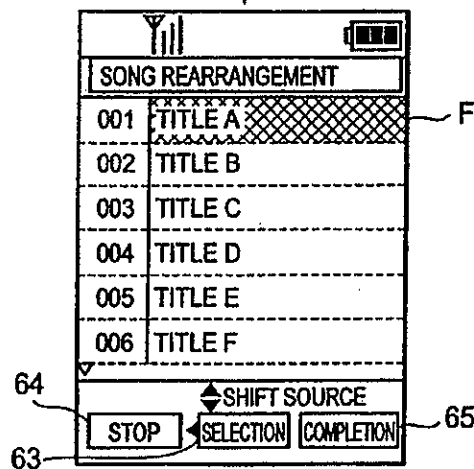


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FIG.7A

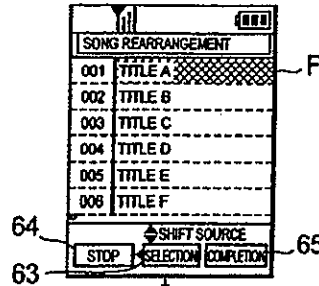


FIG.7B

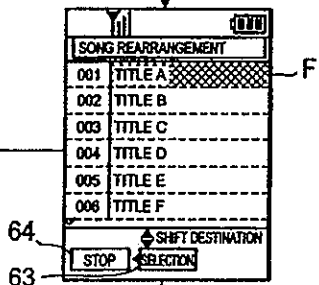


FIG.7C

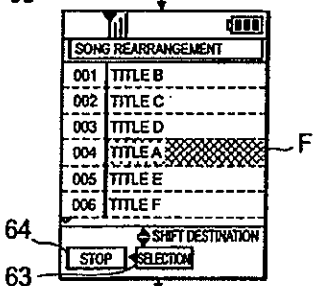


FIG.7D

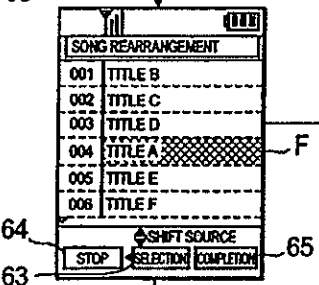
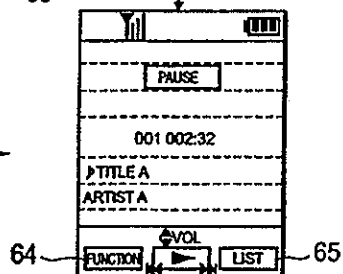


FIG.7E



SELECTION

RETURN

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FIG.8

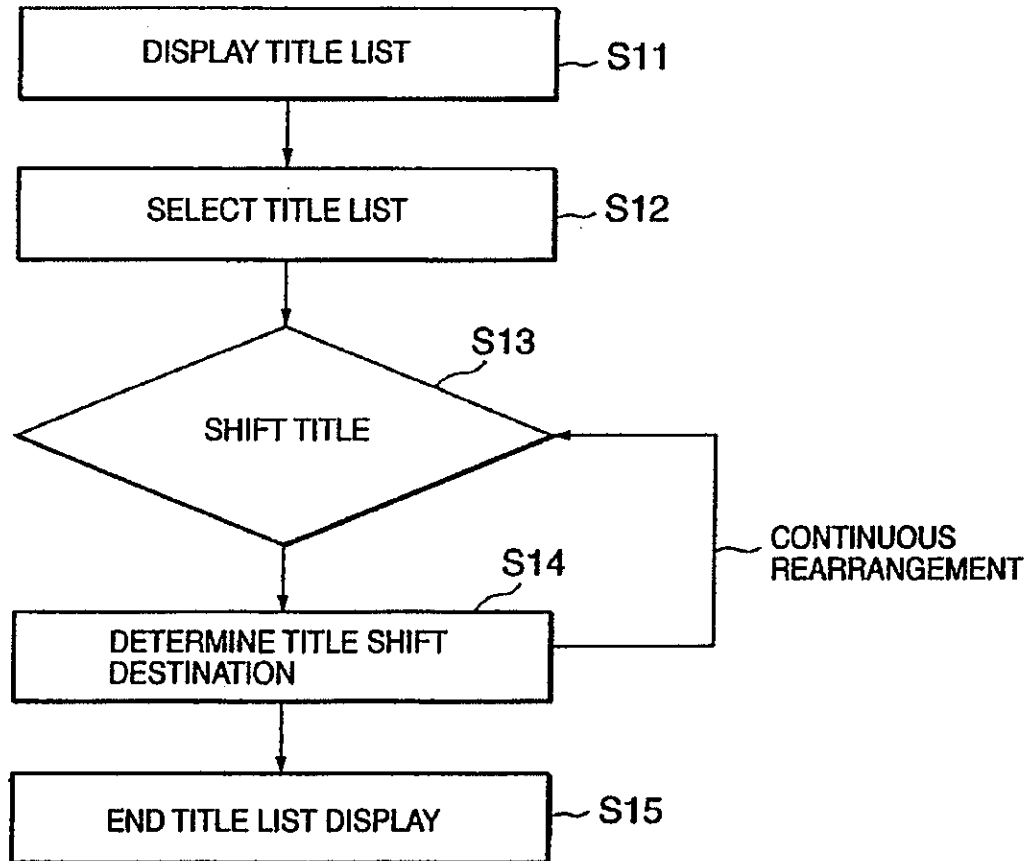


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FIG. 9A

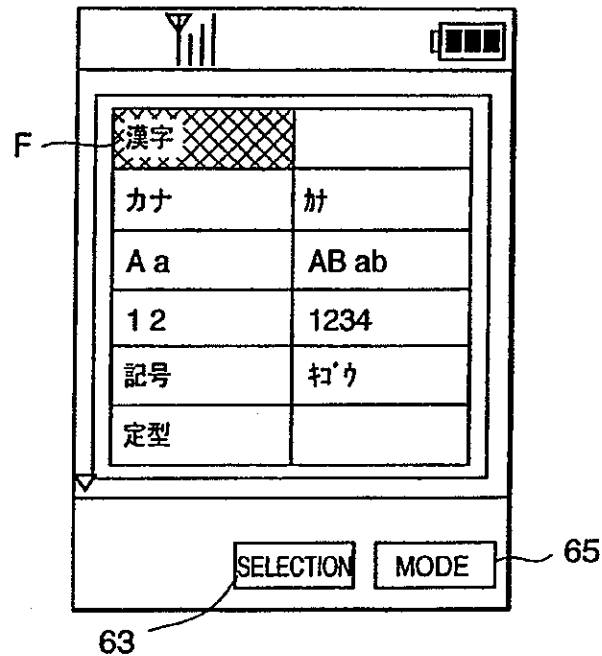


FIG. 9B

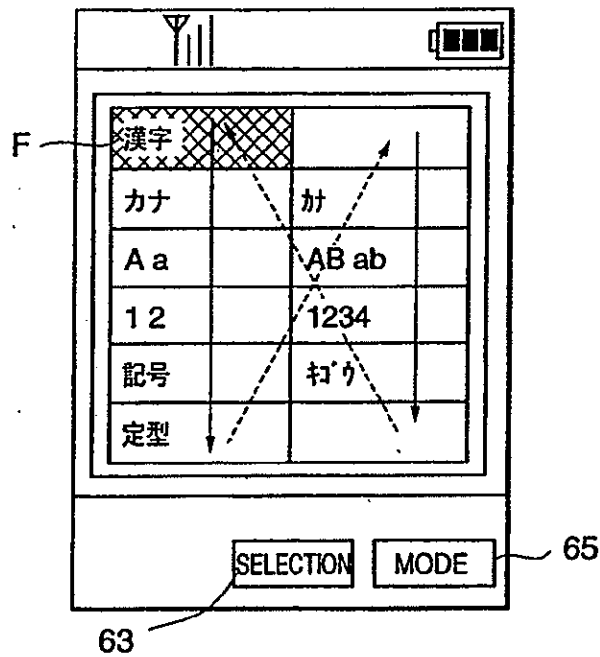


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FIG. 10

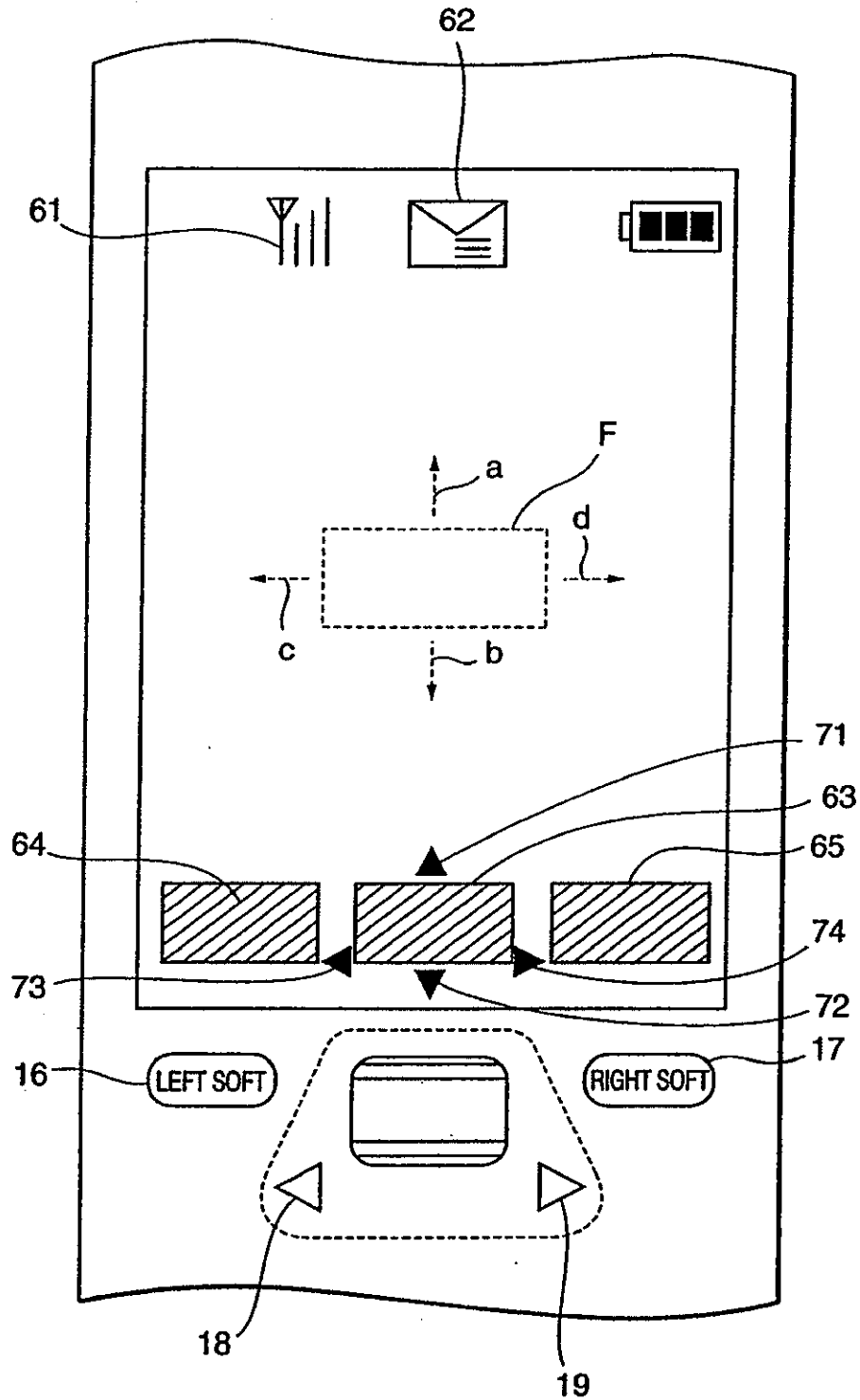


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FIG.11A

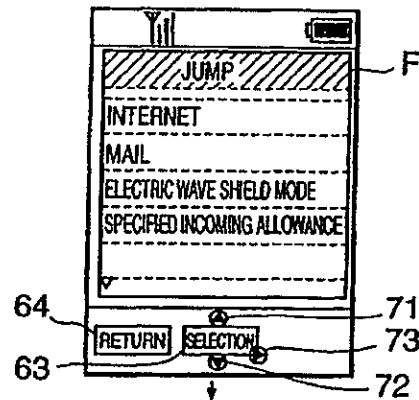


FIG.11B

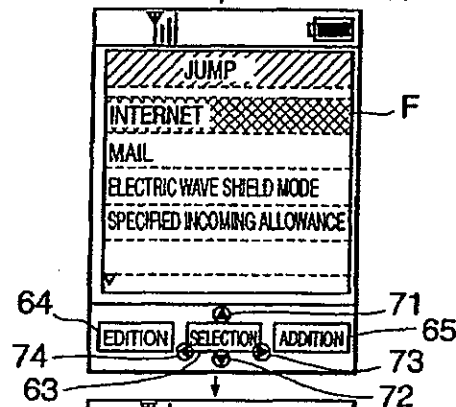


FIG.11C

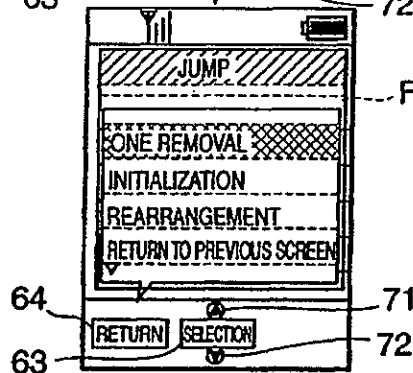


FIG.11D

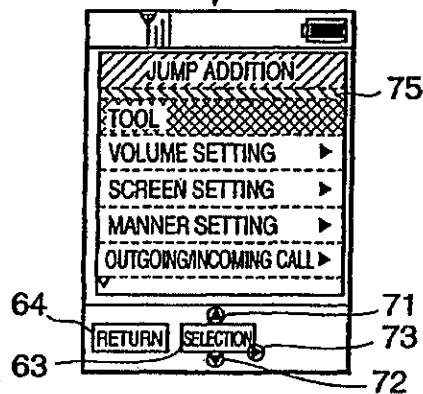


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FIG.12A

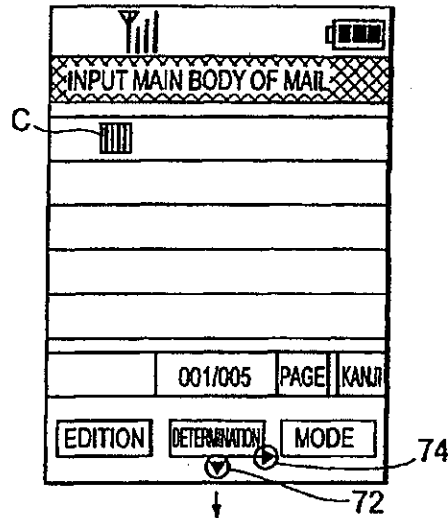


FIG.12B

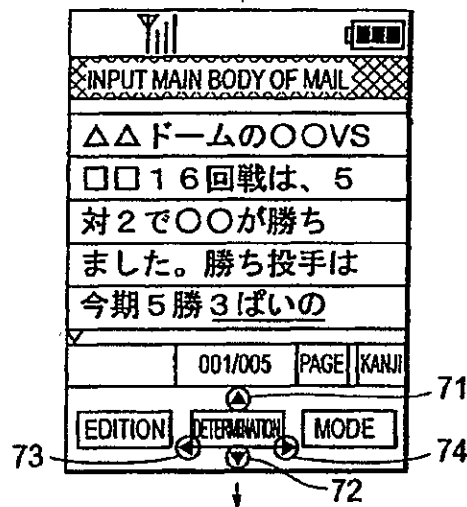


FIG.12C

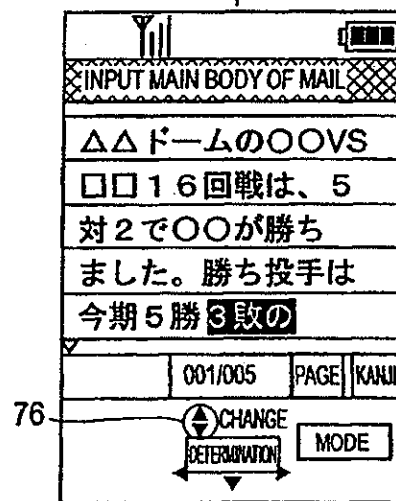


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FIG. 13

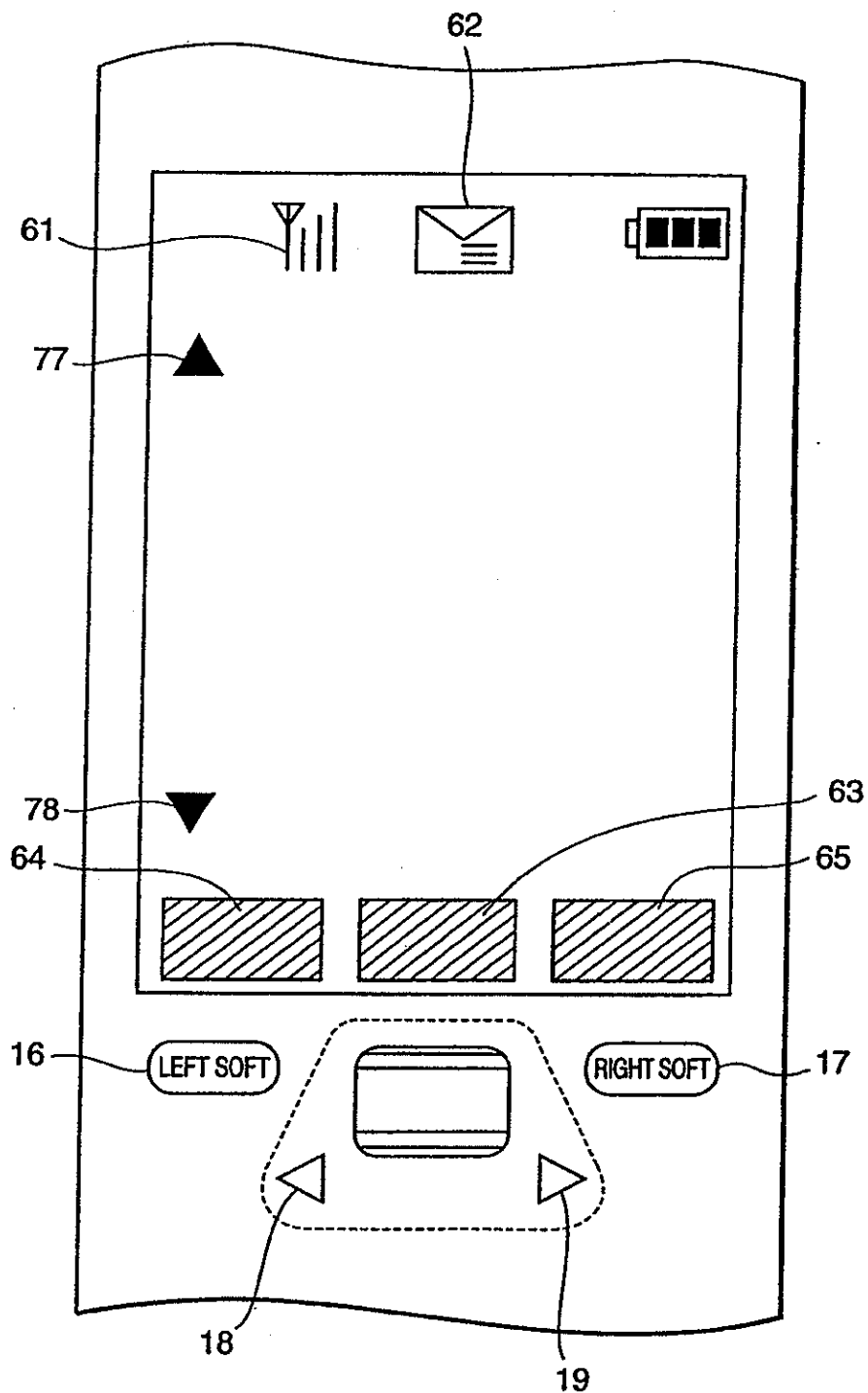


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FIG.14A

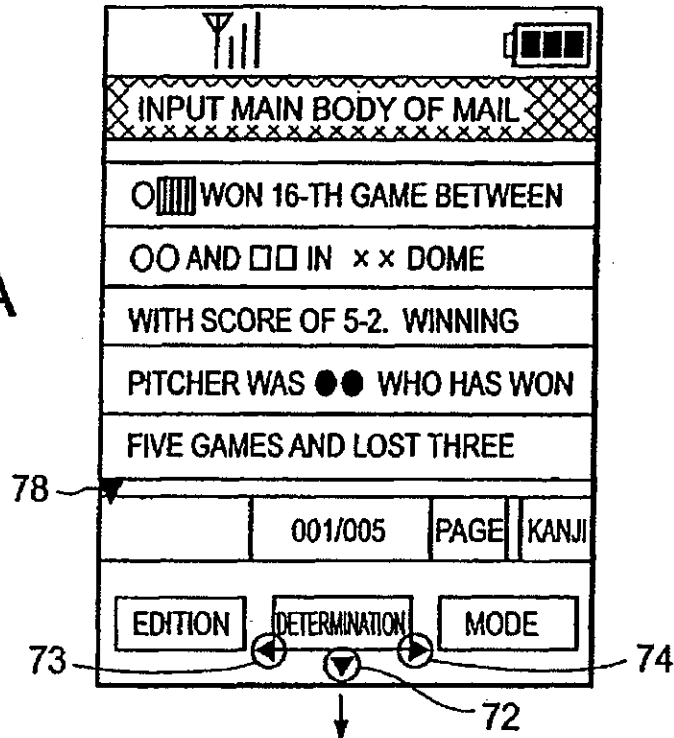


FIG.14B

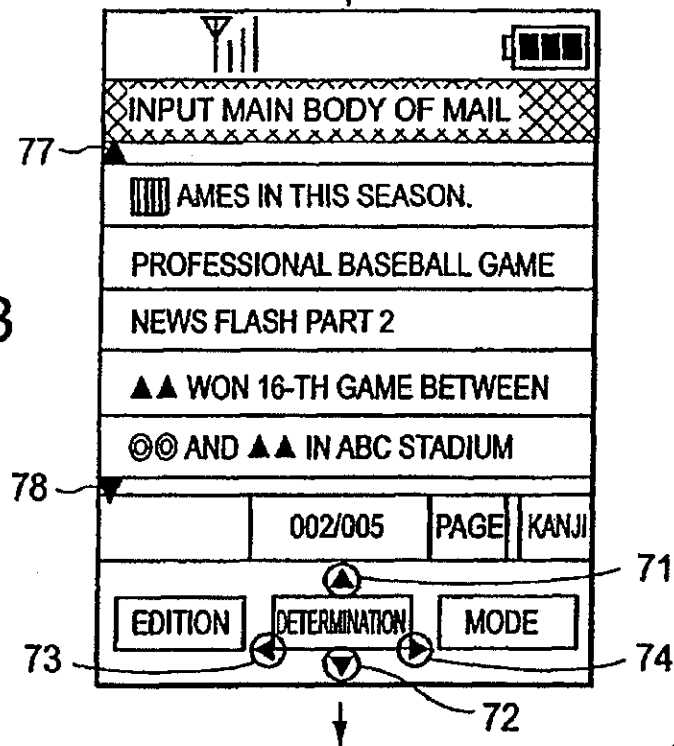


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FIG.15A

[Signal Icon] [Battery Icon]	
INCOMING CALL	
HANAKO AKASAKA	
09012345678	
FUNCTION	CALL MESSAGE

FIG.15B

[Signal Icon] [Battery Icon]	
INCOMING CALL	
HANAKO AKASAKA	
09012345678	
X FORWARD TO ANSWER SERVICE X	
CALL FORWARDING	
ANSWER HOLD	
ANSWER REJECTION	
STOP	SELECTION

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FIG.16

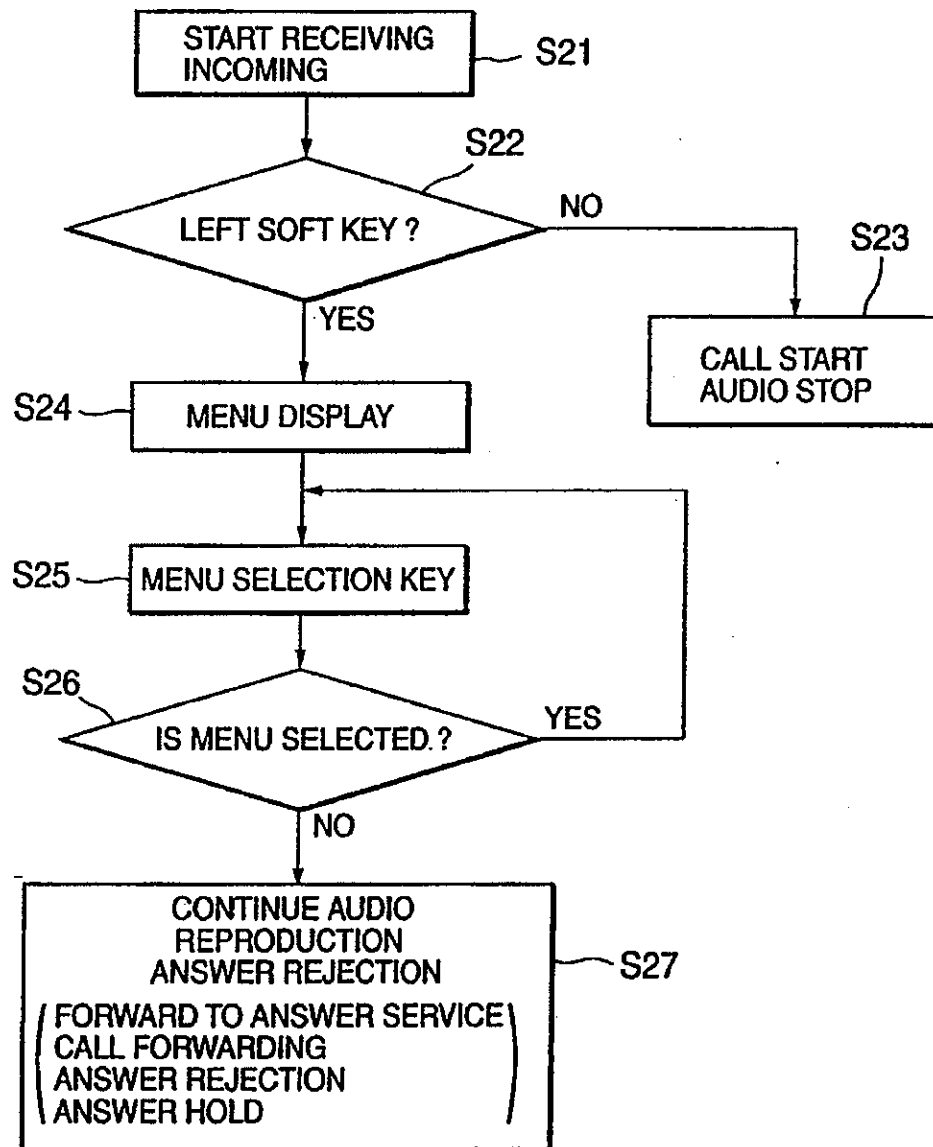


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FIG. 17

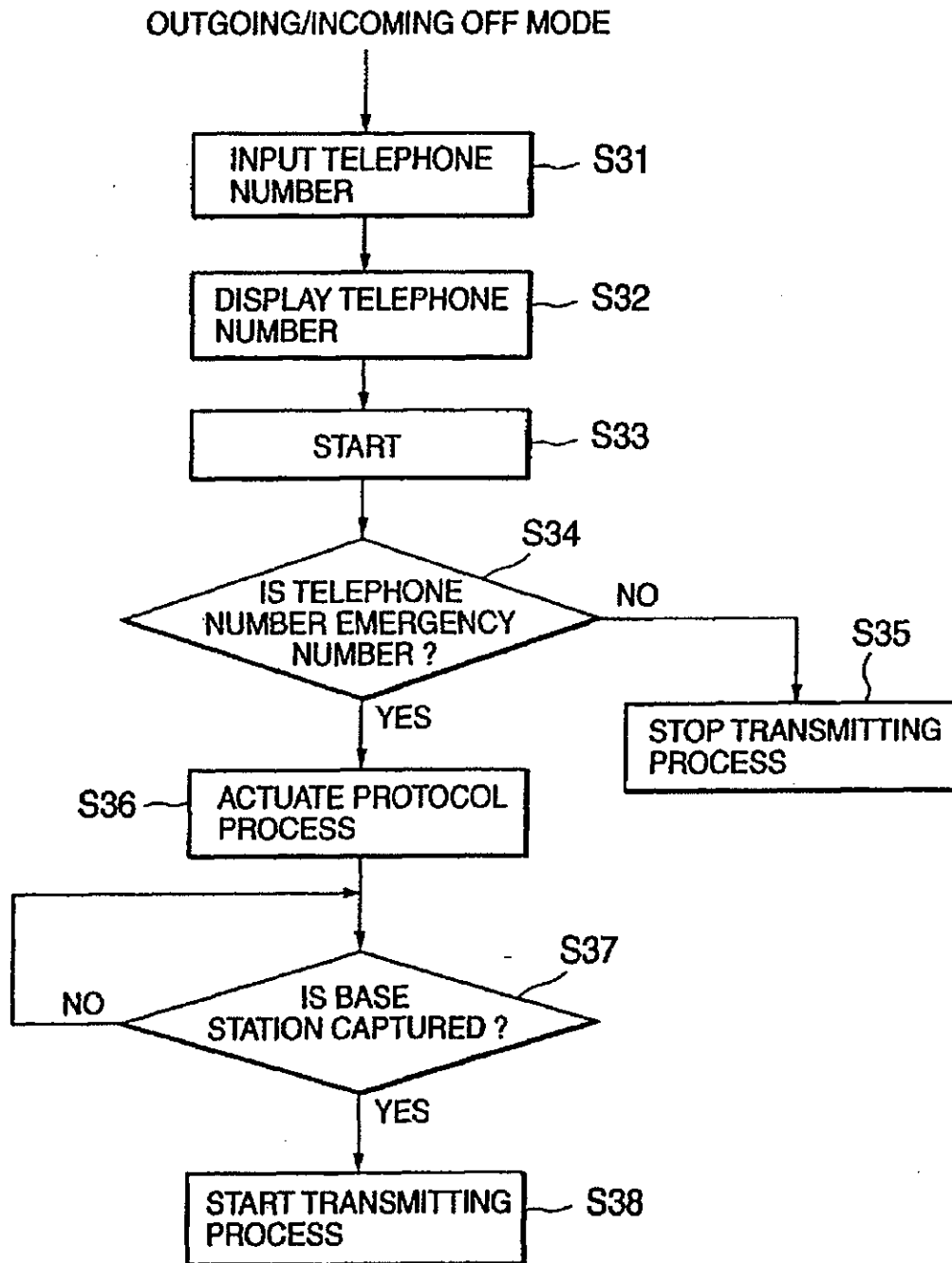


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FIG. 18

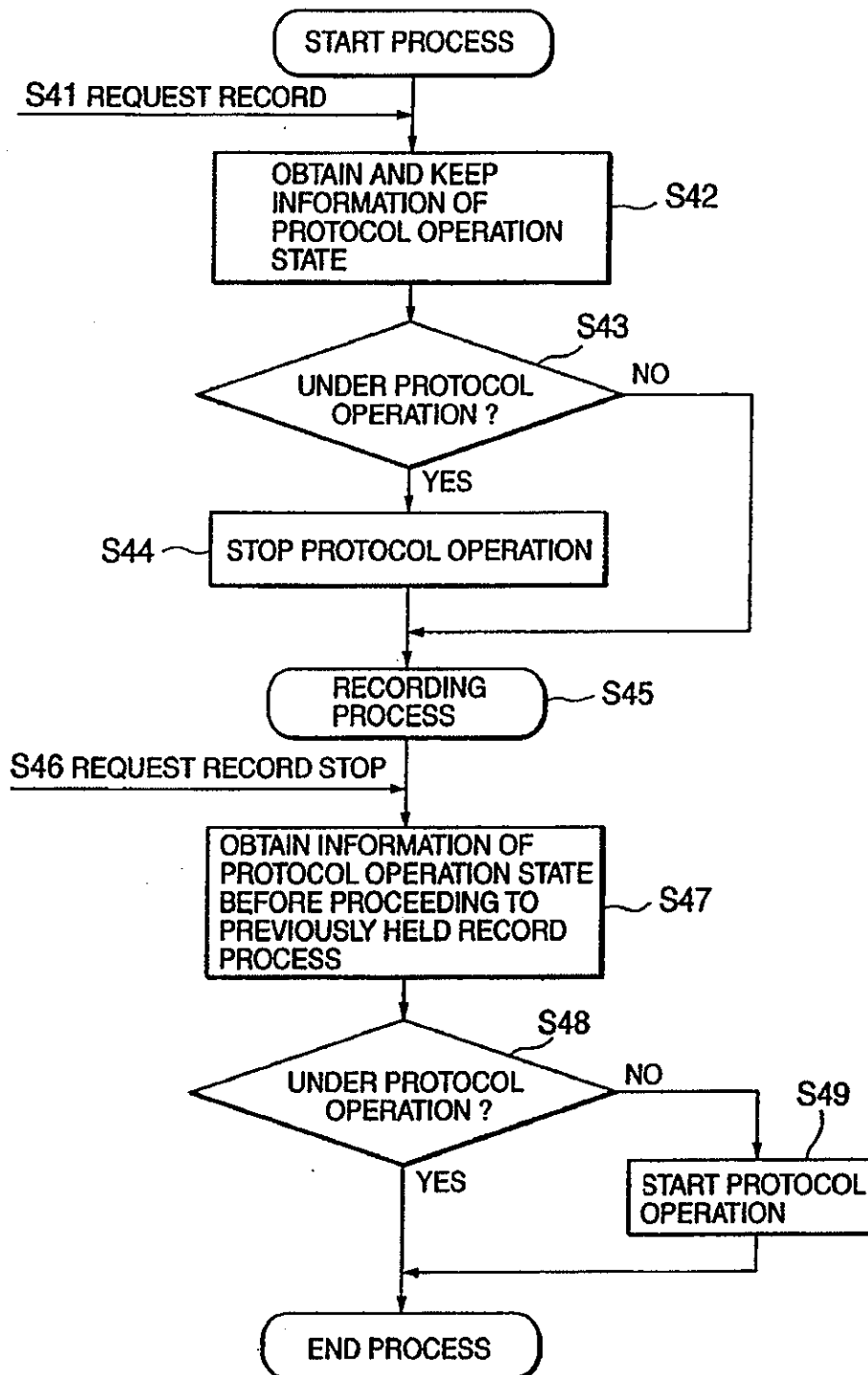


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FIG.19

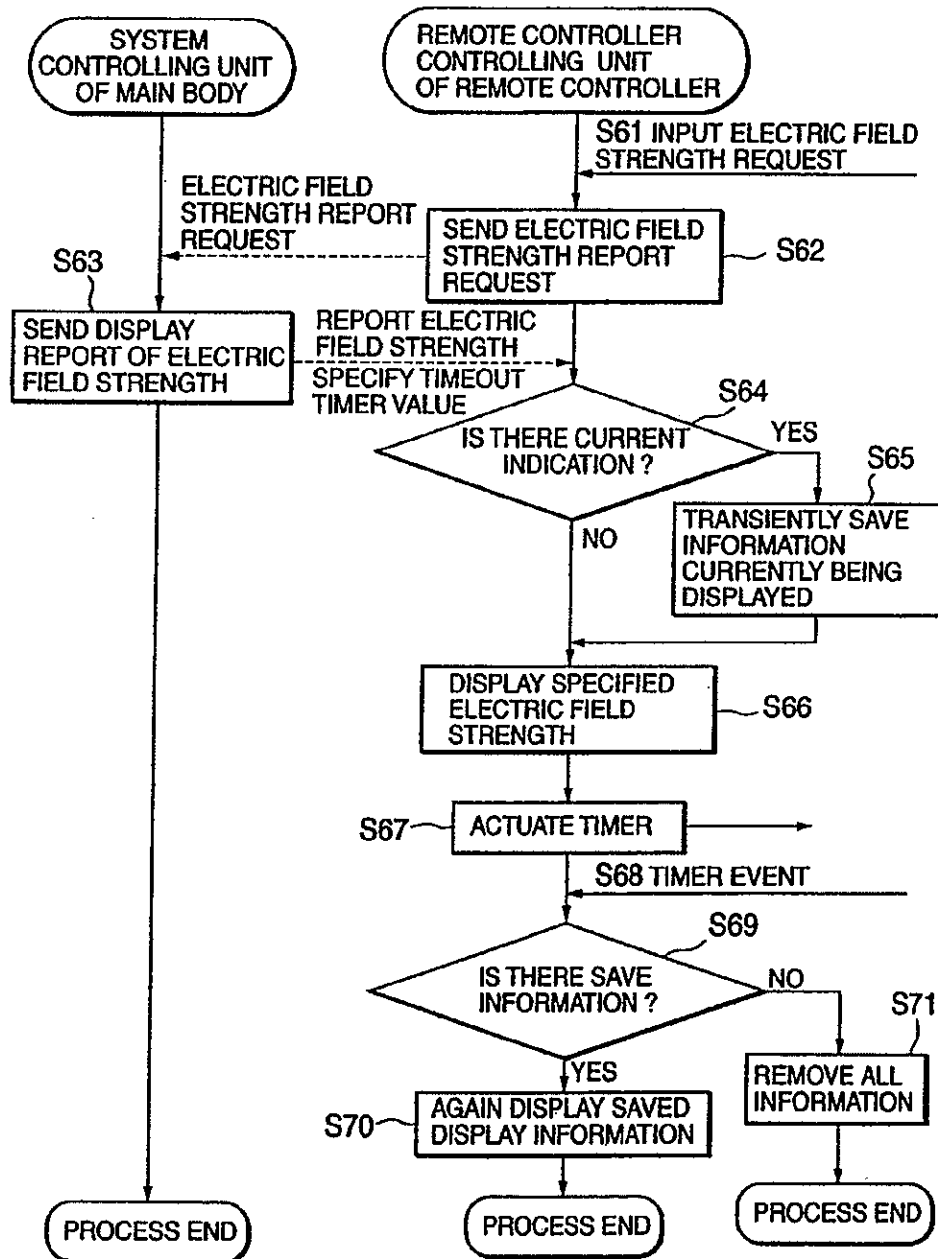


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FIG. 20

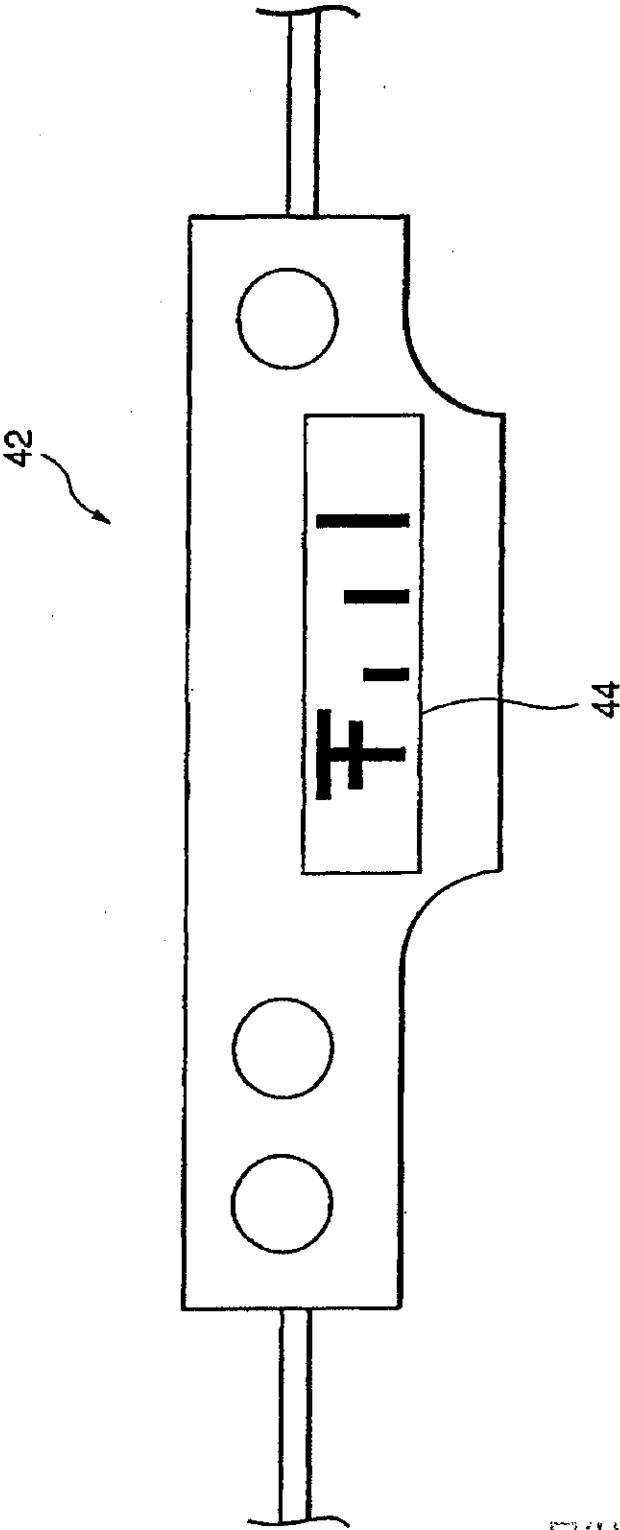


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FIG.21

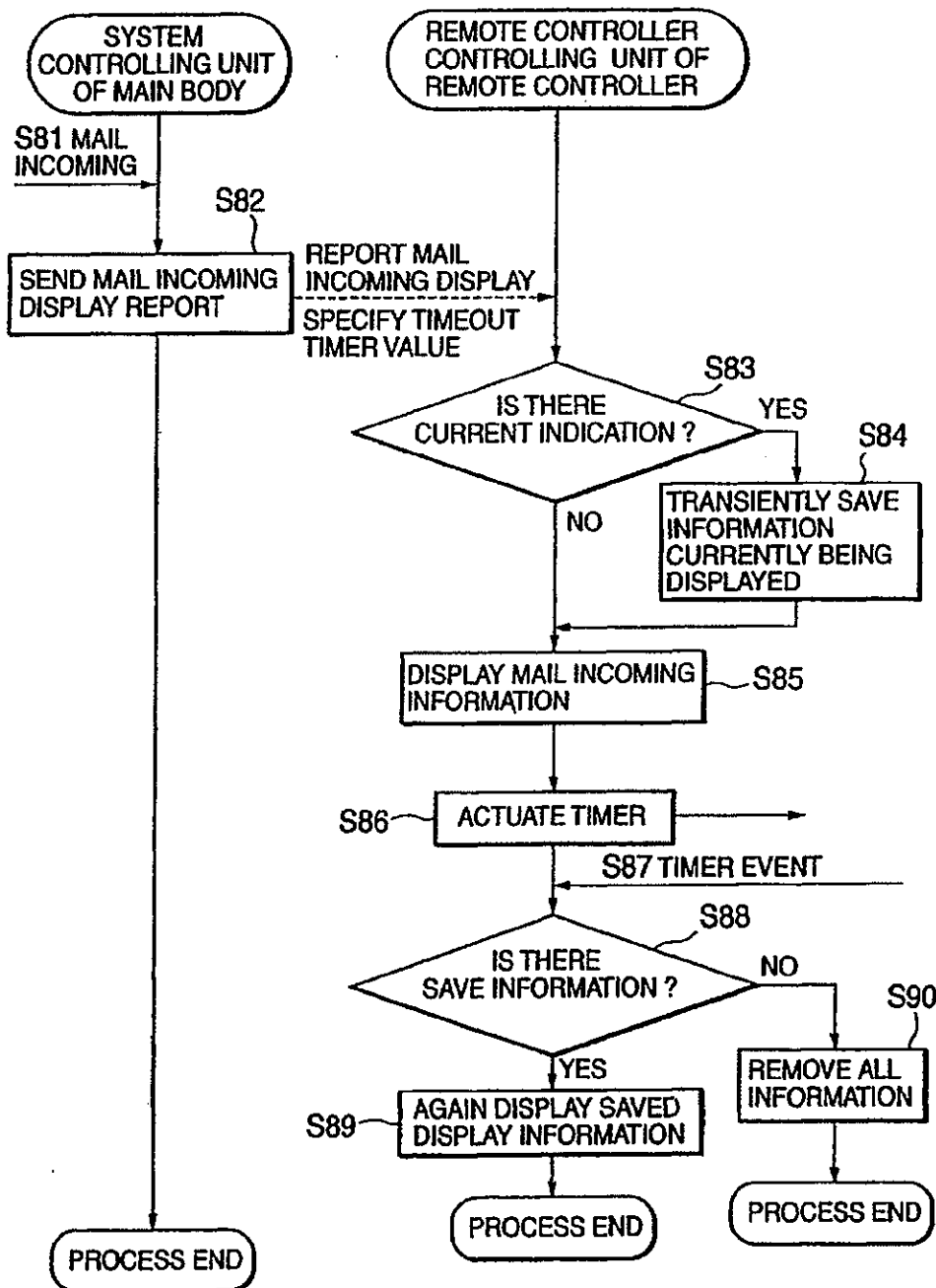


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FIG. 22

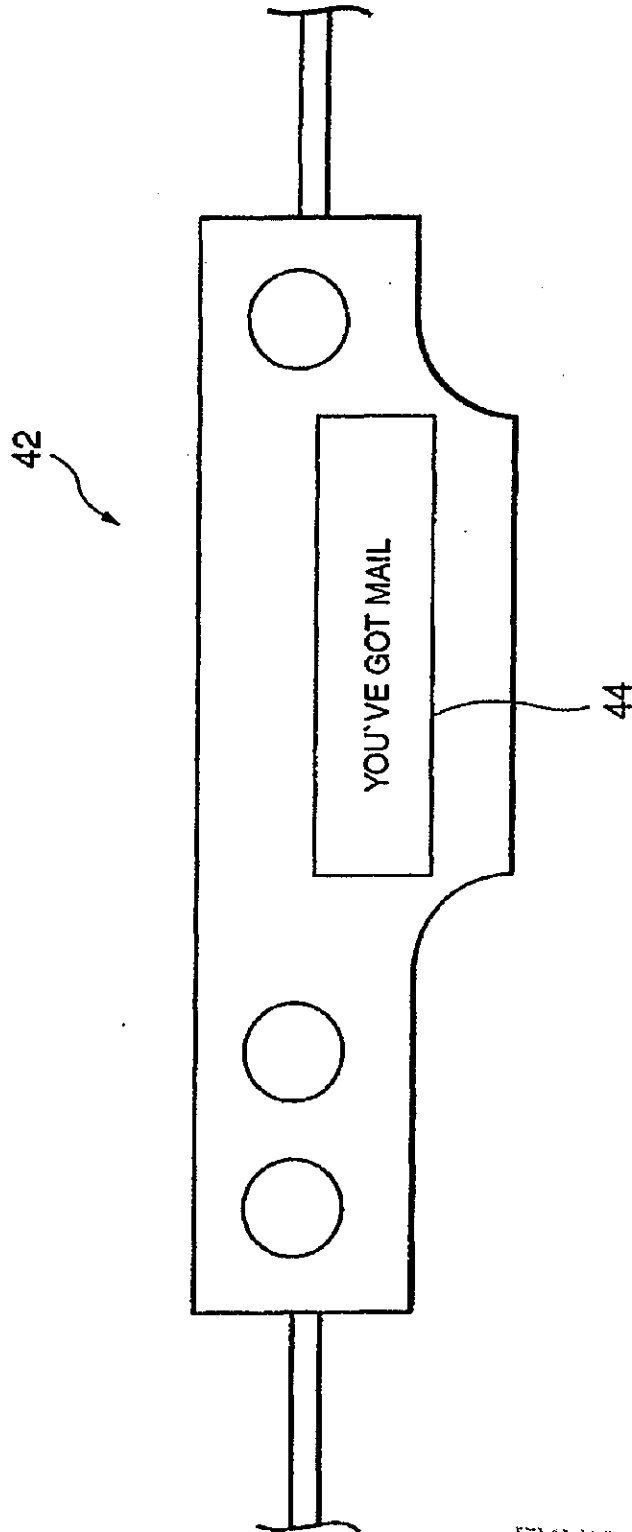


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PORTABLE TELEPHONE

This application is a Continuation of U.S. application Ser. No. 09/927,050, filed Aug. 9, 2001, now U.S. Pat. No. 7,405, 722, which claims priority to Japanese Patent Application No. 2000-24501, filed in Japan on Aug. 11, 2000, which is hereby incorporated by reference in its entirety.

CROSS REFERENCES TO RELATED APPLICATIONS

The present document is based on Japanese Priority Document JP 2000-245401, filed in the Japanese Patent Office on Aug. 11, 2000, the entire contents of which being incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a portable telephone.

2. Description of Related Art

In recent years, not only a telephone call function but also additional functions, such as an electronic mail function for sending and receiving an electronic mail by using an Internet protocol or another unique network protocol and an Internet function so as to read even WEB have been added to a portable telephone. Also, the inclusion of a memory card serving as a small memory medium in a portable telephone can attain a portable telephone in which an audio signal and a picture signal can be recorded and reproduced as the additional functions. In this way, not only the original telephone function but also the various additional functions are added to the portable telephone. It is tried to develop the portable telephone having multiple functions.

A relatively large display is typically mounted in the portable telephone having the thus attained multiple functions. Also, a direction key and a page scroll key are also mounted for retrieving or selecting information displayed on this display.

By the way, even if it is tried to make the display larger, there is also the limit of the size of the portable telephone itself. For example, if an electronic mail is displayed, if WEB is displayed, or if information stored on a memory card is displayed, the display becomes relatively narrow with respect to the information to be displayed.

In such a case, it is necessary to find out a target information or select the information by operating a direction key for shifting a focus position placed as an operation key of the portable telephone in an upper, lower, leftward or rightward direction, or a page scroll key for scrolling upwardly or downwardly displayed information correspondingly to one page.

However, only from the information displayed on the display, a user cannot find out whether or not the information is located outside a display range or whether or not the focus can be shifted from a current position. Thus, as a first step, the user operates the direction key or operates the page scroll key, and thereby checks the existence of the information existing outside the display range. However, such an operation is very troublesome and difficult.

SUMMARY OF THE INVENTION

Accordingly, there has been a need to provide a portable telephone in which the operational performances of the direction keys and the like and the convenience for the user are improved.

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In order to solve the above-mentioned problems, a portable telephone according to the present invention is characterized in that it is provided with: a first operating portion that can be operated in directions opposite to each other; a display for displaying a block indicative of the first operating portion, predetermined information and a pointer; and a controller for controlling the display so as to shift the pointer to a desirable position within the predetermined information on a screen of the display in accordance with an operation of the operating portion and also display a mark indicative of a direction to which the pointer can be shifted and in which the predetermined information exists, adjacently to the block along a shift direction through the first operating portion.

A portable telephone according to the present invention further comprises a second operating portion for shifting the pointer in a direction vertical to a shift direction of the pointer through the first operating portion, wherein the controller controls the display so as to display a mark indicative of a direction to which the pointer can be shifted by the second operating portion and in which the predetermined information exists, adjacently to the block along a shift direction through the second operating portion.

The first operating portion is a rotatable dial, and the second operating portion is two keys, which are arranged closely to each other, on both sides of the rotatable dial.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an appearance perspective view of a portable telephone in an embodiment of the present invention;

FIG. 2 is a plan view of the portable telephone;

FIG. 3 is an enlarged view of a main portion of the portable telephone;

FIG. 4 is an inner configuration view of the portable telephone;

FIG. 5 is a view explaining an electric field strength display, an incoming mail indicating display and a soft key function display to be displayed on a display of the portable telephone;

FIG. 6 includes views explaining a procedure for displaying a title list of a song recorded on a memory card; in which FIG. 6A is a view showing a state where reproduction of audio data is suspended, FIG. 6B is a view showing a state where an edit mode is selected, and FIG. 6C is a view showing a title list display screen;

FIGS. 7A to 7E are views explaining a rearranging procedure for songs recorded on a memory card;

FIG. 8 is a flowchart explaining the rearranging procedure;

FIGS. 9A to 9B are views showing a character input mode selection screen;

FIG. 10 is a view explaining a configuration of a direction key guidance display;

FIGS. 11A to 11D are views showing a jump menu screen;

FIGS. 12A to 12C are views explaining a direction key guidance display by indicating a mail input screen;

FIG. 13 is a view explaining a configuration of a page feeding guidance display;

FIGS. 14A to 14B are views explaining a page feeding guidance display by indicating a mail input screen;

FIGS. 15A and 15B are views showing a display screen when there is an incoming call during music reproduction;

FIG. 16 is a flowchart showing a processing procedure when there is an incoming call during music reproduction;

FIG. 17 is a flowchart showing a processing procedure when a telephone number is inputted in a case of a setting at an outgoing/incoming call off mode;

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FIG. 18 is a flowchart showing a processing procedure when there is a recording request of an audio data;

FIG. 19 is a flowchart showing a processing procedure when an electric field strength display is performed on a remote controller;

FIG. 20 is a flowchart showing charge strength information to be displayed on a display of a remote controller;

FIG. 21 is a flowchart showing a processing procedure when an incoming mail indicating display is performed on a remote controller; and

FIG. 22 is a view showing incoming mail information to be displayed on a display of a remote controller.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

A portable telephone having a function of recording and reproducing an audio data (hereafter, referred to as a portable telephone) is described as an embodiment to which the present invention is applied. The following portable telephone has a function of an electronic mail and searching for WEB through the Internet and a function of recording and reproducing an audio data since a memory card is mounted, as well as a normal telephone call function.

FIG. 1 shows an exterior perspective view of a portable telephone 1 in the embodiment of the present invention. FIG. 2 shows a plan view of this portable telephone 1. And, FIG. 3 shows an enlarged view of the main portion of this portable telephone 1.

The portable telephone 1 is provided with a main body 2 which is substantially rectangular parallelepiped having main functions such as a telephone function and the like, and a remote controller unit 3 that has a remote operation function and an earphone microphone function of the main body 2 and can be disposed in the main body 2.

At first, the main body 2 is described.

A voice output speaker 12 is mounted at one end in a longitudinal direction on an operation surface 11 of the main body 2, and a voice input microphone 13 is mounted at the other end in the longitudinal direction. By the way, from the viewpoint of the positional relation between the speaker 12 and the microphone 13, the direction in which the speaker 12 is mounted is referred to as an upper portion, and the direction in which the microphone 13 is mounted is referred to as a lower direction.

A rotation push switch 14 is mounted at a substantial center in a short side direction of the operation surface 11, between the speaker 12 and the microphone 13 on the operation surface 11 of the main body 2. This rotation push switch 14 is the switch that can be actuated by a rotating operation and also actuated by a pushing operation. This rotation push switch 14 is designed such that its rotating operation direction is the upper and lower directions of the operation surface 11 (X and X' directions shown in FIG. 3) and its pushing direction is the direction pushed vertically to the operation surface 11 (Y-direction shown in FIG. 3).

A display 15 constituted by, for example, a liquid crystal display panel is mounted between the main body 2 and the rotation push switch 14 on the operation surface 11 of the main body 2.

A left soft key 16 and a right soft key 17 are mounted between the display 15 and the rotation push switch 14 on the operation surface 11 of the main body 2. The left soft key 16 is mounted on a left side in a short side direction towards the operation surface 11, and the right soft key 17 is mounted on a right side in the short side direction towards the operation surface 11. Also, on the operation surface 11 of the main body

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2, a leftward direction key 18 is mounted on a left adjacent side of the rotation push switch 14, and a rightward direction key 19 is mounted on a right adjacent side thereof.

A start key 21 to carry out a call start and the like, a clear key 22, an end key 23 to carry out an end of a telephone outgoing and the like and twelve dial keys (0 to 9 and * and #) 24 are mounted between the rotation push switch 14 and the microphone 13 on the operation surface 11 of the main body 2.

A manner key 25 to set a so-called manner mode for removing an incoming tone via a sound, and a memo key 26 to be used when a telephone number and the like are stored during a call are mounted between the dial keys (0 to 9, and * and #) 24 and the microphone 13 on the operation surface 11 of the main body 2.

An antenna 31 for sending and receiving an electric wave to and from a base station for the portable telephone is disposed on a side plane of an upper end of the main body 2.

An insertion slot 32 into which a memory card 4 is inserted is mounted on a side plane of a lower end of the main body 2.

A data input/output terminal 33 to send and receive data to and from a computer and the like, a line input terminal 34 to receive an audio data from an external audio apparatus, such as MD, CD, DVD or the like, and a remote controller unit terminal 35 to establish a connection to the remote controller unit 3 are mounted on a side of a left side plane of the main body 2.

The remote controller unit 3 will be described below.

The remote controller unit 3 is composed of an earphone microphone 41, a remote controller 42 and a connection cable 43.

The earphone microphone 41 is the unit into which an earphone and a microphone are integrated. The usage of this earphone microphone 41 enables a call to be carried out, for example, while the main body 2 is kept in a bag. The earphone microphone 41 is also used when audio data recorded on the memory card 4 is heard. This earphone microphone 41 is configured so as to be detachable from the remote controller 42.

A display unit 44 and an operation input unit 45 are mounted in the remote controller 42. The remote controller 42 is intended to remotely operate the main body 2.

Such a remote controller unit 3 can be operated when the remote controller 42 is connected through the connection cable 43 to the main body 2. For example, the remote controller unit 3 can carry out the remote operations such as an incoming of a telephone, a reproduction, a stop and a fast forward of an audio signal, and the like. By the way, the main body 2 and the remote controller unit 3 may send and receive a data through a wireless communication such as infrared rays and the like without any connection via a cable.

The inner configuration of this portable telephone 1 will be described below.

FIG. 4 is a functional block diagram of the portable telephone 1.

The main body 2 of the portable telephone 1 is provided with the speaker 12, the microphone 13, the rotation operation switch 14, the display 15, the various operation keys 16 to 26, the antenna 31, the insertion slot 32, the data input output terminal 33, the line input terminal 34 and the remote controller unit terminal 35. Moreover, this main body 2 is composed of a transmission/reception unit 51, a voice codec 52, an audio encoder/decoder 53, a memory card interface (memory card I/F) 54, a digital data interface (digital I/F) 55, a remote controller interface (remote controller I/F) 56 and a system controlling unit 57.

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The remote controller unit 3 is composed of the earphone microphone 41, the remote controller 42 and the connection cable 43. The remote controller 42 of the remote controller unit 3 has the display 44, the operation input unit 45 and a remote controller controlling unit 46.

The transmission/reception unit 51 of the main body 2 carries out a process for transmitting an electric wave to the base station, and a process for receiving an electric wave from the base station. The transmission/reception unit 51 demodulates the received electric wave through the antenna 31, and sends the demodulated data to the voice codec 52. Also, the transmission/reception unit 51 modulates the data sent from the voice codec 52, and sends it through the antenna 31.

The voice codec 52 encodes and decodes the voice data. The voice codec 52 performs a voice decoding process on the demodulated data sent from the transmission/reception unit 51. The voice signal on which the voice decoding process is performed is outputted from the speaker 12, or sent through the remote controller I/F 56 to the remote controller unit 3 and outputted from the earphone microphone 41. Also, the voice codec 52 receives the voice signal from the microphone 13 or the earphone microphone 41, and encodes this voice signal and then sends to the transmission/reception unit 51.

The audio encoder/decoder 53 performs an audio encoding/decoding process on audio data to be recorded on the memory card 4. The audio data recorded on the memory card 4 inserted into the insertion slot 32 is sent through the memory card I/F 54 to the audio encoder/decoder 53. The audio encoder/decoder 53 performs the decoding process, such as an encryption decoding process, a voice expanding process or the like, on the audio data. The audio data on which the decoding process is performed is sent through the remote controller I/F 56 to the remote controller unit 3, and outputted from the earphone microphone 41. Also, the audio data inputted from an external portion is inputted through the data input output terminal 33 or the line input terminal 34 to the audio encoder/decoder 53. The audio encoder/decoder 53 performs the encoding process, such as a voice compressing process, an encryption decoding process or the like, on the inputted audio data. The audio data on which the encoding process is performed is recorded through the memory card I/F 54 on the memory card 4 inserted into the insertion slot 32.

The system controlling unit 57 carries out the controls of each of the above-mentioned units.

On the other hand, the remote controller controlling unit 46 in the remote controller 42 of the remote controller unit 3 transmits and receives the data to and from the main body 2, transmits and receives the signal to and from the earphone microphone 41, controls the display on the display unit 44, and controls the operational input from the operation input unit 45.

The main configuration and the main operation of the portable telephone 1 having the above-mentioned configuration will be described below.

This portable telephone 1 is the telephone of a wirelessly communicating system, and it is carried by a user. When this portable telephone 1 is located at a position at which the electric wave transmitted from the base station can be received, it becomes at a communicable state. At this communicable state, after any telephone number is pushed by using the dial keys 24, the start key 21 is pushed to start a call and then call out a partner. Also, at this time of the communicable state, an incoming call from the partner can be received. If there is the incoming call from the partner, any key is pushed to thereby start the call.

Here, in this portable telephone 1, in order to provide a current state of a call quality to the user, as shown in FIG. 5,

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an electric field strength indication 61 indicative of a level of an electric field strength of a received electric wave from the base station is displayed at a predetermined position on a left upper side of the display 15. The electric field strength is detected by, for example, the transmission/reception unit 51. The detected electric field strength information is periodically read by the system controlling unit 57. The system controlling unit 57 carries out the display control of the display 15 on the basis of the read electric field strength information, and provides the electric field strength information to the user. In this embodiment, this electric field strength indication 61 is represented at approximately four stage levels, such as an excellent level, a usual level, a bad level and an incommunicable level, for example.

Also, this portable telephone 1 has an electronic mail function of communicating with the base station and sending and receiving an electronic mail by using an Internet protocol.

For example, mail data is sent by displaying a predetermined mail input screen, and entering a sentence to be transmitted, and then selecting a mail transmission button when it is at the communicable state. Actually, the system controlling unit 57 encodes the inputted electronic mail, and the transmission/reception unit 51 once sends the encoded mail data to the base station, and the mail data is transferred from the base station to a mail server of a partner. Also, when an electronic mail is transferred from the partner to an address of the user, the base station sends the mail data to the portable telephone 1. The portable telephone 1, when receiving the mail data at the time of the communicable state, automatically carries out an incoming mail process, and stores the mail data in an inner memory. Then, the system controlling unit 57 of the portable telephone 1, when obtaining the mail data from the base station, displays a mail incoming indication 62 at a predetermined position on the display 15, as shown in FIG. 5.

Also, this portable telephone 1 has an Internet browsing function of communicating with the base station and viewing or a WEB site on the Internet.

For example, by displaying a browser screen of the Internet and then entering URL (Uniform Resource Locator) on this screen, communication with the base station is carried out, and a data provided through a predetermined URL is downloaded. When an input operation or a selection operation is carried out on the basis of the downloaded data, a predetermined data is further downloaded on the basis of the information.

In this portable telephone 1, the memory card 4 on which audio data is recorded can be attached and detached as necessary. It has a function of recording and reproducing the audio data, such as an operation for reproducing the audio data recorded on the memory card 4 and an operation for recording the audio data on this memory card 4.

When the audio data is reproduced, the memory card 4 is inserted into the insertion slot 32, and a reproduction button is selected. When the reproduction button is selected, the audio data recorded on the memory card 4 in the insertion slot 32 is decoded by the audio encoder/decoder 53, and outputted through the remote controller I/F 56 from the earphone microphone 41.

Also, this portable telephone 1 can record audio data received from an external computer or an external audio reproduction apparatus.

When audio data is recorded through the external computer, the data input output terminal 33 and the external computer are connected to each other by using, for example, an IEEE 1394 interface and the like. Then, an application software on the external computer is used to carry out an operation for transferring desirable audio data to the memory

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card 4 (a so-called check-in operation). Accordingly, new audio data can be written on the memory card 4. By the way, even an operation for editing the audio data recorded on the memory card 4 (for example, a deletion of data, a rearrangement of a reproducing order or the like) can be carried out by the external computer.

Also, when audio data is recorded through the external audio reproduction apparatus, the line input terminal 34 and the external audio reproduction apparatus are connected through a cable to each other. Desirable audio data is reproduced by the audio reproduction apparatus, and a recording start command is given to the portable telephone 1. Thus, a so-called dubbing is started. Then, new audio data can be written on the memory card 4. The transfer of the signal to the line input terminal 34 may be performed in a form of an analog signal or digital data. In a case of the analog signal being inputted, the audio encoder/decoder 53 carries out an A/D conversion, and converts the audio signal into the digital data. Then, the execution of the voice encoding process enables the audio data to be written on the memory card 4.

As mentioned above, this portable telephone 1 has the electronic mail function, the Internet browsing function and the function of recording and reproducing the audio data by using the memory card 4, in addition to the usual telephone call function. In this way, there is provided the portable telephone intended to have multiple function.

The respective operation keys and switches will be described below.

When a user operates each of the respective operation keys described below, its control command is sent to the system controlling unit 57. Then, the system controlling unit 57 carries out a control corresponding to a function of each key, as described below.

The rotation push switch 14 is the switch that can be operated by a rotating operation and can be operated by a pushing operation.

The rotating operation of the rotation push switch 14 functions as, for example, the direction key for shifting upwardly and downwardly the pointer, such as the focus, the cursor or the like, which is displayed on the display 15. The focus is, for example, the display to specify one piece of information (one icon, one menu title, one song title or the like) from information groups (for example, a plurality of icons, menu displays, list displays or the like) displayed on the display 15. Usually, the display of the specified information is highlighted or reversing displayed. This rotation push switch 14 is mounted at the center in the short side direction on the operation surface 11. Moreover, the direction of the rotating operation is the upper and lower directions (the longitudinal direction) of the operation surface 11. Thus, when the focus is shifted upwardly or downwardly, the shift of the focus on the display screen is parallel to the operation of an operating finger. Also, the operating finger is located oppositely to the display screen. Hence, the coincident feeling between the operational feeling and the screen operation is given to the user. Moreover, the buttons such as the upper and lower keys and the like make the operation easy.

The pushing operation of the rotation push switch 14 has the function as the so-called soft key. The soft key is a key in which an action when the button is pushed is changed in a programmable manner on the basis of the menu content and the information displayed on the display 15. This soft key is designed such that a content of a function selected when the button is pushed is displayed on the display 15 and the user can recognize the actual content of the action when this button is currently pushed. Concretely, the function selected when this rotation push switch 14 is pushed is displayed as a central

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soft key function indication 63, at a center on a lower side of the display screen of the display 15, as shown in FIG. 5.

The left soft key 16 functions as the above-mentioned soft key. A function selected when this left soft key 16 is pushed is displayed as a left soft key function indication 64, at a left hand position on a lower side of the display screen of the display 15, as shown in FIG. 5.

The right soft key 17 also functions as the above-mentioned soft key. A function selected when this right soft key 17 is pushed is displayed as a right soft key function indication 65, at a right hand position on a lower side of the display screen of the display 15, as shown in FIG. 5.

The leftward direction key 18 functions as a shift key to shift the focus and the cursor displayed on the display 15 to a leftward direction.

The rightward direction key 19 functions as a shift key to shift the focus and the cursor displayed on the display 15 to a rightward direction.

The start key 21 functions as a key to start a telephone call.

The clear key 22 functions as a key to switch a display state of the display screen to an initial display menu screen, or to clear input information.

The end key 23 functions as a key for terminating a call or a power supply unit key to carry out an end function of a telephone outgoing and turn on and off a power supply of the portable telephone 1.

The dial keys (0 to 9, and * and #) 24 function as the input keys for numerals 0 to 9 and symbols * and #. In addition, various characters are allocated thereto. Each of them functions as a character input key at a time of a character input of an electronic mail or the like. The kind of the allocated character is switched depending on a later-described character input mode setting screen. The kinds of the allocated characters include, for example, a kanji (Chinese character), a double-byte (full size) kana (Japanese character), a double-byte (full size) alphabet, a double-byte (full size) numeral, a double-byte (full size) symbol (character letter or pictorial letter), a standard sentence format, a single-byte (half size) kana, a single-byte (half size) alphabet, a single-byte (half size) numeral, a single-byte (half size) of symbol (character letter or pictorial letter) and the like.

The manner key 25 functions as a key to set the manner mode of removing an incoming tone via a voice or sound.

The memo key 26 functions as a key to store a telephone number and the like during a call service.

By the way, the manner key 25 and the memo key 26 also have a page feed function of scrolling information displayed on the display 15, correspondingly to one page. In a case of other than making a call, for example, writing an electronic mail or browsing a WEB, the manner key 25 functions as an upward page feed key, and the memo key 26 functions as a downward page feed key. Hereafter, the manner key 25 is referred to as an upward page feed key 25, and the memo key 26 is referred to as a downward page feed key 26.

(Rearrangement of Song Order)

An operation for rearranging an order of songs (music pieces) of audio data recorded on the memory card 4 will be described below.

In this portable telephone 1, it is possible to rearrange and edit the order of songs (music pieces) of the audio data recorded on the memory card 4. By the way, the music order described here implies the number order of the numbers given to respective information units, for example, such as the numbers of tracks or the numbers of files recorded in a management information of a record medium. Typically, it corresponds to a reproducing order in a case of a continuous

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reproduction. Thus, even if the song order is rearranged, the actual content (audio data) recorded on the memory card 4 is not rewritten. The file number and the track number managed as the management information, or a link relation between songs (music pieces) or the like are rewritten.

At first, in the portable telephone 1, the audio data is reproduced. Once it is interrupted, a display screen is displayed as shown in FIG. 6A. If the left soft key 16 is pushed while this screen is displayed and "Function" is selected, an edition mode selection screen is displayed as shown in FIG. 6B.

On this edition mode selection screen, the rotation push switch 14 is rotationally operated to shift a focus F upwardly and downwardly so that the focus F is located at a position of "Song Rearrangement". In succession, when the rotation push switch 14 is pushed and operated to select "Selection", a title list display screen is displayed as shown in FIG. 6C.

On this title list display screen, the titles and the title numbers to specify the songs (pieces of music) recorded on the memory card 4 are arranged in the upward and downward directions based on a song order currently being registered, and displayed in a form of list.

The focus F is firstly shifted from this state of the title list display screen to a position of a title of a song (music piece) desired to be shifted. At this time, the focus F is shifted by rotationally operating the rotation push switch 14 since the title list is arranged in the upward and downward directions. Here, as shown in FIG. 7A, it is assumed that the focus F is shifted to a position of "Title A". In succession, if the rotation push switch 14 is pushed and operated to select "Selection", "Title A" is selected as shown in FIG. 7B.

Here, in a case where the left soft key 16 is pushed when the screen shows the state at which this "Title A" is selected, and "Return" is selected, the operational flow returns back to a display screen in which the reproduction of the audio data is once stopped, as shown in FIG. 7E.

On the other hand, in a case where the rotation push switch 14 is rotationally operated when the screen shows the state at which this "Title A" is selected, the title character letters of "Title A" together with the focus F are shifted upwardly and downwardly on the title list. Then, the focus F and the title character letters of "Title A" are shifted to a position at which the rearrangement on the title list is desired. Here, as shown in FIG. 7C, it is assumed that they are shifted to a position between "Title D" and "Title E". In succession, the rotation push switch 14 is pushed and operated to select "Determination". Then, as shown in FIG. 7D, this leads to the state that the selected title is shifted to the desired position, which results in the completion of the rearrangement of the title list. Moreover, if another title is further desired to be shifted, the focus F is shifted from this screen to a position of a title of a song (music piece) desired to be shifted. At that position, the rotation push switch 14 is pushed and operated to select "Selection". Such operations enable the plurality of titles to be continuously shifted.

When the shifts of the titles are all completed, "Completion" is selected by pushing the right soft key 17 from a state of FIG. 7D. When this "Completion" is selected, the system controlling unit 57 rewrites the management information of the memory card 4 in accordance with the order of the title list currently being displayed, and also returns the display screen back to the screen in which the reproduction of the audio data is once stopped, as shown in FIG. 7E.

The above-mentioned processing procedure will be described below with reference to a flowchart in FIG. 8.

The title list in which the plurality of titles to specify the songs or music pieces recorded on the memory card 4 are arranged in accordance with the recording order is displayed

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(Step S11). In succession, by operating the rotation push switch 14 in the rotating direction, the focus is shifted to a title position of a song desired to be shifted. At the title position, the rotation push switch 14 is operated in the pushing direction, and its title is selected (Step S12). Next, the title selected by operating the rotation push switch 14 in the rotating direction is shifted to any position on the list (Step S13). Then, at the title position, the rotation push switch 14 is operated in the pushing direction to thereby determine the shift destination of the title (Step S14). After the determination of the shift destination of the title, it is possible to operate the rotation push switch 14 in the rotating direction to thereby select a title of a next song or music piece desired to be shifted. When the shifts of the titles are all completed, the display of the title list is ended, and the order of recording the songs recorded on the memory card 4 is rewritten in accordance with the title list order (Step S15).

As mentioned above, in the portable telephone 1, the editing work can be very easily carried out by rearranging the recording order of the audio data recorded on the memory card 4 in accordance with such an operational procedure.

By the way, the example of rearranging the audio data recorded on the memory card 4 has been described as mentioned above. However, in this procedure, the target for the rearrangement is not limited to the audio data. It may be applied to any information, if it is the information to define a recording order, for example, such as a picture data, a computer data, a telephone number list, an address list and the like. Also, the memory card 4 is exemplified as a recording medium. However, it may be any medium if it is a rewritable recording medium, such as the inner memory of the portable telephone 1, MD, and DVD-RAM.

(Switching of Character Input Mode)

An operation for switching a character input mode will be described below.

In the portable telephone 1, a plurality of character kinds are assigned to the dial keys 24. Any character kind of a character can be entered by switching the character input mode.

In the portable telephone 1, when the right soft key 17 is pushed to select "Mode" when a character input screen is displayed at the time of writing an electronic mail or the like, a character input mode selection screen is displayed as shown in FIG. 9A.

On this character input mode selection screen, all the character kinds assigned to the dial keys 24 are displayed on a list of two columns. The character kinds assigned to the dial keys 24 include, for example, a kanji (Chinese character), a double-byte (full size) kana, a double-byte (full size) alphabet, a double-byte (full size) numeral, a double-byte (full size) symbol (character letter or pictorial letter), a standard sentence format, a single-byte (half size) kana, a single-byte (half size) alphabet, a single-byte (half size) numeral, and a single-byte (half size) symbol (character letter or pictorial letter). On this character input selection screen as shown in FIG. 9A and FIG. 9B, a kanji (Chinese character) (top column), a double-byte kana (second upper column), a double-byte alphabet (third upper column), a double-byte numeral (third lower column), a double-byte symbol (character letter or pictorial letter) (second lower column), a standard sentence format (bottom column) are displayed in the left column of the list, and a single-byte kana (second upper column), a single-byte alphabet (third upper column), a single-byte numeral (third lower column), and a single-byte symbol (character letter or pictorial letter) (second lower column) are displayed in the right column of the list.

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On this character input mode selection screen, the rotating operation of the rotation push switch 14 enables the focus F to be cyclically shifted in an order of a kanji→a double-byte kana→a double-byte alphabet→a double-byte numeral→a double-byte symbol (character)→a standard sentence format→a single-byte kana→a single-byte alphabet→a single-byte numeral→a single-byte symbol (character)→a kanji→a double-byte kana and so on, as shown in FIG. 9B. Also, pushing the leftward direction key 18 or the rightward direction key 19 causes the focus F to be shifted between the left and right columns.

When this character input mode selection screen is displayed, the rotation push switch 14 and the direction keys 18, 19 that are operated as mentioned above are used to shift the focus to the character kind desired to be used. Then, when the rotation push switch 14 is pushed and operated to select "Selection", the operational flow returns back to the screen to write the electronic mail or the like. Thus, it is possible to enter the character set of the selected character kind.

As mentioned above, in the portable telephone 1, when the character input mode is operationally set on a character write screen, the character input mode selection screen in which all the character kinds are displayed is displayed. The selection of a character kind based on this character input mode selection screen enables the character of any character kind assigned to the dial keys 24 to be entered.

For this reason, in the portable telephone 1, the character input mode can be easily selected without any troublesome work such as an operation for pushing the mode set buttons, one by one, and then switching the character input mode.

By the way, on the character input mode selection screen, it may be designed to display only the character kind that can be entered at that time or select only the character kind that can be entered at that time. For example, when an electronic mail address or URL is entered, it is possible to design the character input mode selection screen so that only a half size of alphabet and a half size of numeral can be selected.

(Guidance Display)

A guidance display of a shiftable direction of a focus or the like and a guidance display of a page feed key will be described below.

In this portable telephone 1, a direction key guidance display is carried out for indicating whether or not the rotation push switch 14 can be rotationally operated and whether or not the leftward direction key 18 and the rightward direction key 19 can be operated. That is, the direction key guidance display indicates whether or not the pointer such as the focus, the cursor and the like can be effectively shifted upwardly and downwardly by rotationally operating the rotation push switch 14 and whether or not the pointer such as the focus, the cursor and the like can be effectively shifted in the leftward and rightward directions by operating the leftward direction key 18 and the rightward direction key 19.

This direction key guidance display is constituted by an upwardly shiftable mark 71, a downwardly shiftable mark 72, a leftwardly shiftable mark 73 and a rightwardly shiftable mark 74, as shown in FIG. 10. Those direction key guidance displays are displayed as respective arrow marks around a central soft key function indication 63. That is, the upwardly shiftable mark 71 is displayed as an upward arrow mark at an upper position of the central soft key function indication 63. The downwardly shiftable mark 72 is displayed as a downward arrow mark at a lower position of the central soft key function indication 63. The leftwardly shiftable mark 73 is displayed as a left arrow mark at a left position of the central soft key function indication 63. And, the rightwardly shiftable

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mark 74 is displayed as a rightward arrow mark at a right position of the central soft key function indication 63.

The upwardly shiftable mark 71 is displayed if the rotation push switch 14 can be upwardly operated, and it is not displayed if the rotation push switch 14 cannot be upwardly operated. In other words, the upwardly shiftable mark 71 is displayed, for example, if the focus F can be shifted in a direction of an arrow "a" in FIG. 10 (i.e., for example, if a selectable information exists at a further upper position of the focused information), and it is not displayed if the focus F cannot be shifted in the direction of the arrow "a" in FIG. 10 (i.e., for example, if the selectable information does not exist at the further upper position of the focused information).

The downwardly shiftable mark 72 is displayed if the rotation push switch 14 can be downwardly operated, and it is not displayed if the rotation push switch 14 cannot be downwardly operated. In other words, the downwardly shiftable mark 72 is displayed, for example, if the focus F can be shifted in a direction of an arrow "b" in FIG. 10 (i.e., for example, if a selectable information exists at a further lower position of the focused information), and it is not displayed if the focus F cannot be shifted in the direction of the arrow "b" in FIG. 10 (i.e., for example, if the selectable information does not exist at the further lower position of the focused information).

The leftwardly shiftable mark 73 is displayed if the leftward direction key 18 can be operated in the leftward direction, and it is not displayed if the leftward direction key 18 cannot be operated in the leftward direction. The leftwardly shiftable mark 73 is displayed, for example, if the focus F can be shifted in a direction of an arrow "c" in FIG. 10 (i.e., for example, if a selectable information exists at a further leftward position of the focused information or if there is a screen of an upper hierarchy of the selected information), and it is not displayed if the focus F cannot be shifted in the direction of the arrow "c" in FIG. 10 (i.e., for example, if the selectable information does not exist at the further leftward position of the focused information or if there is not the screen of the upper hierarchy of the selected information).

The rightwardly shiftable mark 74 is displayed if the rightward direction key 19 can be operated in the rightward direction, and it is not displayed if the rightward direction key 19 cannot be operated in the rightward direction. That is, the rightwardly shiftable mark 74 is displayed, for example, if the focus F can be shifted in a direction of an arrow "d" in FIG. 10 (i.e., for example, if a selectable information exists at a further rightward position of the focused information or if there is a screen of a lower hierarchy of the selected information), and it is not displayed if the focus F cannot be shifted in the direction of the arrow "d" in FIG. 10 (i.e., for example, if the selectable information does not exist at the further rightward position of the focused information or if there is not the screen of the lower hierarchy of the selected information).

An actual display example of the direction key guidance display will be described below with reference to the display screen of the portable telephone 1.

FIGS. 11A to 11D are views showing a jump menu that is a short cut screen to each display menu.

FIG. 11A is a display screen of a state at which when a jump menu screen is displayed, the focus F points out a character string of "Jump" of its menu title. The upwardly shiftable mark 71, the downwardly shiftable mark 72 and the leftwardly shiftable mark 73 are displayed at the state of this display screen. At this time, it is possible to shift the focus F upwardly and downwardly using the rotation push switch 14. Moreover, at this time, it is also possible to display the lower hierarchy on the screen by pushing the rightward direction key 19.

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Pushing the rightward direction key 19 on the display screen of FIG. 11A results in a display screen of FIG. 11B. This display screen of FIG. 11B is a selection screen showing an individual menu within the jump menu, and it is a screen of a state at which the focus F points out a selection position of "Internet". The upwardly shiftable mark 71, the downwardly shiftable mark 72, the leftwardly shiftable mark 73 and the rightwardly shiftable mark 74 are displayed on this display screen. At this time, it is possible to shift the focus F upwardly and downwardly by rotating the rotation push switch 14. Moreover, at this time, it is also possible to display the upper hierarchy (the screen of FIG. 11A) on the screen by pushing the leftward direction key 18, and to display the lower hierarchy on the screen by pushing the rightward direction key 19.

Pushing the left soft key 16 on the display screen of FIG. 11B results in a display screen of FIG. 11C. This display screen of FIG. 11C is an edition screen showing an individual menu within the jump menu. The upwardly shiftable mark 71 and the downwardly shiftable mark 72 are displayed on this display screen. At this time, it is possible to shift the focus F upwardly and downwardly by rotating the rotation push switch 14.

Pushing the right soft key 17 on the display screen of FIG. 11B results in a display screen of FIG. 11D. This display screen of FIG. 11D is an addition screen of an individual menu display within the jump menu. The upwardly shiftable mark 71, the downwardly shiftable mark 72 and the leftwardly shiftable mark 73 are displayed on this display screen. At this time, it is possible to shift the focus F upwardly and downwardly by rotating the rotation push switch 14. Moreover, at this time, it is also possible to display the lower hierarchy on the screen by pushing the rightward direction key 19.

Here, a division line 75 indicative of a head of a list is displayed on this display screen of FIG. 11D. The division line 75 indicative of the head of this list is used in the following manner, for example. That is, there is a case that although the number of displayed lists is definite, the focus is desired to be cyclically shifted by the rotating operation of the rotation push switch 14, namely, there is a case that the focus is desired to be shifted in order to make the focus coincide with the lowest portion of the list by instructing the further upward direction even if the focus coincides with the uppermost portion of the list. If the cyclic focus shift is carried out as mentioned above, a portion at which the head of the list is located cannot be evidently provided to the user. Accordingly, this portable telephone 1 is designed such that the division line 75 is displayed at the uppermost division position of the list.

FIGS. 12A to 12C are views showing an input screen of an electronic mail.

FIG. 12A is a display screen when even one character is not still written to a main body of a mail, and a cursor C is located on a left upper portion. The downwardly shiftable mark 72 and the rightwardly shiftable mark 74 are displayed on this display screen. At this time, it is possible to shift the cursor C downwardly by rotating the rotation push switch 14 downwardly. Moreover, at this time, it is also possible to shift the cursor C in the rightward direction by pushing the rightward direction key 19.

FIG. 12B is a display screen under a condition that the main body of the mail is written to a certain degree. The characters on the display shown in FIG. 12B and FIG. 12C are in Japanese in order to explain the character conversion function of the portable telephone of the present embodiment. The sentences shown in these figures means "○○ won 16-the game between ○○ and □□ in ΔΔ dome with score of 5-2. Win-

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ning pitcher was XX (not shown) who has won five games and lost three games in this season." The last word in the fifth row, which is shown with an underline, has just been currently inputted to be converted into a word with kanji. The upwardly shiftable mark 71, downwardly shiftable mark 72, the leftwardly shiftable mark 73 and the rightwardly shiftable mark 74 are displayed on this display screen. After the conversion, the cursor C will appear after the converted word. At this time, it is possible to shift the cursor C upwardly and downwardly by rotating the rotation push switch. Moreover, at this time, it is also possible to shift the cursor C in the leftward direction by pushing the leftward direction key 18, and to shift the cursor C in the rightward direction by pushing the rightward direction key 19.

FIG. 12C is a display screen when the word underlined in FIG. 12B has been converted into one of word with kanji (Chinese character). On this display screen, a conversion candidate display 76 is displayed for indicating that a conversion candidate is outputted by rotationally operating the rotation push switch 14.

In this portable telephone 1, a page feed guidance display is also carried out for indicating whether or not a previous page feed can be done by using the upward page feed key 25 or whether or not a next page feed can be done by using the downward page feed key 26.

That is, the page feed guidance display is the information to indicate whether or not the operation of the upward page feed key 25 or the downward page feed key 26 enables a page to be fed, namely, whether or not there is further information, currently invisible, beyond the display screen.

This page feed guidance display is constituted by an upwardly feedable page mark 77 and a downwardly feedable page mark 78, as shown in FIG. 13. Those page feed guidance displays are displayed at upper and lower positions on the left side of the display screen, respectively.

The upwardly feedable page mark 77 is displayed if the page feed can be upwardly done by using the upward page feed key 25, and it is not displayed if the operation is impossible.

The downwardly feedable page mark 78 is displayed if the page feed can be downwardly done by using the downward page feed key 26, and it is not displayed if the operation is impossible.

An actual display example of the page feed guidance display will be described below with reference to the display screen of the portable telephone 1.

FIGS. 14A to 14B are views showing an input screen of an electronic mail.

FIG. 14A is a display screen when the cursor is located at the position of the second character on the first row, under a condition that the main body of the mail is written to a certain degree. The downwardly feedable page mark 78 is displayed on this display screen. At this time, it is possible to scroll the page downwardly by pushing the downward page feed key 26.

FIG. 14B is a display screen when the page is downwardly scrolled correspondingly to one page from the state of FIG. 14A. The upwardly feedable page mark 77 and the downwardly feedable page mark 78 are displayed on this display screen. At this time, it is possible to scroll the page upwardly by pushing the upward page feed key 25. Also, it is possible to scroll the page downwardly by pushing the downward page feed key 26.

In the portable telephone 1, such executions of the direction key guidance display and the page feed key guidance display can improve the operational performances of the

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direction keys and the page feed keys and accordingly improve the convenience of the user.

(Answer Rejection During Music Reproduction)

The process of the portable telephone 1 when there is an incoming call from a partner during an audio reproduction will be described below with reference to display screens of FIGS. 15A, 15B and a flowchart of FIG. 16.

When the portable telephone 1 receives an incoming call from a partner during an audio reproduction (Step S21), a display screen is displayed as shown in FIG. 15A. At this time, if any key except the left soft key 16 is pushed (Step S22), the incoming call is received to start a call. Here, if the call is started, the audio reproduction is transiently suspended (Step S23). Also, when there is the incoming call, and the left soft key 16 is pushed (Step S22), a menu is displayed as shown in FIG. 15B (Step S24).

At this step S24, a menu display is carried out for indicating "Forward to Answer Service", "Incoming Call Forwarding", "Answer Holding" and "Answer Rejection".

In succession, in accordance with this menu display, the rotation push switch 14 is rotationally operated to then select any one of the menus (Steps S25, S26).

Here, if "Forward to Answer Service" is selected, a process is carried out for forwarding the telephone call from the partner to a telephone answer service station installed in the base station. If "Incoming Call Forwarding" is selected, a process is carried out for forwarding the telephone call from the partner to another telephone number. Also, if "Answer Holding" is selected, a state at which the incoming call from the partner is held is maintained (namely, the calling state is held). And, if "Answer Rejection" is selected, a process is carried out for disconnecting the telephone call from the partner.

In the portable telephone 1, if such a menu selection is done, an operation for rejecting a call is carried out correspondingly to the selection. At this time, the audio reproduction is continued (Step S27).

As mentioned above, in the portable telephone 1, if there is the incoming call during the audio reproduction, the rejection of the call is done depending on the operational input. Due to this mechanism, in the portable telephone 1, the simple operation enables the reproduction to be continued if there is the incoming call during the audio reproduction.

(Emergent Telephone Call in Case of Outgoing/Incoming Call Off Mode)

In this portable telephone 1, an outgoing/incoming call off mode can be set so as not to transmit and receive an electric wave by stopping the operation of the transmission/reception unit 51. When this outgoing/incoming call off mode is selected, for example, on the menu screen, the system controlling unit 57 stops a protocol operation of the transmission/reception unit 51, and perfectly stops transmitting and receiving the electric wave to and from the base station. Such setting of the outgoing/incoming call off mode can stop only the transmission and reception of the electric wave without turning off the power supply of the main body. Thus, it can be set at the state that the functions except the telephone function can be used. Hence, for example, although the telephone function cannot be used at this outgoing/incoming call off mode, it is possible to carry out the input operation of the character of the electronic mail, the recording and the reproduction of the music, and the like other operations.

Here, a process when a telephone number input is carried out in a case of this outgoing/incoming call off mode is set being described with reference to FIG. 17.

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If the outgoing/incoming call off mode is set, when the dial key 24 is pushed and a telephone number is inputted (Step S31), the system controlling unit 57 displays the pushed telephone number on the display 15 (Step S32).

In succession, when the start key 33 is pushed (Step S33), the system controlling unit 57 judges whether or not its telephone number inputted is one of emergency phone call numbers (for example, in a case of Japan, 110 for police, 118 for coast guard and 119 for fire station and/or ambulance) or a pre-registered predetermined telephone number (Step S34). By the way, the registered telephone number is desired to be different from a usual address registration, and it is desired to be a telephone number specially registered for an emergency.

If the telephone number inputted is not one of the emergency phone call numbers or the pre-registered telephone number, the outgoing call is stopped, and the outgoing/incoming call off mode is maintained in its original state (Step S35). That is, a phone call cannot be made.

On the other hand, if it is one of the emergency phone call numbers or the pre-registered telephone number, the system controlling unit 57 cancels the outgoing/incoming call off mode, and then actuates the protocol process of the operation of the transmission/reception unit 51 (Step S36).

In succession, when the protocol process of the operation of the transmission/reception unit 51 is started, the transmission/reception unit 51 starts an operation for capturing a base station.

When the transmission/reception unit 51 captures the base station, the transmission/reception unit 51 starts a process for transmitting an input telephone number (Step S38).

As mentioned above, in this portable telephone 1, even if it is set at the outgoing/incoming call off mode at which the transmission/reception of the electric wave is stopped and the outgoing/incoming of a call is not done, if a phone call of emergency or a preliminarily registered phone call is made, a call can be started without canceling operation of the outgoing/incoming call off mode by the user. Thus, it is possible to immediately make a report or make a call.

(Automatic Outgoing/Incoming Call Off During Recording Audio Data)

As mentioned above, in the portable telephone 1, the audio data inputted from the line input terminal 34 or the data input/output terminal 33 can be recorded on the memory card 4. A process when there is a request for recording audio data in the portable telephone 1 is described with reference to FIG. 18.

At first, when the power supply of the portable telephone 1 is turned on and there is the request for recording the audio data (Step S41), the system controlling unit 57 obtains information of a protocol operation state of the transmission/reception unit 51, and stores it in a memory (Step S42).

The system controlling unit 57 judges whether or not the protocol for the transmission/reception of the transmission/reception circuit 51 is currently operated (Step S43). If the protocol is operated, the operational flow proceeds to step S44. If it is not operated, the operational flow proceeds to step S45.

The system controlling unit 57, if the protocol of the transmission/reception circuit 51 is operated, stops the operation of the protocol of this transmission/reception circuit 51, and sets at the portable phone 1 at the outgoing/incoming call off mode in which the outgoing/incoming of the telephone call is not carried out.

The system controlling unit 57 starts the operation for recording the audio data (Step S45). Thus, the operation for

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recording the audio data at this step S45 is always carried out at the state at which it is set at the outgoing/incoming call off mode.

The system controlling unit 57, if there is a record stop request (Step S46), obtains a protocol operation state of the transmission/reception circuit 51 prior to the actuation of the recording operation stored in the memory at the previous step S42 (Step S47).

It judges whether or not the protocol is under operation, from the information read out at the step S47 (Step S48). If the protocol is under operation, the operational flow proceeds to step S49. If it is not under operation, the process, is ended.

Next, the system controlling unit 57, if the protocol of the transmission/reception circuit 51 is under operation, starts the operation of the protocol of the transmission/reception circuit 51 (Step S49). Then, the series of audio recording processes is ended.

As mentioned above, in the portable telephone 1, the interference in the recording operation caused by the incoming call can be avoided by automatically setting it at the outgoing/incoming call off mode, if there is the recording operation request.

(Display of Electric Field Strength in Remote Controller)

In the portable telephone 1, the remote controller unit 3 is mounted as mentioned above. The remote controller 42 in this remote controller unit 3 carries out a remote control for reproducing the audio data recorded on the memory card 4 and a remote control for the function of the main body of the portable telephone.

Such process for displaying electric field strength through the remote controller 42 will be described below with reference to a flowchart shown in FIG. 19.

If the user requests a display of electric field strength (Step S61), the remote controller controlling unit 46 of the remote controller 42 sends a report request of the electric field strength to the system controlling unit 57 (Step S62).

The system controlling unit 57 of the main body 2 sends electric field strength information currently being held (the information for displaying the electric field strength indication 61) and a timeout timer value to the remote controller 42 (Step S63).

When receiving the report from the system controller 57, the remote controller controlling unit 46 of the remote controller 42 judges whether or not any indication is currently displayed on the display unit 44 of the remote controller 42 (Step S64). If any indication is displayed on the display unit 44, the operational flow proceeds to step S65. If it is not displayed, the operational flow proceeds to step S66.

The remote controller controlling unit 46 of the remote controller 42 transiently saves the information currently being displayed on the display unit 44 (Step S65).

The remote controller controlling unit 46 of the remote controller 42 displays the electric field strength on the display unit 44, based on the electric field strength information sent out from the system controlling unit 57 of the main body 2 (Step S66). In the embodiment, the electric field strength information is displayed on the display unit 44 at approximately four stage levels, for example, such as an excellent level, a usual level, a bad level and an impossible communication. However, the indication is not limited to such four-stage-level display, and any other way for indicating the electric field strength may be employed.

The remote controller controlling unit 46 of the remote controller 42 actuates a timer (Step S67). The actuated timer carries out counting until a counted value reaches the timeout

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timer value sent out from the system controlling unit 57 of the main body 2. If the counting is ended, a timer event is generated.

If the timer event is generated from the timer (Step S68), The remote controller controlling unit 46 of the remote controller 42 judges whether or not there is the save information transiently saved at the step S65 (Step S69). If there is the save information, the operational flow proceeds to step S70. If there is not the save information, the operational flow proceeds to step S71.

In succession, if there is the save information, the remote controller controlling unit 46 of the remote controller 42 again displays the save information, and ends the process (Step S70). Also, the remote controller controlling unit 46 of the remote controller 42, if there is not the save information, removes the indication on the display unit 44, and ends the process (Step S71).

By the way, it may be designed that the timeout timer value is not sent out from the main body 2 and that it is set in advance on the remote controller side.

As mentioned above, the portable telephone 1 has the remote controller unit 3 separately mounted from the main body 2, and the electric field strength information is displayed on this remote controller unit 3. This mechanism of the portable telephone 1 enables the electric field strength of the received electric wave to be simply and conveniently checked by the user. For example, even if the main body 2 of the portable telephone is kept in a bag or the like, the electric field strength information is displayed on, for example, the remote controller unit 3. Thus, the user can check a current electric wave reception state very simply without especially taking out the main body 2 from the bag or the like to check the status. Also, the electric field strength information is not always displayed on the remote controller unit 3. That is, it is displayed, as necessary, in accordance with the operation from the user. Hence, it is possible to effectively use the display region placed on the remote controller unit 3.

(Display of Incoming Call on Remote Controller)

In the portable telephone 1, the remote controller unit 3 is disposed as mentioned above. The remote controller 42 of this remote controller unit 3 carries out the remote control for reproducing the audio data recorded on the memory card 4 and the remote control to the function of the main body 2 of the portable telephone.

A process for displaying a mail incoming by using such a remote controller 42 will be described below with reference to a flowchart shown in FIG. 21.

When automatically receiving a mail data from the base station (Step S81), the system controlling unit 57 of the main body 2 sends out a mail incoming display report and a timeout timer value to the remote controller 42 (Step S82).

When receiving the report from the system controller 57, the remote controller controlling unit 46 of the remote controller 42 judges whether or not any indication is currently displayed on the display unit 44 of the remote controller 42 (Step S83). If any indication is displayed on the display unit 44, the operational flow proceeds to step S84. If it is not displayed, the operational flow proceeds to step S85.

The remote controller controlling unit 46 of the remote controller 42 transiently saves the information currently being displayed on the display unit 44 (Step S84).

In accordance with a mail incoming report sent out from the system controlling unit 57 of the main body 2, the remote controller controlling unit 46 of the remote controller 42 displays the mail incoming indicative of the presence of the

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mail incoming (Step S85). This incoming indication is displayed, for example, such as "You've Got Mail", as shown in FIG. 22.

The remote controller controlling unit 46 of the remote controller 42 actuates the timer (Step S86). Then, the actuated timer carries out counting until a counted value reaches the timeout timer value sent out from the system controlling unit 57 of the main body 2. When the count is ended, the timer event is generated.

When the timer event is generated from the timer (Step S87), the remote controller controlling unit 46 of the remote controller 42 judges whether or not there is the save information transiently saved at the step S84 (Step S88). If there is the save information, the operational flow proceeds to step S89. If there is not the save information, the operational flow proceeds to step S90.

In succession, when there is the save information, again displays the save information, the remote controller controlling unit 46 of the remote controller 42, and ends the process (Step S89). Also, the remote controller controlling unit 46 of the remote controller 42, when there is not the save information, removes the indication on the display unit 44, and ends the process (Step S90).

By the way, it may be designed that the timeout timer value is not sent out from the main body 2 and that it is set in advance on the remote controller side.

As mentioned above, the portable telephone 1 has the remote controller unit 3 separately mounted from the main body 2, and the fact of the incoming of the electronic mail is displayed on this remote controller unit 3.

This mechanism of the portable telephone 1 which is a characteristic feature of the invention enables the fact of the incoming of the electronic mail to be quickly reported to the user. Also, the user can easily recognize the fact of the incoming of the electronic mail. In the portable telephone 1, for example, even if the main body 2 is kept in a bag or the like, the mail incoming is displayed on, for example, the display of the remote controller unit 3. Thus, the user can recognize the fact of the incoming of the electronic mail quickly and easily without especially checking the main body 2.

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What is claimed is:

1. A communication apparatus comprising:

a communication unit configured to transmit an outgoing call and to respond to an incoming call to communicate with at least another device;

a reproduction unit configured to reproduce music data; and

a controller unit configured to stop communicating with the other device and continue reproduction of said music data when an outgoing/incoming call off mode is selected.

2. The communication apparatus according to claim 1, wherein said controller unit is operable to input electronic mail characters even when said outgoing/incoming call off mode is selected.

3. The communication apparatus according to claim 1, further comprising:

a memory operable to record music data, and wherein said controller unit sets said outgoing/incoming call off mode when said memory is operated to record music data.

4. A method of operating a communication device comprising the steps of:

transmitting an outgoing call and responding to an incoming call to communicate with at least another device; reproducing music data; and

stopping communicating with the other device and continuing the reproduction of said music data when an outgoing/incoming call off mode is selected.

5. The method according to claim 4, further comprising the step of inputting electronic mail characters in said communication device even when said outgoing/incoming call off mode is selected.

6. The method according to claim 4, further comprising the steps of:

recording music data in a memory of said communication device; and

setting said outgoing/incoming call off mode upon recording music data in said memory.

* * * * *

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(12) **Reissued Patent**
Böhnke et al.

(10) **Patent Number:** **US RE40,568 E**
(45) **Date of Reissued Patent:** **Nov. 11, 2008**

(54) **SYNCHRONIZATION SYMBOL STRUCTURE
USING OFDM BASED TRANSMISSION
METHOD**

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(75) **Inventors:** **Ralf Böhnke**, Esslingen (DE); **Thomas Dölle**, München (DE); **Tino Puch**, Bonn (DE)

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(73) **Assignee:** **Sony Corporation**, Tokyo (JP)

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(22) **Filed:** **Nov. 23, 2005**

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Reissue of:

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Issued: **Nov. 25, 2003**
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Filed: **Jan. 6, 2000**

(51) **Int. Cl.**
H04J 11/00 (2006.01)

(52) **U.S. Cl.** **370/203; 370/208; 370/350; 375/355**

(58) **Field of Classification Search** **370/203, 370/208, 350, 375/355**
See application file for complete search history.

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Primary Examiner—Frank Duong
(74) *Attorney, Agent, or Firm*—Frommer Lawrence & Haug LLP, William S. Frommer

(57) **ABSTRACT**

The present invention proposes a method for generating synchronization bursts for OFDM transmission systems. The symbols of a predefined symbol sequence are mapped according to a predefined mapping scheme on subcarriers of the OFDM systems by a mapping unit (2), wherein the symbols of the predefined symbol sequence represent subcarriers of the OFDM system with nonzero amplitudes. A synchronization burst is generated by an inverse fast Fourier transforming unit (3) transforming the subcarriers of the OFDM system mapped to said predefined symbol sequence. The mapping (2) of the symbols of the predefined symbol sequence is set such that the resulting time domain signal of the synchronization burst represents a periodic nature. According to the invention the predefined symbol sequence is set such that the envelope fluctuation of the time domain signal of the synchronization burst is minimized. Therefore advantageous symbol sequences reducing said the envelope fluctuation of the time domain signal are proposed.

34 Claims, 9 Drawing Sheets

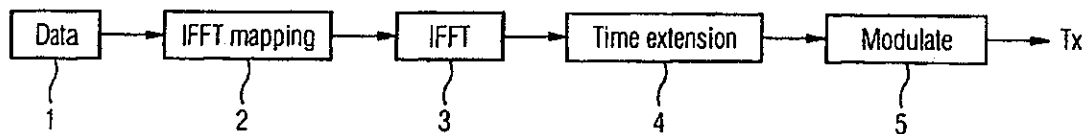


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FIG 1

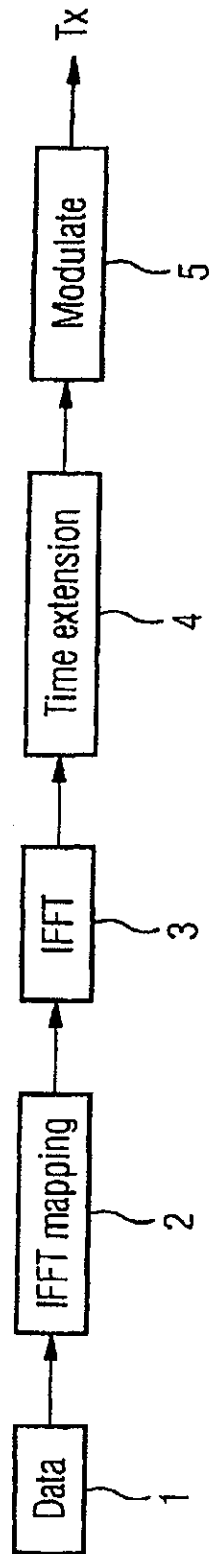


FIG 2

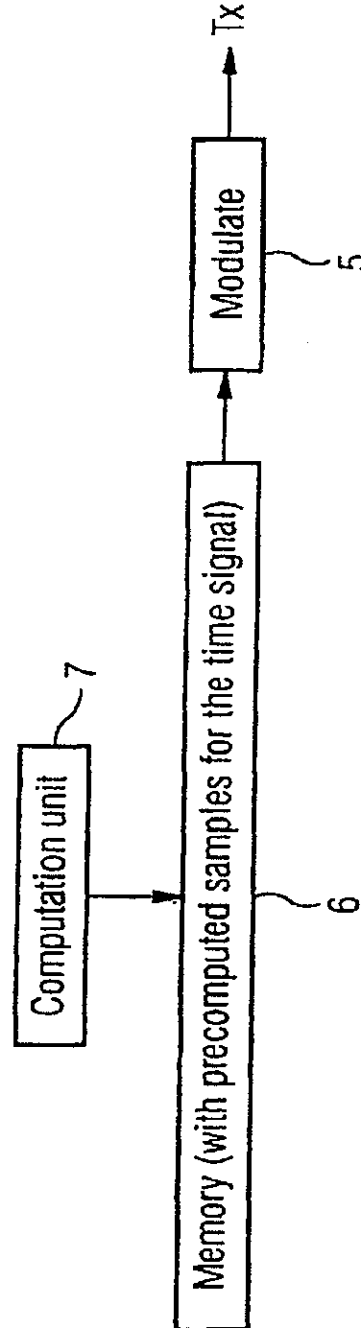


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FIG 3

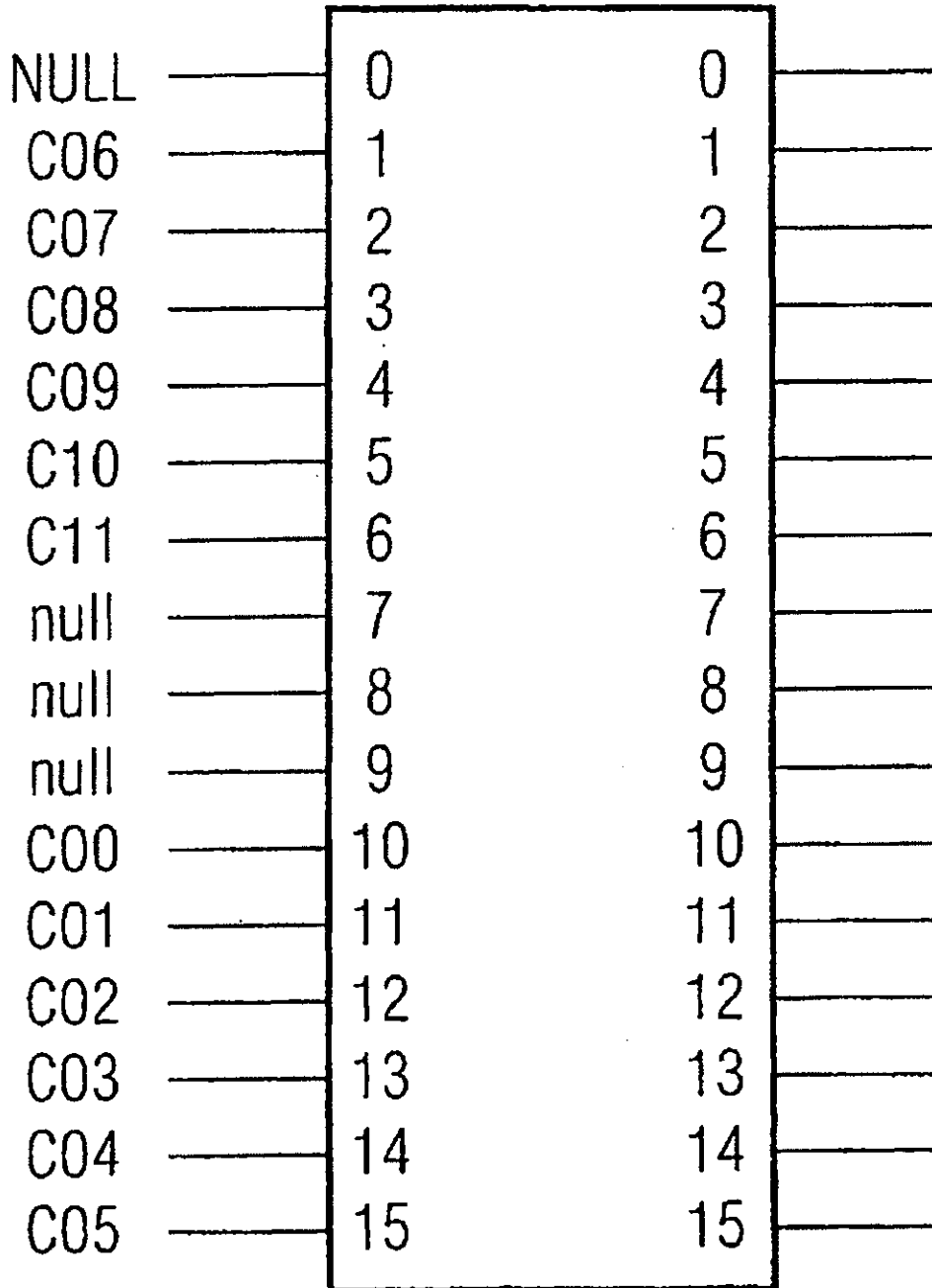


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FIG 4a

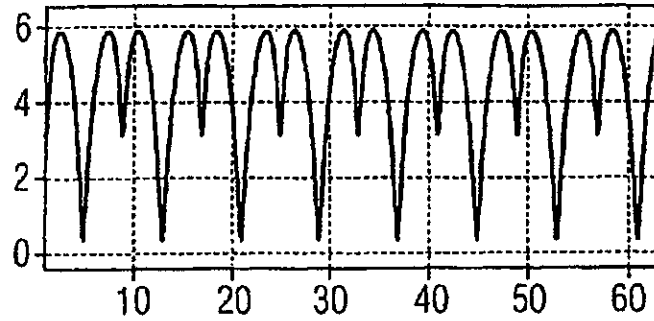


FIG 4b

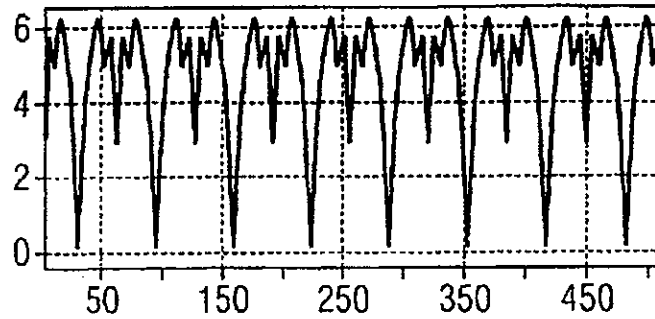


FIG 4c

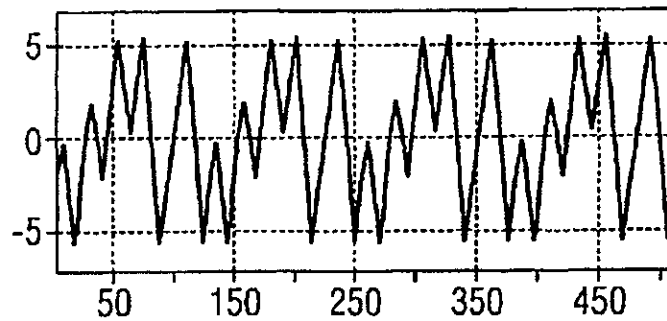


FIG 4d

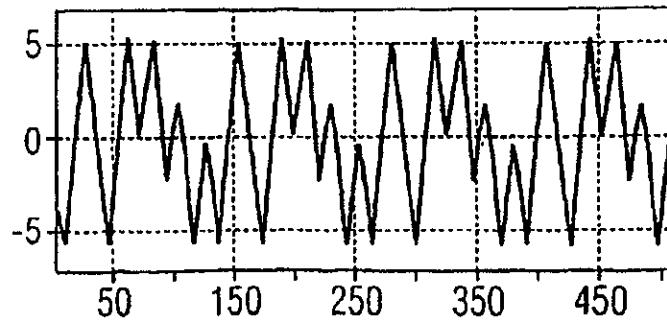


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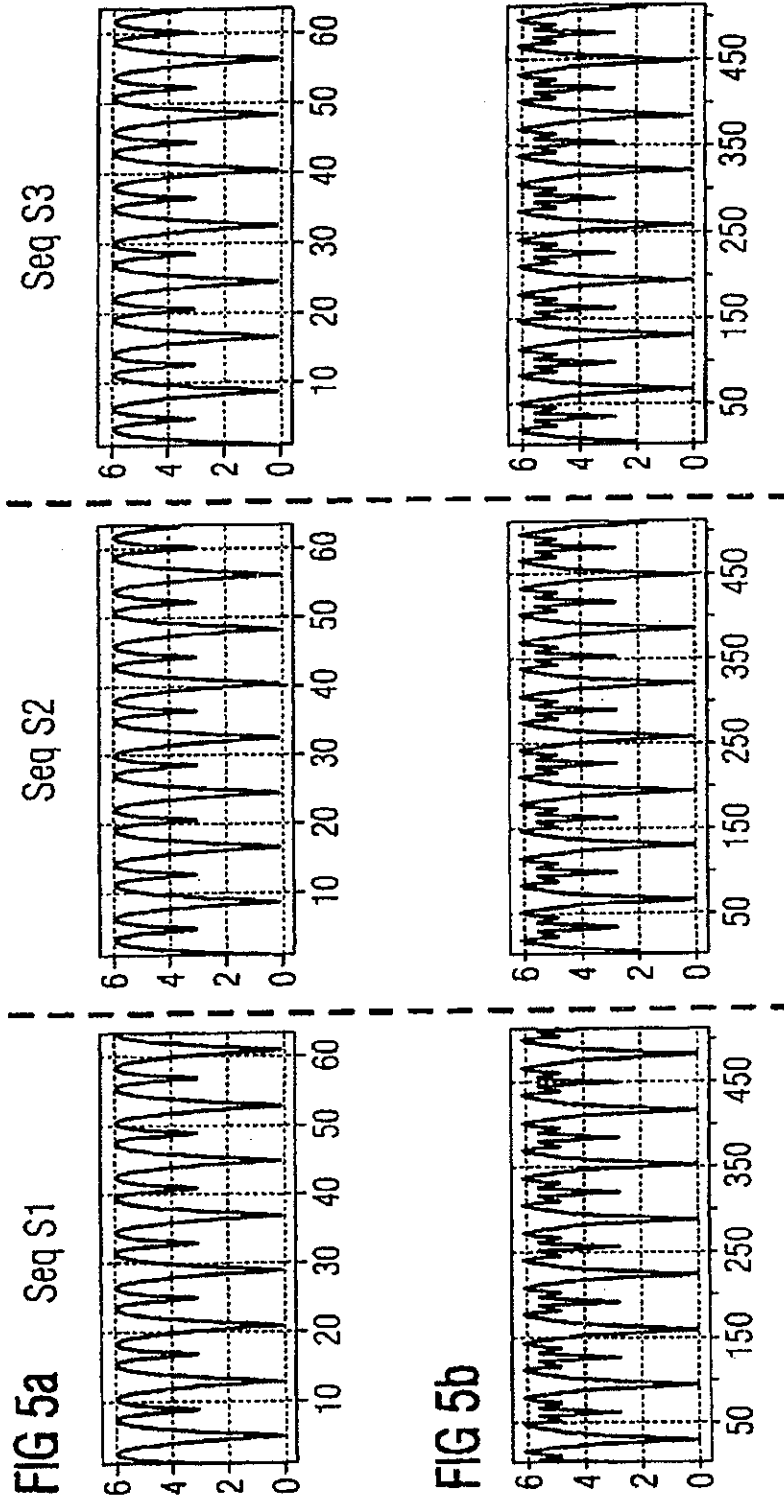


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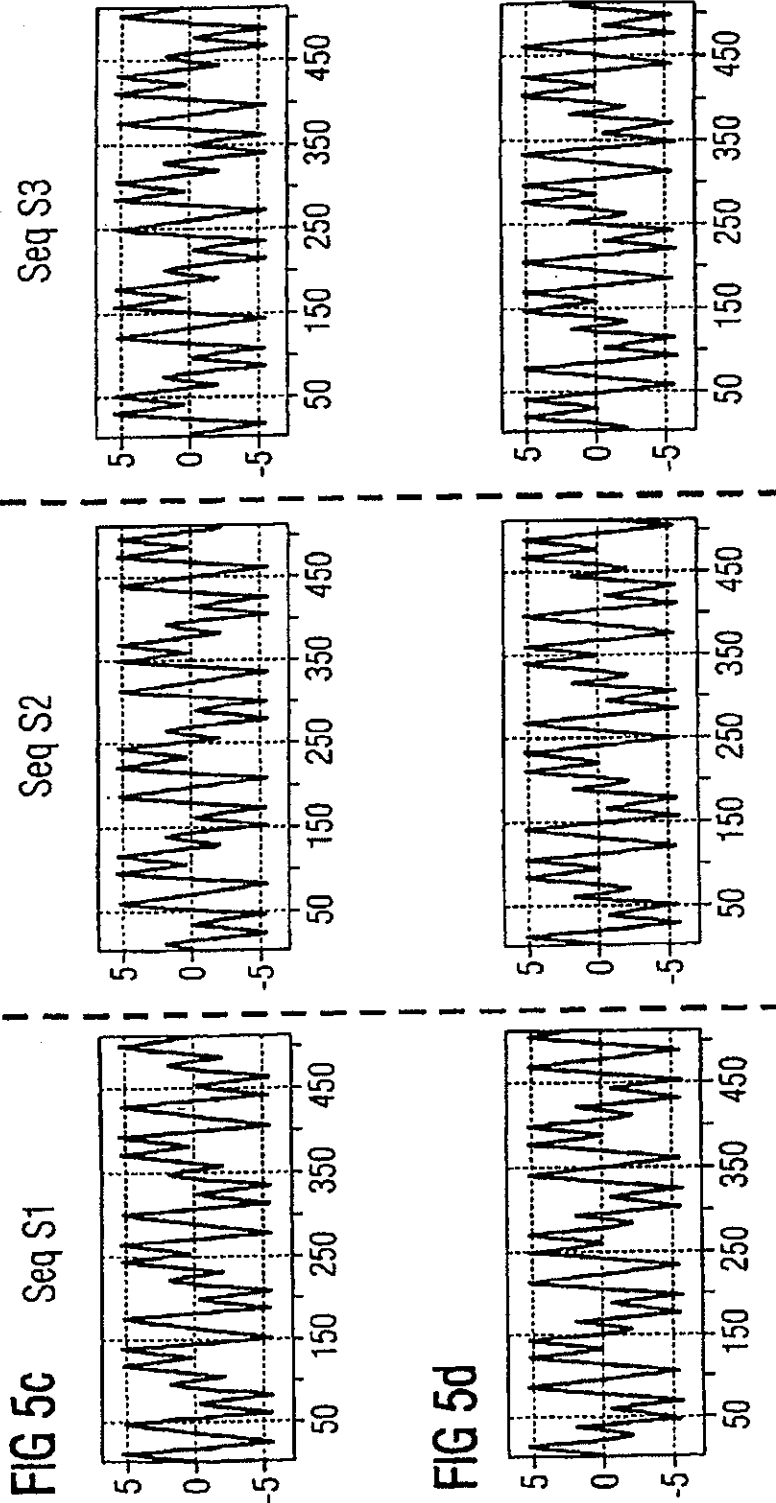


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FIG 6

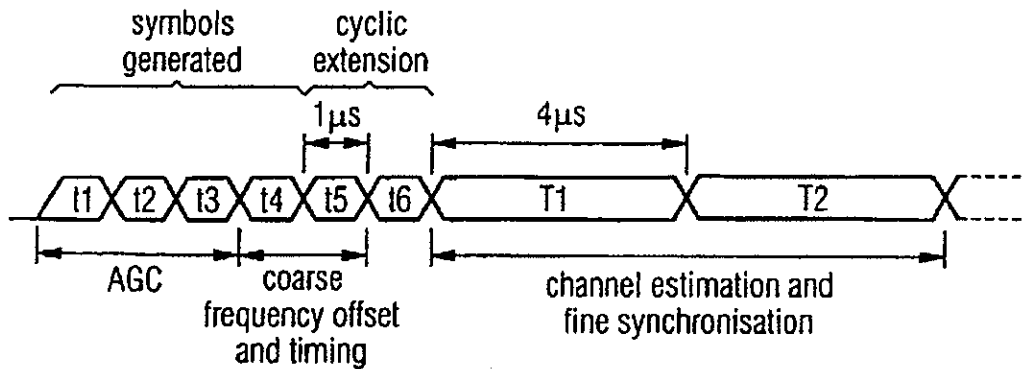


FIG 7

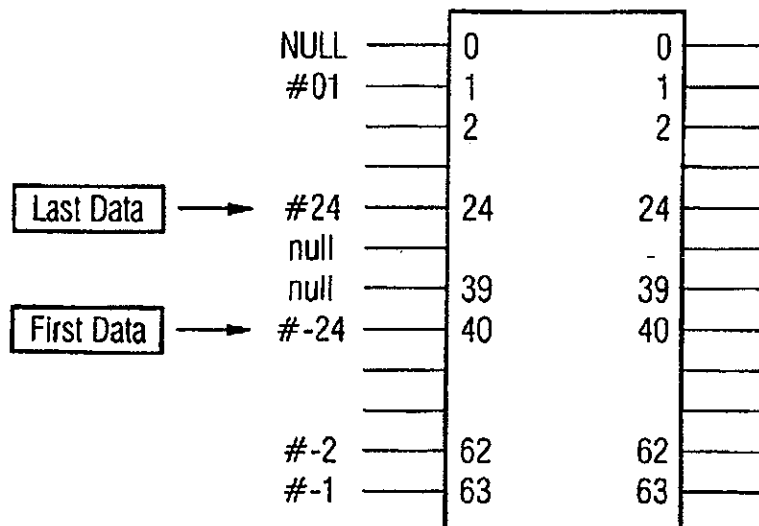


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FIG 8a

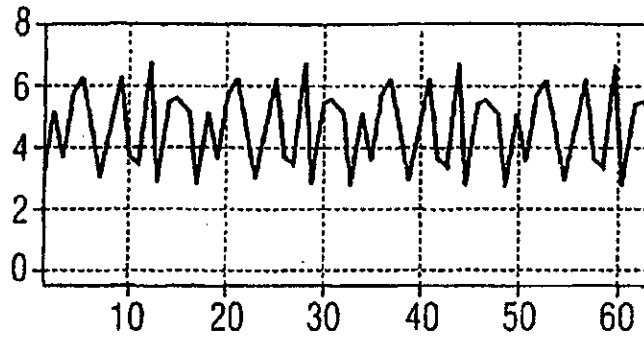


FIG 8b

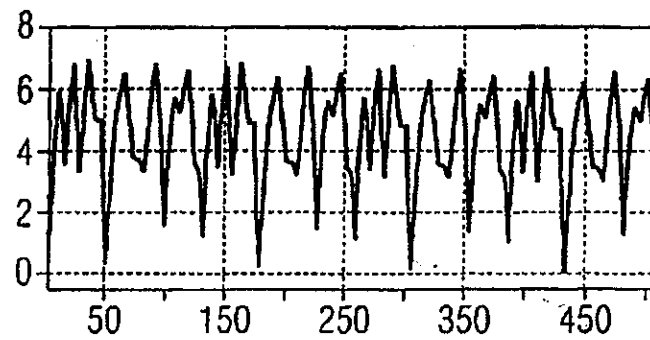


FIG 8c

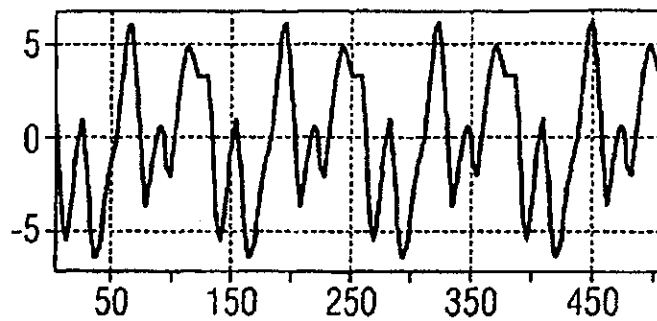


FIG 8d

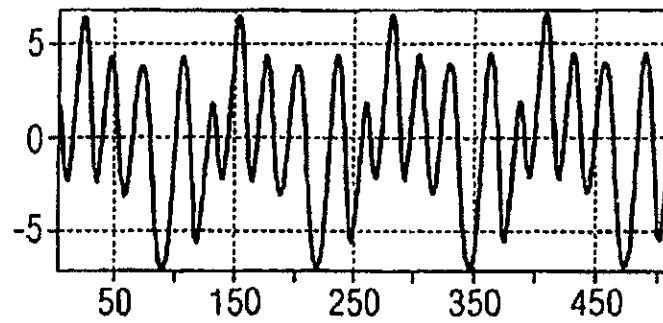


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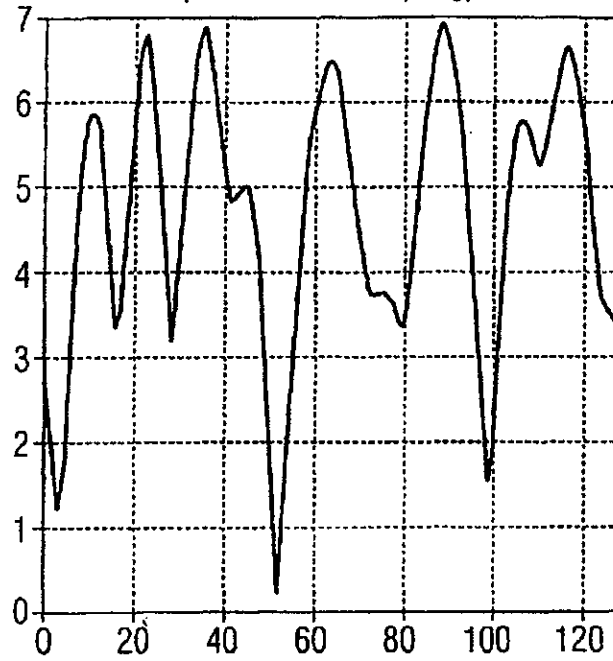
Nov. 11, 2008

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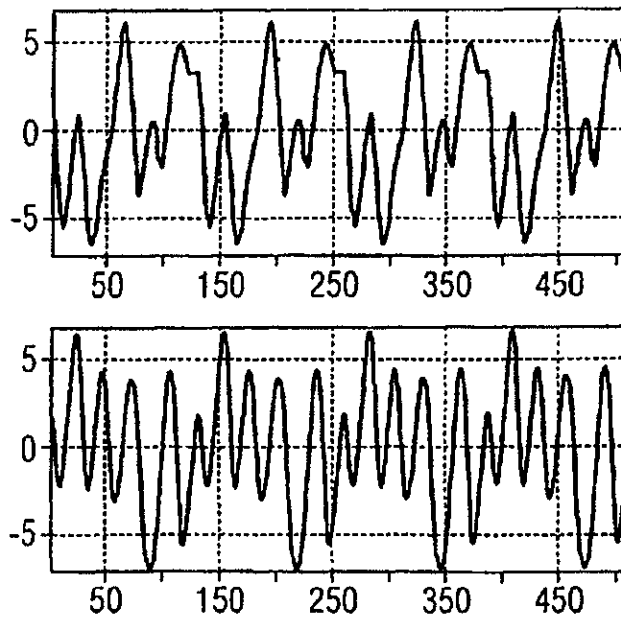
Time domain signal (magnitude) using the state of the art
(8-times oversampling)

FIG 9a



Signal (In and Quad part) using state of the art sequence
(8-times oversampling)

FIG 9b



PAPR: 3.01 dB
Dynamic Range: 30.82 dB

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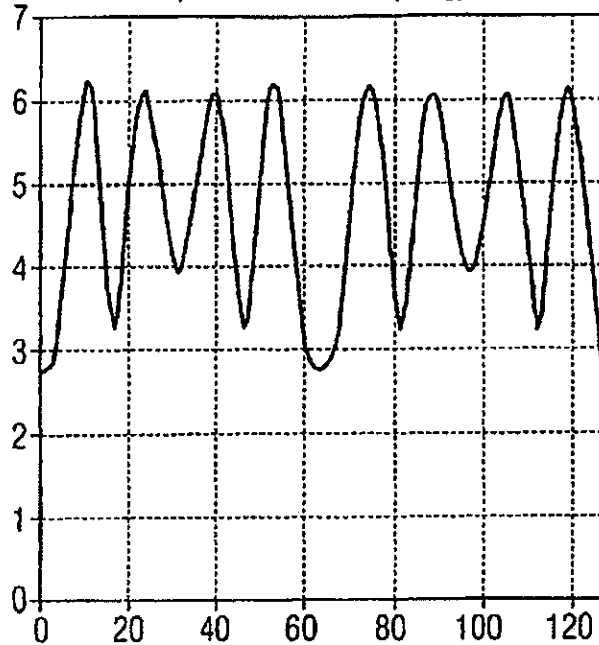
Nov. 11, 2008

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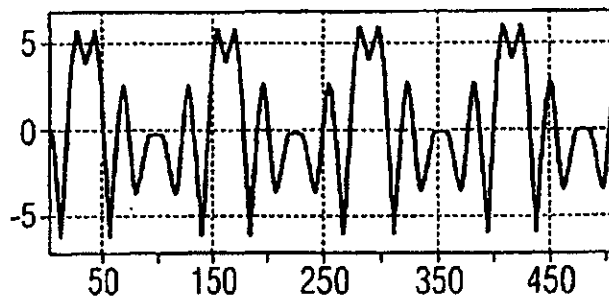
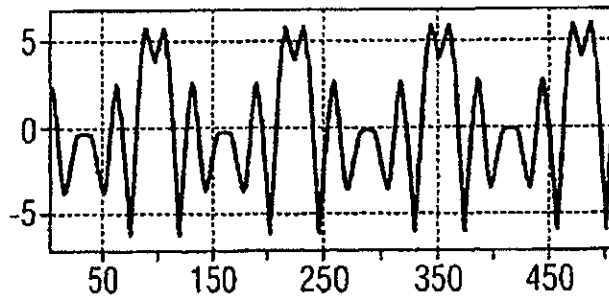
FIG 10a

Time domain signal (magnitude) using 'Seq-Alt1'
(8-times oversampling)



Signal (In and Quad part) using 'Seq-Alt1'
(8-times oversampling)

FIG 10b



PAPR: 2.24 dB
Dynamic Range: 7.01 dB

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SYNCHRONIZATION SYMBOL STRUCTURE
USING OFDM BASED TRANSMISSION
METHOD

Matter enclosed in heavy brackets [] appears in the original patent but forms no part of this reissue specification; matter printed in *italics* indicates the additions made by reissue.

The present invention relates to a method for generating synchronization bursts for OFDM transmission systems, a method for synchronizing wireless OFDM systems, an OFDM transmitter as well as to a mobile communications device comprising such a transmitter.

The present invention relates generally to the technical field of synchronizing wireless OFDM (orthogonal frequency division multiplexing) systems. Thereby it is known to use a synchronization burst constructed using especially designed OFDM symbols and time domain repetitions.

Particularly from the document IEEE P802.11a/d2.0 "Draft supplement to a standard for telecommunications and information exchange between systems—LAN/MAN specific requirements—part 1: wireless medium access control (MAC) and physical layer (PHY) specifications: high-speed physical layer in the 5 GHz band" a synchronization scheme for OFDM systems is proposed. This document is herewith included by reference as far as it concerns the synchronization including the proposed implementation. Said known scheme will now be explained with reference to FIG. 6 to 8 of the enclosed drawings.

FIG. 6 shows the structure of the known synchronization field. As shown in FIG. 6 the synchronization field consists of so-called short symbols t_1, t_2, \dots, t_6 and two long symbols T_1, T_2 . In view of the present invention particularly the short symbols t_1, t_2, \dots, t_6 are of interest. Among the short symbols t_1, t_2, \dots, t_6 used for the amplifier gain control (t_1, t_2, t_3) and the course frequency offset and timing control only the symbols t_1, t_2, t_3 and t_4 are actually generated, whereas the symbols t_5, t_6 are cyclic extensions (copies of the symbols t_1 and t_2 , respectively). It is to be noted that FIG. 5 shows only the synchronization preamble structure as the structure of the following signal field indicating the type of baseband modulation and the coding rate as well as the structure of further following data fields are not of interest in view of the present invention. For further details reference is made to said prior art document.

The symbols t_1, t_2, t_3, t_4 are generated by means of an OFDM modulation using selected subcarriers from the entire available subcarriers. The symbols used for the OFDM modulation as well as the mapping to the selected subcarriers will now be explained with reference to FIG. 6.

Each of the short OFDM symbols t_1, \dots, t_6 is generated by using 12 modulated subcarriers phase-modulated by the elements of the symbol alphabet:

$$S = \sqrt{2}(\pm 1 \pm j)$$

The full sequence used for the OFDM modulation can be written as follows:

$$S_{-24,24} = \sqrt{2} * \{1+j, 0, 0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, -1-j, 0, 0, 0, 1-j, 0, 0, 0, 0, 0, 0, 1+j, 0, 0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, 1+j, 0, 0, 0, -1-j, 0, 0, 0, 1+j\}$$

The multiplication by a factor of $\sqrt{2}$ is in order to normalize the average power of the resulting OFDM symbol.

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The signal can be written as:

$$r_{\text{SHORT}}(t) = w_{\text{SHORT}}(t) \sum_{k=-N/2}^{N/2} S_k \exp(j2\pi k \Delta f t)$$

The fact that only spectral lines of $S_{-24, 24}$ with indices which are a multiple of 4 have nonzero amplitude results in a periodicity of $T_{\text{FFT}}/4 = 0.8 \mu\text{sec}$. The interval T_{SHORT} is equal to nine $0.8 \mu\text{sec}$ periods, i.e. $7.2 \mu\text{sec}$.

Applying a 64-point IFFT to the vector S , where the remaining 15 values are set to zero, four short training symbols t_1, t_2, t_3, t_4 (in the time domain) can be generated. The IFFT output is cyclically extended to result in 6 short symbols $t_1, t_2, t_3, \dots, t_6$. The mapping scheme is depicted in FIG. 7. The so called virtual subcarriers are left unmodulated.

The way to implement the inverse Fourier transform is by an IFFT (Inverse Fast Fourier Transform) algorithm. If, for example, a 64 point IFFT is used, the coefficients 1 to 24 are mapped to same numbered IFFT inputs, while the coefficients -24 to -1 are copied into IFFT inputs 40 to 63. The rest of the inputs, 25 to 39 and the 0 (DC) input, are set to zero. This mapping is illustrated in FIG. 7. After performing an IFFT the output is cyclically extended to the desired length.

With the proposed inverse fast Fourier transform (IFFT) mapping as shown in FIG. 7 the resulting time domain signal consists of 4 periodically repeated short symbols t_1, t_2, t_3, t_4 , and cyclically extended by a copy of t_1, t_2 , which copy is depicted in FIG. 5 as t_5, t_6 . Note that in the present case only spectral lines with indices which are a multiple of 4 have nonzero amplitude. Other periodic natures can be generated by setting other multiples of the spectral lines to nonzero amplitudes.

Though the known synchronization scheme is very effective, it provides for disadvantage regarding the time domain signal properties.

For OFDM (or in general multicarrier signals) the signal envelope fluctuation (named Peak-to-Average-Power-Ratio=PAPR) is of great concern. A large PAPR results in poor transmission (due to nonlinear distortion effects of the power amplifier) and other signal limiting components in the transmission system (e.g. limited dynamic range of the AD converter).

For synchronization sequences it is even more desirable to have signals with a low PAPR in order to accelerate the receiver AGC (automatic gain control) locking and adjusting the reference signal value for the A/D converter (the whole dynamic range of the incoming signal should be covered by the A/D converter resolution without any overflow/underflow).

FIGS. 8a, 8b show the "absolute" ($\sqrt{\ln^* + \text{Quad} * \text{Quad}}$) value of the resulting time domain signal waveform with the sequences proposed by Lucent Technologies. Oversampling (8^*) was considered in order to ensure the peak was captured correctly using the limited 64-point IFFT.

FIGS. 8c, 8d show the real and imaginary part of the resulting transmitted time domain waveform. The resulting PAPR is 2.9991 dB (no oversampling) and 3.0093 dB (with 8 times oversampling).

Therefore it is the object of the present invention to provide for a synchronization technique which bases on the known synchronization technique but which presents improved time domain signal properties to reduce the requirements for the hardware.

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The above object is achieved by means of the features of the independent claims. The dependent claims develop further the central idea of the present invention.

According to the present invention therefore a method for generating synchronization bursts for OFDM transmission systems is provided. Symbols of a predefined symbol sequence are mapped according to a predefined mapping scheme on subcarriers of the OFDM system wherein the symbols of the predefined symbol sequence represent subcarriers with nonzero amplitudes. A synchronization burst is generated by inverse fast Fourier transforming the subcarriers mapped with a predefined symbol sequence. According to the present invention the predefined symbol sequence is optimized such that the envelope fluctuation of the time domain signal (Peak-to-average-power-ratio) is minimized.

The predefined symbol sequence can be chosen such that the following equations are satisfied for all symbols of the predefined symbol sequence:

$$n=2m, \\ C_{i-1} = \pm C_{1-n}$$

n being the number of symbols of the predefined symbol sequence,

m being an integer larger than one,

C being the symbol value, and

i being an integer running from 1 to m.

The mapping of the symbols of the predefined symbol sequence and the Inverse Fast Fourier Transform can be set such that the resulting time domain signal of the synchronization burst represents a periodic nature.

Alternatively the mapping of the symbols of the predefined symbol sequence and the Inverse Fast Fourier Transform is set such that one burst part of the synchronization burst in the time domain is generated and the periodic nature of the synchronization burst in the time domain is achieved by copying the one burst part.

The number of symbols of a symbol sequence (n) can for example be 12.

The above equations define generally the symbol sequences according to the present invention. The predefined symbol sequence can therefore be for example:

A A A -A -A -A -A -A -A -A -A -A,

wherein A is a complex value.

Alternatively the predefined symbol sequence can be:

A -A A A -A A A A A -A -A -A,

wherein A is a complex value.

Alternatively the following predefined symbol sequence can be used:

A B -A B -A -B B A -B A -B -A,

wherein A, B are complex values.

As a further alternative the following sequence can be used:

A -B -A -B -A B -B A B A B -A,

wherein A, B are complex values.

According to the present invention furthermore a method for synchronizing wireless OFDM systems is provided, wherein a synchronization burst is generated according to a method as set forth above and the synchronization burst is transmitted respectively before the transmission of data fields.

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Thereby the time domain signals of the synchronization burst can be precomputed and stored in a memory, such that the computation of the time domain signal of the burst is only effected once.

According to the present invention furthermore a OFDM transmitter is provided comprising a mapping unit for mapping the symbols of a predefined symbols sequence according to a predefined mapping scheme on subcarriers of the OFDM system, wherein the symbols of a predefined symbols sequence represent the subcarriers of the OFDM system with nonzero amplitudes. Furthermore an inverse fast Fourier transforming unit is provided for generating a synchronization burst by inverse fast Fourier transforming the subcarriers of the OFDM mapped with said predefined symbols sequence. The mapping unit thereby is designed such that the resulting time domain signal of the synchronization burst represents a periodic nature. The mapping unit according to the present invention uses a predefined symbol sequence which is such that the envelope fluctuation of the time domain signal of the synchronization burst is minimized.

According to the present invention furthermore a mobile communications device such as set forth above is used.

With reference to the figures of the enclosed drawings referred embodiments of the present invention will now be explained.

FIG. 1 shows schematically a transmitter according to the present invention,

FIG. 2 shows an alternative embodiment for a transmitter according to the present invention,

FIG. 3 shows an alternative mapping scheme according to the present invention,

FIGS. 4a to 4d show the time domain signal properties achieved with the synchronization symbol structure using OFDM based transmission according to the present invention,

FIGS. 5a to 5d show the time domain signal properties of synchronization symbol structures according to alternative embodiments of the present invention,

FIG. 6 shows a synchronization preamble structure known from the prior art,

FIG. 7 shows an IFFT mapping according to the prior art, and

FIGS. 8a to 8d show the time domain properties of the synchronization symbol structure according to the prior art,

FIGS. 9a and 9b show the time domain properties, particularly the dynamic range of the synchronization symbol structure according to the prior art, and

FIGS. 10a and 10b show the time domain properties of the synchronization symbol structure according to further alternative embodiments of the present invention,

According to the present invention the time domain synchronization burst structure as shown in FIG. 6 is maintained. The IFFT mapping as shown in FIG. 7 can be maintained or alternatively the IFFT mapping according to FIG. 3 can be used. The symbol sequences mapped to the subcarriers are optimized to sequences which result in a lower PAPR.

According to the present invention a short OFDM symbol (t1, ... t6) consists of 12 phase-modulated subcarriers.

	C00	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11
Seq0	A	A	A	-A	-A	-A	-A	A	-A	-A	A	-A
Seq1	A	-A	A	A	-A	A	A	A	A	-A	-A	-A

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-continued

	C00	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11
Seq2	A	B	-A	B	-A	-B	B	A	-B	A	-B	-A
Seq3	A	-B	-A	-B	-A	B	-B	A	B	A	B	-A

with

$$A = \exp(j\pi/2 + \pi\varphi_A) \text{ and}$$

$$B = A * \exp(j\pi/2) = \exp(j2\pi\varphi_A + j\pi/2) \text{ and } 0.0 \leq \varphi_A < 1.0.$$

Generally the predefined symbol sequence therefore is chosen such that the envelope fluctuation of the time domain signal of the synchronization burst is minimized.

Therefore generally the predefined symbol sequence is set such that the following equations are satisfied for all symbols for the predefined symbol sequence:

$$n=2m,$$

$$C_{i-1} = \pm C_{n-i}$$

wherein n is a number of symbols of the predefined symbol sequence,

m is an integer larger than 1,

c is the symbol value, and

i is an integer value running from 1 to m.

In the following the time domain signal properties of the new sequences according to the present invention will be shown with reference to FIGS. 4a to 4d and FIGS. 5a to 5d.

For simplicity we use in our demonstration the classical quadriphase symbol alphabet,

$$S = \sqrt{\frac{1}{2}} (\pm 1 \pm j),$$

(this corresponds to $\phi_A=0.125$)

Symbol		
A	$\exp(j\pi/4)$	$\sqrt{\frac{1}{2}} (+1 + j)$
-A	$-\exp(j\pi/4) = \exp(j5\pi/4)$	$\sqrt{\frac{1}{2}} (-1 - j)$

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-continued

Symbol		
B	$\exp(j\pi/4 + j\pi/2) = \exp(j3\pi/4)$	$\sqrt{\frac{1}{2}} (-1 + j)$
-B	$-\exp(j3\pi/4) = \exp(j7\pi/4)$	$\sqrt{\frac{1}{2}} (+1 - j)$

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Table 1: Complex symbol mapping

FIGS. 5a and 5b thereby show the time domain signal (magnitude) when using the optimized sequence according to the present invention in the case of no oversampling/8-times oversampling is effected.

PAPR (in decibel) is limited to 2.059 (even when using a time domain oversampling to capture the actual peak).

FIGS. 5c and 5d show the in-phase and quadrature-phase component, respectively, of the resulting wave form. It is clearly visible that the full symbol consists of four repetitions of a short sequence.

FIGS. 5a to 5d show graphics corresponding to FIGS. 4a to 4d for the other proposed sequences S1, S2 and S3.

Further simulations have shown that not only the PAPR can be optimized but also the dynamic range of the signal should be minimized. Therefore another four sequences, with achieve a small PAPR and at the same time a small overall dynamic range are proposed further below.

Using the sequence as proposed in the state of the art the PAPR is 3.01 dB and the dynamic range (defined as the ratio of the peak power to the minimum power) is 30.82 dB (see FIGS. 9a and 9b).

Using the sequences according to the present invention and as described above the PAPR is reduced to 2.06 dB, however, the dynamic range is increased as the signal power is '0' at some points.

Therefore the following four sequences are proposed as a further embodiment of the present invention:

The symbol sequence is C0, C1, ... C11 and the mapping is:

$$S = 2 * \{C00, 0, 0, 0, C01, 0, 0, 0, C02, 0, 0, 0, C03, 0, 0, 0, C04, 0, 0, 0, C05, 0, 0, 0, 0, 0, 0, C06, 0, 0, 0, C07, 0, 0, 0, C08, 0, 0, 0, C09, 0, 0, 0, C10, 0, 0, 0, C11\}$$

	C00	C01	C02	C03	C04	C05	C06	C07	C08	C09	C10	C11
Seq-Alt0	A	A	A	A	-A	-A	A	-A	-A	A	-A	A
Seq-Alt1	A	-A	A	-A	-A	A	-A	-A	A	A	A	A
Seq-Alt2	A	B	-A	-B	-A	-B	-B	-A	-B	-A	B	A
Seq-Alt3	A	-B	-A	B	-A	B	B	-A	B	-A	-B	A

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with $A = \exp(j\pi/2 * \pi * \phi_A)$ and

$$B = A * \exp(j\pi/2) = \exp(j2\pi * \phi_A + j\pi/2)$$

and $0.0 \leq \phi_A < 1.0$.

Using these sequences the PAPR is reduced to 2.24 dB and the dynamic range is limited to 7.01 dB as it is shown in FIGS. 10a and 10b.

The advantages are the same as described before, however, the clipping problem is further reduced due to the very limited dynamic range of the signal.

With reference to FIG. 1 and 2 possible implementations of a transmitter according to the present invention will now be explained.

In the transmitter the sync symbol data 1 are prepared and mapped in a IFFT mapping unit 2 to the appropriate IFFT points. The subcarriers of the OFDM system are transformed by a IFFT unit 3 and then the time domain signal is extended in a time extension unit 4 by copying parts of the signals (for example, t1, t2 are copied to t5, t6). The time extended signal is then sent to the I/Q modulator 5.

As shown in FIG. 2 alternatively the time domain signal can be precomputed once in a computation unit 7 and then be stored in a memory 6 for the precomputed sample for the time signal. Then the time domain signal of the synchronization burst can be sent to the modulator 5 directly from the memory 6.

With reference to FIG. 3 a modified IFFT mapping scheme will now be explained.

According to this scheme, the principle of setting only every fourth subcarrier of the OFDM system to a non-zero amplitude (see FIG. 7) is abandoned. Therefore the time domain signal achieved according to the mapping scheme of FIG. 3 will not present a periodic nature.

The IFFT size is now only 16 (instead of 64 as it is the case in FIG. 7). Only one of the bursts t1, t2, . . . t6 will be generated. The other bursts can be generated by copying to retain the periodic nature of the synchronization time domain signal necessary for the correlation and synchronization on the receiving side. Therefore for example the time extension unit 4 can perform the copying of the 16-sample burst t1 generated by the IFFT 16 according to FIG. 7 to the other burst t2, t3, . . . t6. Obviously the mapping scheme according to FIG. 3 reduces the computing effort necessary for the IFFT. The periodic nature of the time domain signal of the SYNCH bursts is therefore no longer achieved by the IFFT step, but by copying the burst t1 generated with the simplified IFFT mapping scheme.

The mapping scheme shown in FIG. 3 is also advantageous in combination with the precomputing technique shown in FIG. 2.

According to the present invention therefore a synchronization burst structure to be used in high speed wireless transmission systems is proposed. The synchronization burst is constructed using especially designed OFDM symbols and time domain repetitions. The resulting synchronization burst achieves a high timing detection and frequency offset estimation accuracy. Furthermore the burst is optimized to achieve a very low envelope fluctuation (Low peak-to-average-power-ratio) to reduce the complexity on the receive and to reduce time and frequency acquisition time at the receiver.

Therefore the synchronization performance can further be improved. As with the scheme according to the present invention the envelope of the OFDM based synchronization burst in the time domain is reduced, the AGC pool-in speed at the receiver can be improved and an accurate time and frequency synchronization can be achieved. Furthermore the synchronization complexity on the receiver side can be

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reduced due to the reduced resolution requirements necessary due to reduced envelope fluctuation.

The advantages of the present invention can be set forth as following:

- 5 An OFDM based SYNCH symbol with a reduced Peak-to-Average-Power-Ratio (PARP) is proposed,
- Improved synchronization performance (compared to the state of the art proposal),
- Reduced AGC (automatic gain control) pull-in time due to reduced dynamic range of the SYNCH burst,
- Improved AGC settlement (AGC has to adjust to an incoming signal level that later on now overflow/underflow in the AD happens. The reduced dynamic range of the SYNCH burst help to find this reference level more accurate),
- 15 Reduced synchronization detection complexity on the receiver (reduced resolution necessary due to reduced envelope fluctuation).

What is claimed is:

1. A method for generating synchronization bursts for OFDM transmission systems, comprising the following steps:

mapping the symbols of a predefined symbol sequence according to a predefined mapping scheme on subcarriers S of the OFDM system, wherein the symbols of the predefined symbol sequence represent subcarriers of the OFDM system with non-zero-amplitude, and

generating a synchronization burst by Inverse Fourier Transforming the subcarriers S of the OFDM system mapped with the symbols of said predefined symbol sequence,

characterized in that

the predefined symbol sequence is set such that the envelope fluctuation of the time domain signal of the synchronization burst is minimized and the symbols of the predefined symbols sequence can be expressed as

$A - A A - A - A A - A - A A A A A$

40 A being a complex value.

2. A method for synchronizing wireless OFDM systems, characterized by the steps of

generating a synchronization burst according to a method according to claim 1, and

transmitting the synchronization burst.

3. A method according to claim 2, characterized in that the time domain signal of the synchronization burst is precomputed and stored in a memory.

4. An OFDM transmitter, comprising:

a unit for mapping the symbols of a predefined symbol sequence according to a predefined mapping scheme on subcarriers of the OFDM system, wherein the symbols of the predefined symbol sequence represent subcarriers of the OFDM system with non-zero-amplitude, and

a unit for generating a synchronization burst by Inverse Fourier Transforming the subcarriers of the OFDM system mapped with the symbols of said predefined symbol sequence,

characterized in that

the mapping unit is designed to modulate the subcarriers such that the envelope fluctuation of the time domain signal of the synchronization burst is minimized by using the following predefined symbol sequence:

$A - A A - A - A A - A - A A A A A$

A being a complex value.

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5. An OFDM transmitter according to claim 4, characterized by
a time extension unit copying the burst part to achieve a periodic nature of the time domain signal.

6. An OFDM transmitter according to claim 4, characterized by
a processing unit for precomputing the time domain signal of the synchronization burst
and a memory for storing the precomputed time domain signal of the synchronization burst.

7. A mobile communications device, comprising a transmitter according to claim 4.

8. A synchronization burst signal for synchronizing OFDM systems generated by a method according to claim 1.

9. A method for generating a synchronization signal by using a plurality of subcarriers for an OFDM transmission system, comprising the steps of:
mapping symbols of a predefined symbol sequence in accordance with a predefined mapping scheme on said plurality of subcarriers, wherein pre-selected twelve symbols of the predefined symbol sequence have non-zero values, and
generating a synchronization signal by Inverse Fourier Transforming said plurality of subcarriers mapped with the symbols of said predefined symbol sequence, wherein the symbols of the predefined symbols sequence are expressed as
 $A - A A - A A - A A - A A A A A$
 A being a complex value.

10. A method for generating a synchronization signal by using a plurality of subcarriers in an OFDM transmission system, comprising the steps of:
generating a predefined symbol sequence having at least twelve symbols corresponding to respective pre-selected ones of said plurality of subcarriers, and
generating said synchronization signal in time domain by performing Inverse Fourier Transforming on said pre-selected ones of said plurality of subcarriers, wherein said twelve symbols are set to nonzero having complex values and others of said symbols are set to zero, such that said twelve symbols are arranged periodically in said predefined symbol sequence in the frequency domain, and
wherein said symbol sequence of said twelve symbols is $A - A A - A A - A A - A A A A A$, where A is a complex value.

11. A method for generating a synchronization signal by using a plurality of subcarriers in an OFDM transmission system, comprising the steps of:
generating a predefined symbol sequence having twelve symbols each set to a non-zero value and a plurality of further symbols each set to a zero value, wherein each of said symbols is mapped respectively on a predefined subcarrier of said plurality of subcarriers, and
generating said synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers mapped with said predefined symbol sequence, wherein said twelve symbols of the predefined symbol sequence is expressed as
 $A - A A - A A - A A - A A A A A$
 A being a complex value.

12. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:
receiving a plurality of subcarriers on which a predefined symbol sequence is mapped, said predefined symbol

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sequence having twelve symbols set to non-zero values and other symbols set to zero values, and wherein said twelve symbols of said predefined symbols sequence are expressed as
 $A - A A - A A - A A - A A A A A$
 A being a complex value,
generating a synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers, and
transmitting said synchronization signals and said OFDM data signals.

13. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:
receiving a plurality of subcarriers on which a predefined symbol sequence is mapped,
generating a synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers, and
transmitting said synchronization signals and said OFDM data signals, wherein said predefined symbol sequence has twelve symbols having complex value and said twelve symbols of said predefined symbols sequence can be expressed as
 $A - A A - A A - A A - A A A A A$
wherein twelve symbols are arranged in said predefined symbol sequence such that every fourth subcarrier among said plurality of subcarriers has non-zero amplitude.

14. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:
generating synchronization signals in time domain by performing Inverse Fourier Transforming on a plurality of subcarriers on which a predefined symbol sequence is mapped in accordance with a predefined mapping scheme, and
transmitting said synchronization signals and said OFDM data signals, wherein said predefined symbol sequence contains the following symbol sequence comprising twelve complex values:
 $A - A A - A A - A A - A A A A A$
wherein said twelve symbols are mapped on every fourth subcarriers of said plurality of subcarriers.

15. Apparatus for generating a synchronization signal by using a plurality of subcarriers for an OFDM transmission system, comprising:
a unit mapping symbols of a predefined symbol sequence in accordance with a predefined mapping scheme on said plurality of subcarriers, wherein pre-selected twelve symbols of the predefined symbol sequence have non-zero values, and
a unit for generating a synchronization signal by Inverse Fourier Transforming said plurality of subcarriers mapped with the symbols of said predefined symbol sequence, wherein the symbols of the predefined symbols sequence are expressed as
 $A - A A - A A - A A - A A A A A$
 A being a complex value.

16. Apparatus for generating a synchronization signal by using a plurality of subcarriers in an OFDM transmission system, comprising
a unit for generating a predefined symbol sequence having at least twelve symbols corresponding to respective pre-selected ones of said plurality of subcarriers, and

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a unit for generating said synchronization signal in time domain by performing Inverse Fourier Transforming on said preselected ones of said plurality of subcarriers, wherein said twelve symbols are set to nonzero having complex values and others of said symbols are set to zero, such that said twelve symbols are arranged periodically in said predefined symbol sequence in the frequency domain, and

wherein said symbol sequence of said twelve symbols is $A -A -A -A -A -A -A -A -A -A -A -A$, where A is a complex value.

17. Apparatus for generating a synchronization signal by using a plurality of subcarriers in an OFDM transmission system, comprising:

a unit for generating a predefined symbol sequence having twelve symbols each set to a non-zero value and a plurality of further symbols each set to a zero value, wherein each of said symbols is mapped respectively on a predefined subcarrier of said plurality of subcarriers, and

a unit for generating said synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers mapped with said predefined symbol sequence,

wherein said twelve symbols of the predefined symbol sequence is expressed as

$A -A -A -A -A -A -A -A -A -A -A -A$

A being a complex value.

18. Apparatus for transmitting OFDM data signals in an OFDM transmission system, comprising:

a unit for receiving a plurality of subcarriers on which a predefined symbol sequence is mapped, said predefined symbol sequence having twelve symbols set to non-zero values and other symbols set to zero values, and wherein said twelve symbols of said predefined symbols sequence are expressed as

$A -A -A -A -A -A -A -A -A -A -A -A$

A being a complex value,

a unit for generating a synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers, and

a transmitter for transmitting said synchronization signals and said OFDM data signals.

19. Apparatus for transmitting OFDM data signals in an OFDM transmission system, comprising:

a unit for receiving a plurality of subcarriers on which a predefined symbol sequence is mapped,

a unit for generating a synchronization signal in time domain by performing Inverse Fourier Transforming on said plurality of subcarriers, and

a transmitter for transmitting said synchronization signals and said OFDM data signals,

wherein said predefined symbol sequence has twelve symbols having complex value and said twelve symbols of said predefined symbols sequence can be expressed as

$A -A -A -A -A -A -A -A -A -A -A -A$

wherein twelve symbols are arranged in said predefined symbol sequence such that every fourth subcarrier among said plurality of subcarriers has non-zero amplitude.

20. Apparatus for transmitting OFDM data signals in an OFDM transmission system, comprising:

a unit for generating synchronization signals in time domain by performing Inverse Fourier Transforming on

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a plurality of subcarriers on which a predefined symbol sequence is mapped in accordance with a predefined mapping scheme, and

a transmitter for transmitting said synchronization signals and said OFDM data signals,

wherein said predefined symbol sequence contains the following symbol sequence comprising twelve complex values:

$A -A -A -A -A -A -A -A -A -A -A -A$

wherein said twelve symbols are mapped on every fourth subcarriers of said plurality of subcarriers.

21. A method for synchronizing a wireless communication device in an OFDM communication system, comprising the steps of:

receiving data signals and a synchronization signal exhibiting periodicity, the data signals and synchronization signal being transmitted from a transmitter side by using a plurality of subcarriers, said synchronization signal being based on a predefined symbol sequence having twelve complex value symbols with the symbol sequence

$A -A -A -A -A -A -A -A -A -A -A -A$

wherein A is a complex value, and

wherein said twelve symbols are mapped on every fourth subcarrier of said plurality of subcarriers so that said periodic nature of synchronization signal contains four repetitions of one synchronization signal in time domain; and

performing time and frequency synchronization in accordance with said periodicity of synchronization signal.

22. A method for synchronizing a wireless communication device in an OFDM communication system, comprising the steps of:

receiving data and synchronization signals transmitted from a transmitter side by using a plurality of subcarriers, and

performing time and frequency synchronization in accordance with said synchronization signal;

wherein said synchronization signal is generated based on a predefined symbol sequence comprising twelve symbols having complex values and a sequence of said twelve symbols is expressed as

$A -A -A -A -A -A -A -A -A -A -A -A$

wherein A is a complex value.

23. A method for synchronizing a wireless communication device in an OFDM communication system, comprising the steps of:

receiving data and synchronization signals transmitted from a transmitter side by using a plurality of subcarriers, and

performing time and frequency synchronization in accordance with said synchronization signal;

wherein said synchronization signal is generated based on a predefined symbol sequence comprising twelve non-zero symbols having complex value and other symbols being set to zero so that said twelve symbols are arranged with periodicity in said predefined symbol sequence in the frequency domain, and

wherein a sequence of said twelve symbols in the frequency domain is

$A -A -A -A -A -A -A -A -A -A -A -A$

wherein A is a complex value.

24. A method for synchronizing a wireless communication device in an OFDM communication system, comprising the steps of:

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receiving data and synchronization signals transmitted from a transmitter side by using a plurality of subcarriers, and

performing time and frequency synchronization in accordance with said synchronization signal;

wherein said synchronization signal is based on a predefined symbol sequence comprised of twelve symbols having complex value, said twelve symbols being expressed as

$A -A A -A A -A -A A A A$

wherein A is a complex value and

wherein the twelve symbols are arranged such that every fourth subcarrier among said plurality of subcarriers has non-zero amplitude.

25. A method for transmitting data signals in an OFDM transmission system, comprising the steps of:

generating a predefined symbol sequence comprised of a plurality of complex value symbols mapped on a plurality of subcarriers,

generating a synchronization signal by supplying said plurality of subcarriers having non-zero amplitude to an inverse Fourier Transform unit, such that said plurality of subcarriers mapped with said predefined symbol sequence are transformed into a time domain signal to generate only one synchronization signal,

copying said one synchronization signal to generate other synchronization signals in the time domain; and transmitting said generated synchronization signals and said data signals.

26. The method according to claim 25,

wherein the symbols of said predefined symbol sequence are expressed by C_{i-1} or C_{n-i} , wherein:

n is the number of symbols of said predefined symbol sequence,

m is a half value of n ,

i is an integer running from 1 to m

wherein said symbols expressed by C_{i-1} are supplied to one set of inputs of said inverse Fourier transform unit, and said symbols expressed by C_{n-i} are supplied to another set of said inputs of said inverse Fourier transform unit.

27. A method for transmitting data signals in an OFDM transmission system, comprising the steps of:

receiving a plurality of subcarriers on which a predefined symbol sequence is mapped, said predefined symbol sequence being formed of a plurality of symbols set to complex values,

transforming said plurality of subcarriers, of non-zero amplitude, mapped with said predefined symbol sequence into a time domain signal using inverse Fourier transformation, so as to generate only one synchronization signal,

copying said one synchronization signal in the time domain to provide a synchronization signal with periodicity, and

transmitting said provided synchronization signal and said data signals.

28. A method for transmitting data signals in an OFDM transmission system, comprising the steps of:

receiving a plurality of subcarriers on which a predefined symbol sequence is mapped, said predefined symbol sequence being formed of a plurality of symbols set to complex values,

transforming said plurality of subcarriers, set to non-zero amplitude, mapped with said predefined symbol sequence into a time domain signal by using Inverse

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Fourier Transformation, to generate only one synchronization signal,

copying said one synchronization signal to generate other synchronization signals in the time domain; and

transmitting said generated synchronization signals and said data signals.

29. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:

generating one synchronization signal in the time domain by performing Inverse Fourier Transformation on a plurality of subcarriers on which a predefined symbol sequence is mapped in accordance with a predefined mapping scheme, wherein all symbols of said predefined symbol sequence are set to complex values,

generating a synchronization signal of periodicity by copying said one synchronization signal in the time domain, and

transmitting said synchronization signal of periodicity and said OFDM data signals.

30. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:

generating a predefined symbol sequence having at least twelve non-zero complex value symbols, each of said twelve symbols being mapped in a periodic manner on a plurality of pre-selected subcarriers in the frequency domain,

generating a time domain signal by performing Inverse Fourier transformation on said plurality of pre-selected subcarriers mapped with said predefined symbol sequence,

said predefined symbol sequence conforming with the following equations for all symbols of said predefined symbol sequence:

$$n=2m,$$

$$C_{i-1} = \pm C_{n-i}$$

wherein:

n is the number of symbols of said predefined symbol sequence,

m is an integer larger than one,

C is the symbol value, and

i is an integer from 1 to m .

31. A method for transmitting OFDM data signals by using a plurality of subcarriers in an OFDM transmission system, comprising the steps of:

generating a predefined symbol sequence having at least twelve symbols corresponding to respective pre-selected ones of said plurality of subcarriers,

generating a time domain signal by performing Inverse Fourier transformation on said plurality of pre-selected subcarriers corresponding to the symbols of said predefined symbol sequence,

wherein each of twelve symbols is set to a nonzero complex value and said predefined symbol sequence has a binary symbol sequence expressed by A and $-A$, where A is a complex value, and wherein said predefined symbol sequence satisfies the following equations for all symbols of said predefined symbol sequence:

$$n=2m,$$

$$C_{i-1} = \pm C_{n-i}$$

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wherein:

n is the number of symbols of said predefined symbol sequence,

m is an integer larger than one,

C is the symbol value, and

i is an integer from 1 to m .

32. A method for transmitting OFDM data signals by using a plurality of subcarriers in an OFDM transmission system, comprising the steps of:

generating a predefined symbol sequence having at least twelve symbols corresponding to respective pre-selected subcarriers of said plurality of subcarriers,

generating a time domain signal by performing Inverse Fourier transformation on said plurality of pre-selected subcarriers corresponding to the symbols of said predefined symbol sequence,

wherein each of said twelve symbols has a nonzero complex value expressed by A or $-A$, and wherein said predefined symbol sequence satisfies the following equations for all symbols of said predefined symbol sequence:

$$n=2m,$$

$$C_{i-1}=\pm C_n \cdot i$$

wherein:

n is the number of symbols of said predefined symbol sequence,

m is an integer larger than one,

C is the symbol value, and

i is an integer from 1 to m .

33. A method for transmitting OFDM data signals by using a plurality of subcarriers in an OFDM transmission system, comprising the steps of:

generating a predefined symbol sequence having predefined symbols, each of said symbols being mapped on a respective predefined subcarrier, and

generating a time domain signal by Inverse Fourier Transforming said plurality of subcarriers mapped with the symbols of said predefined symbol sequence,

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wherein said predefined symbols are set to nonzero complex values and have a binary sequence of symbol values expressed by A or $-A$,

wherein said predefined symbol sequence satisfies the following equations for all symbols of said predefined symbol sequence:

$$n=2m,$$

$$C_{i-1}=\pm C_n \cdot i$$

wherein:

n is the number of symbols of said predefined symbol sequence,

m is an integer larger than one,

C is the symbol value, and

i is an integer from 1 to m .

34. A method for transmitting OFDM data signals in an OFDM transmission system, comprising the steps of:

mapping symbols of a predefined symbol sequence in accordance with a predefined mapping scheme on said plurality of subcarriers, wherein pre-selected symbols of the predefined symbol sequence have non-zero values, and

generating a time domain signal by Inverse Fourier Transforming said plurality of subcarriers mapped with the symbols of said predefined symbol sequence,

wherein said predefined symbol sequence satisfies the following equations for all symbols of said predefined symbol sequence:

$$n=2m,$$

$$C_{i-1}=\pm C_n \cdot i$$

wherein:

n is the number of symbols of said predefined symbol sequence,

m is an integer larger than one,

C is the symbol value, and

i is an integer from 1 to m .

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US007120137B2

(12) **United States Patent**
Take

(10) **Patent No.:** US 7,120,137 B2
(45) **Date of Patent:** Oct. 10, 2006

(54) **METHOD AND APPARATUS FOR
ASSIGNING CODES**

(75) **Inventor:** Keijiro Take, Tokyo (JP)

(73) **Assignee:** Mitsubishi Denki Kabushiki Kaisha,
Tokyo (JP)

(*) **Notice:** Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 0 days.

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(22) **Filed:** Mar. 10, 2004

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Related U.S. Application Data

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13, 2001, which is a continuation of application No.
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6,477,158.

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H04B 7/216 (2006.01)
H04J 3/06 (2006.01)

(52) **U.S. Cl.** 370/335; 370/342; 370/350

(58) **Field of Classification Search** 370/320,
370/335, 342, 441, 479, 203, 350, 332, 508-510;
375/200

See application file for complete search history.

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Primary Examiner—Chi Pham

Assistant Examiner—Tri H. Phan

(74) *Attorney, Agent, or Firm*—Oblon, Spivak, McClelland,
Maier & Neustadt, P.C.

(57) **ABSTRACT**

A base station controller selects codes corresponding to rate
information included in a new starting call message from a
mobile station, and further selects codes assignable to the
mobile station out of the selected codes as candidate codes.
Then, the base station controller detects codes which meet
both the characteristics of being at upper level of the
candidate codes in the tree structure and being assignable to
other mobile station, and further detects levels of the
detected codes. Detected levels for all the candidate codes
are compared to find a candidate code whose level is the
lowest and to assign the candidate code to the mobile station
sending the new starting call message.

4 Claims, 17 Drawing Sheets

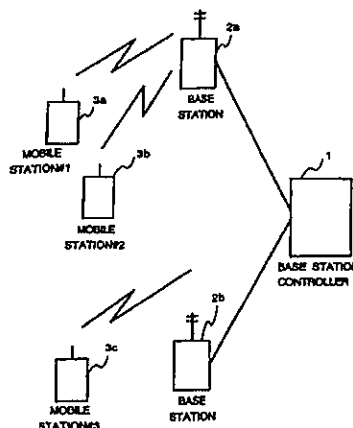


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Fig.1

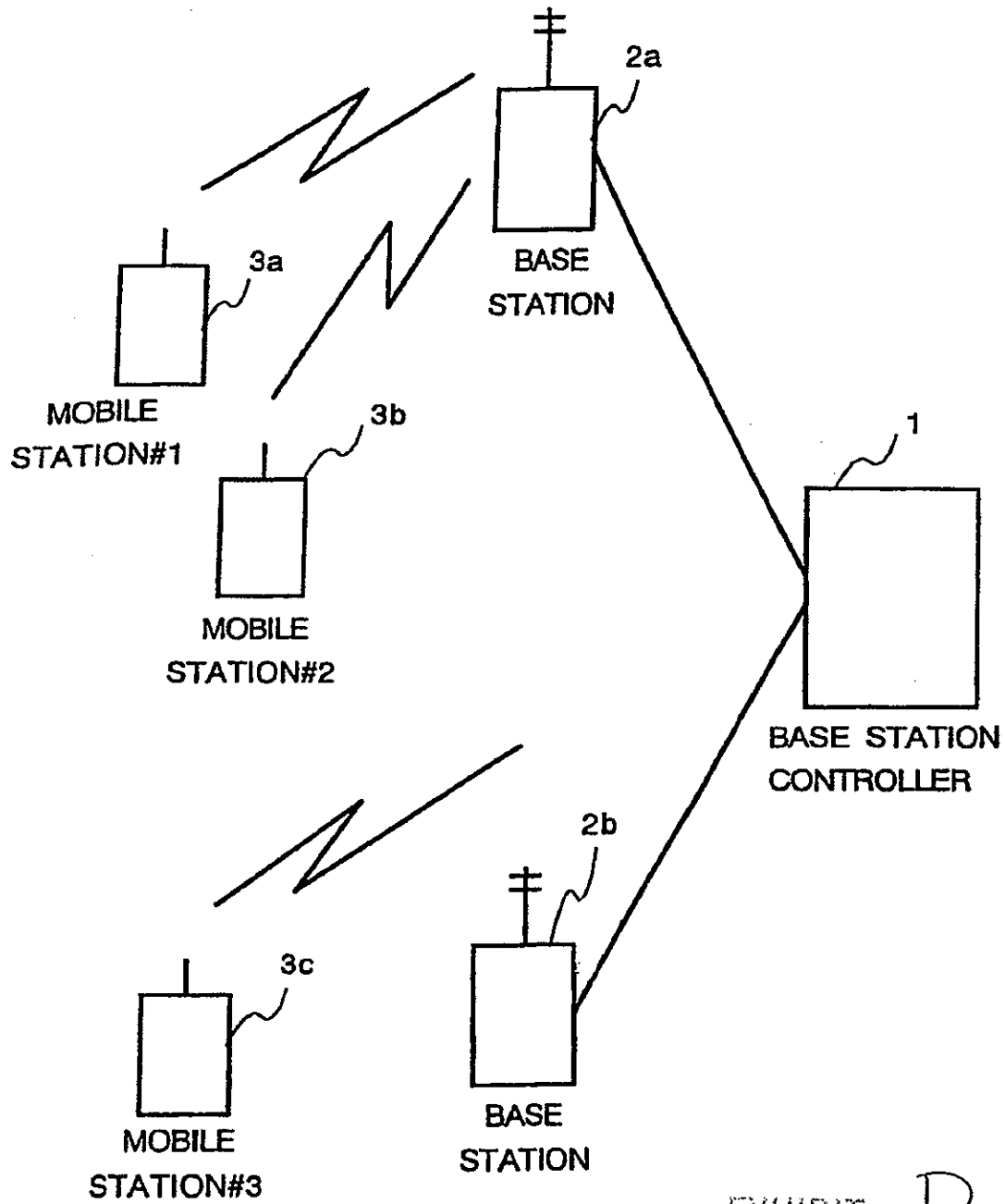


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Fig.2

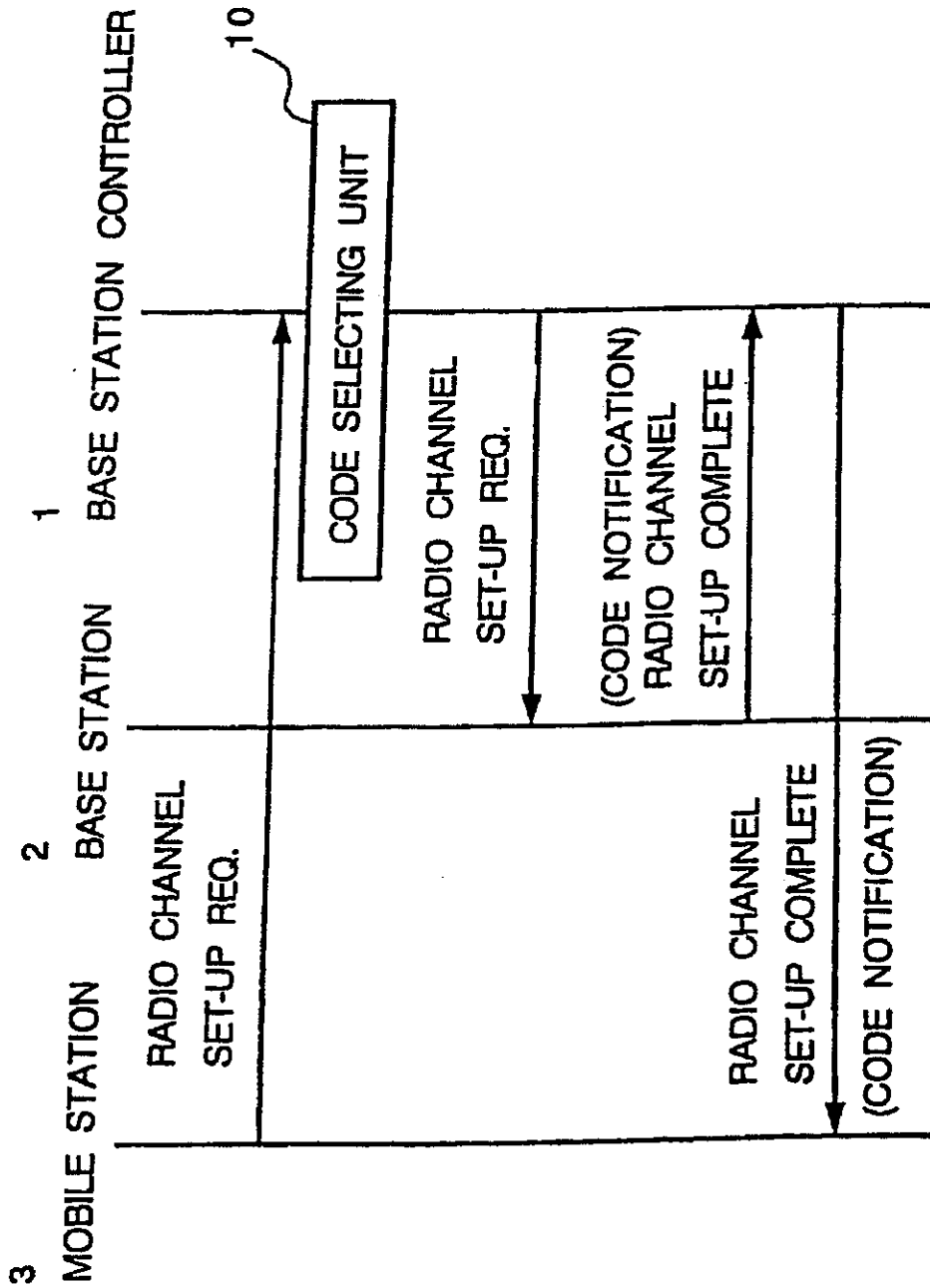


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Fig. 3

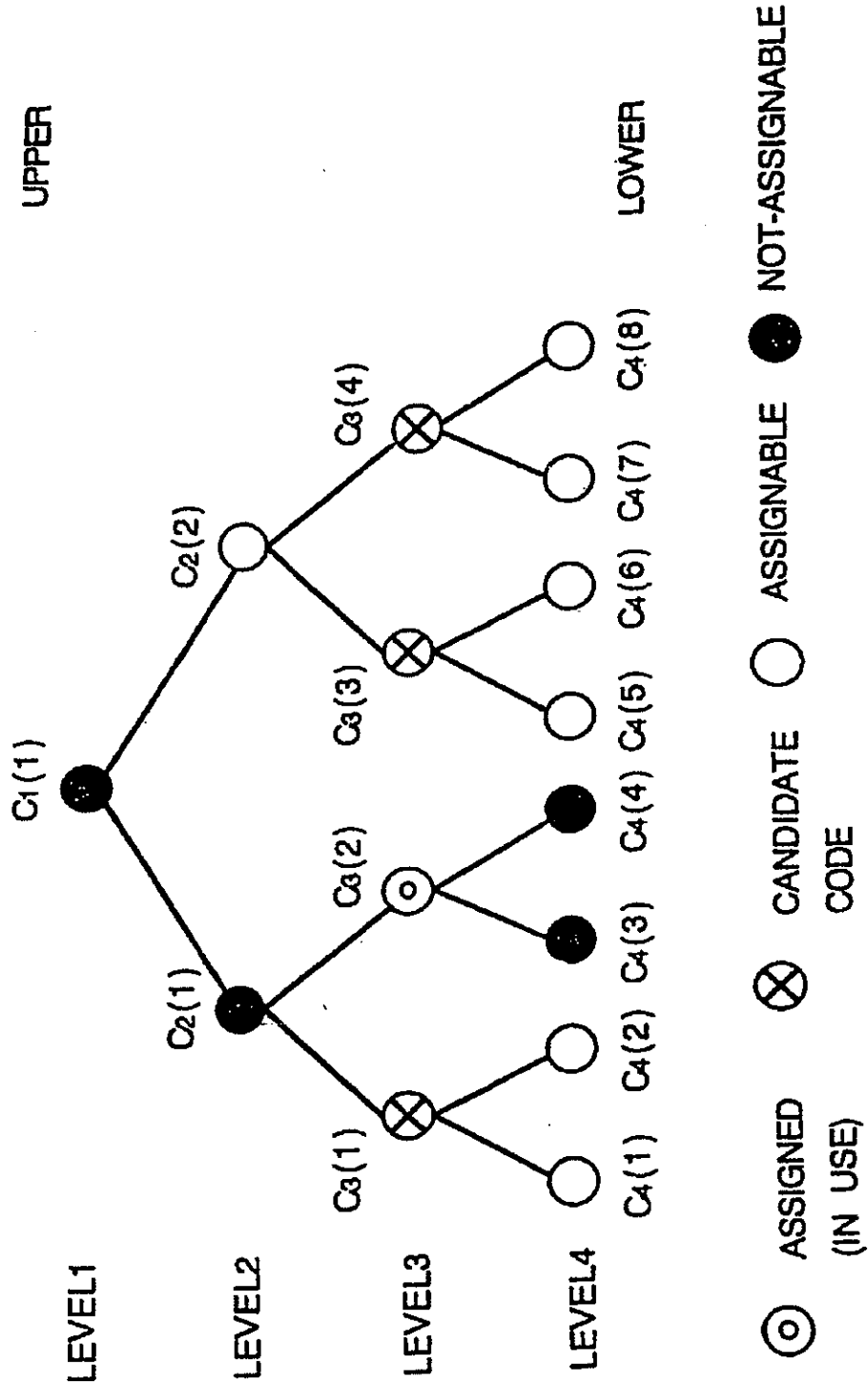


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Fig.4

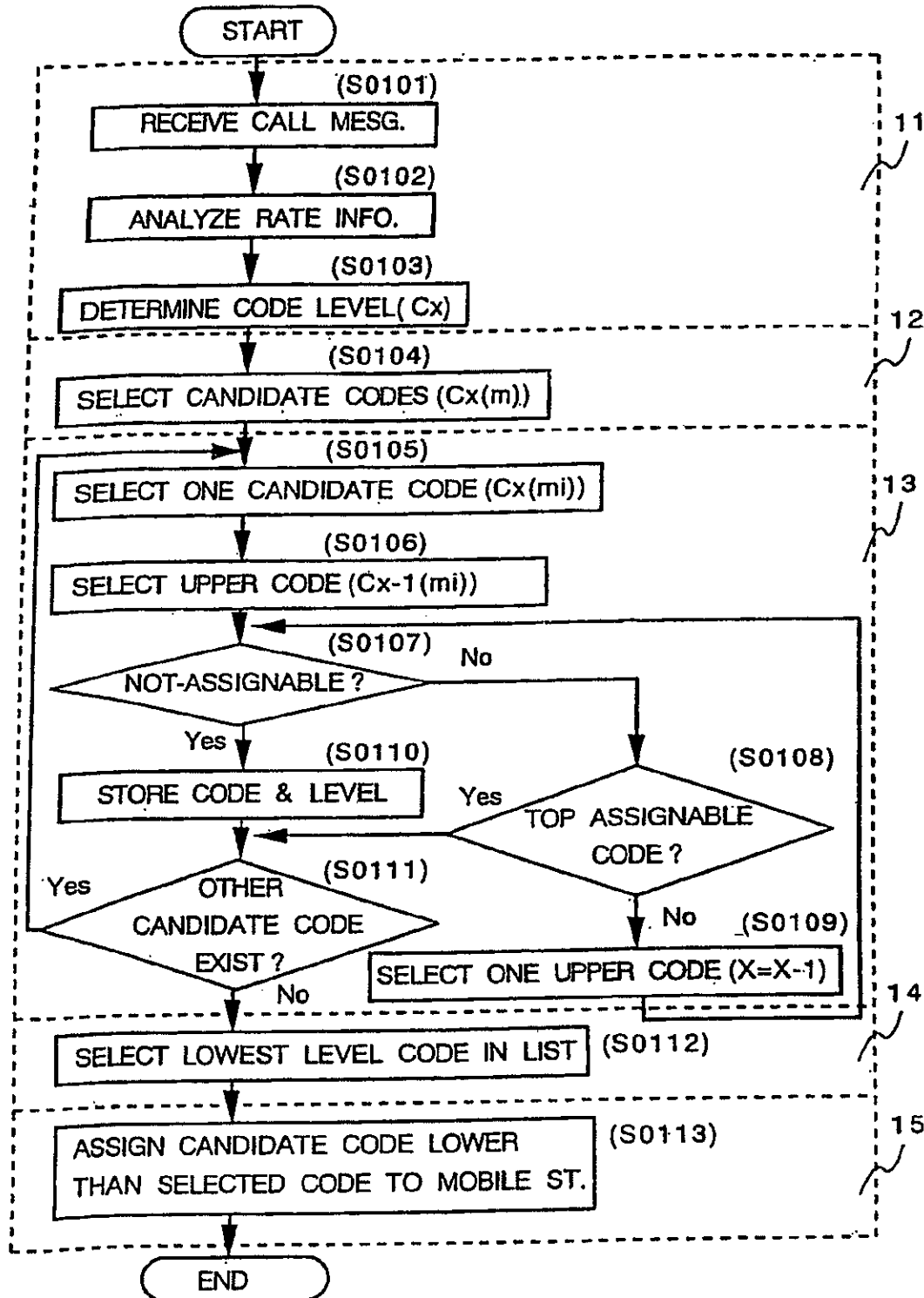


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Fig.5

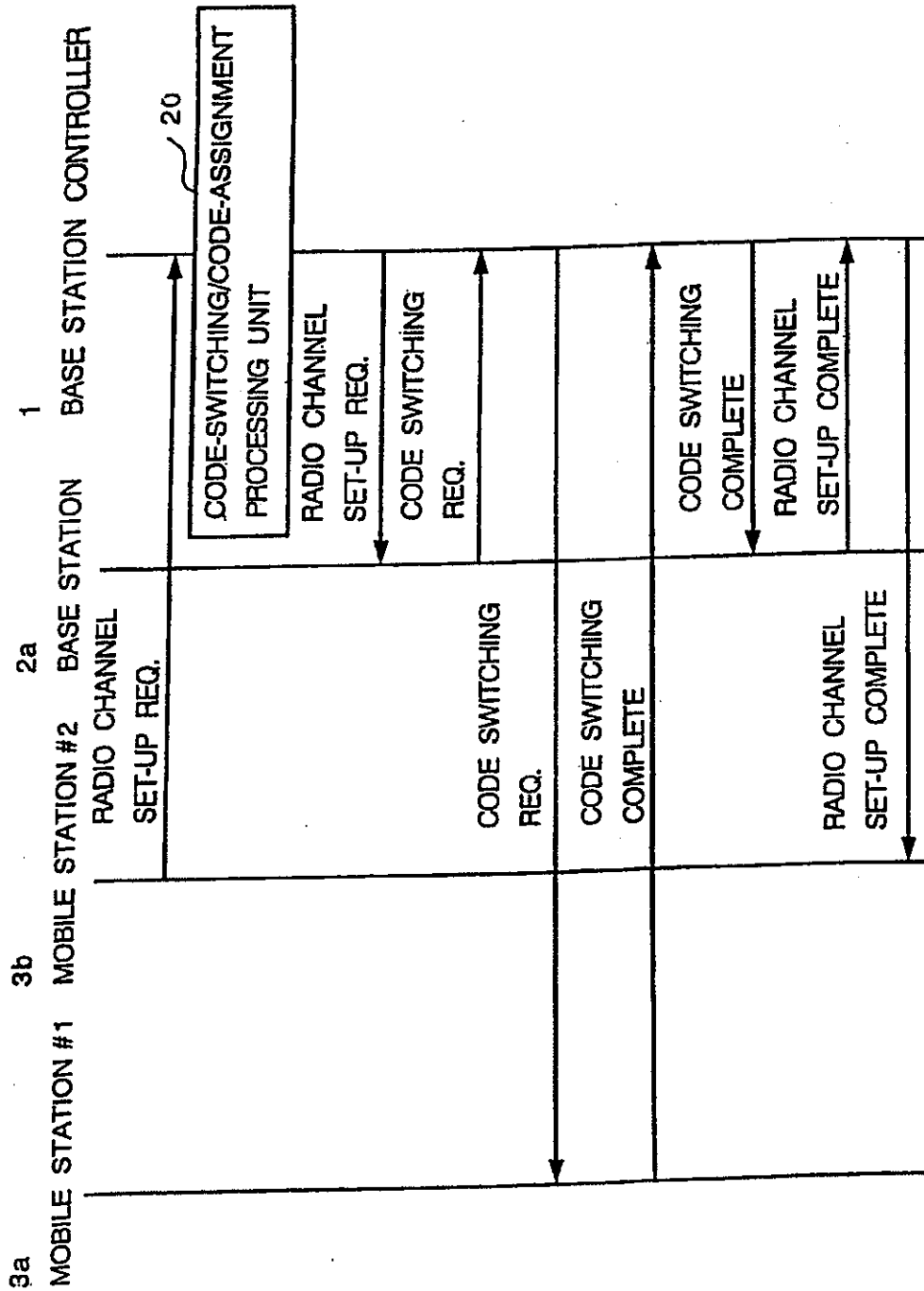


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Fig. 6

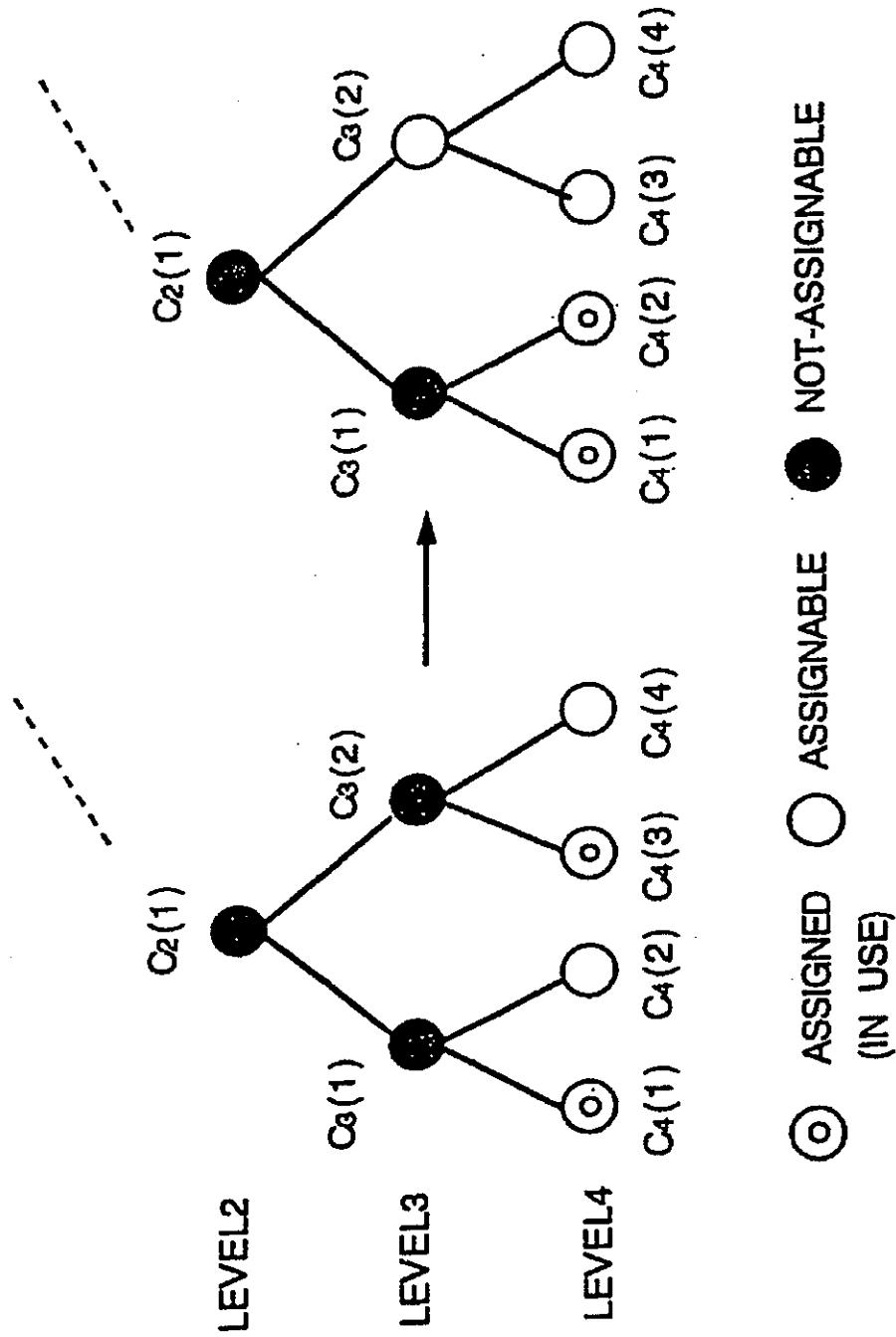


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Fig. 7

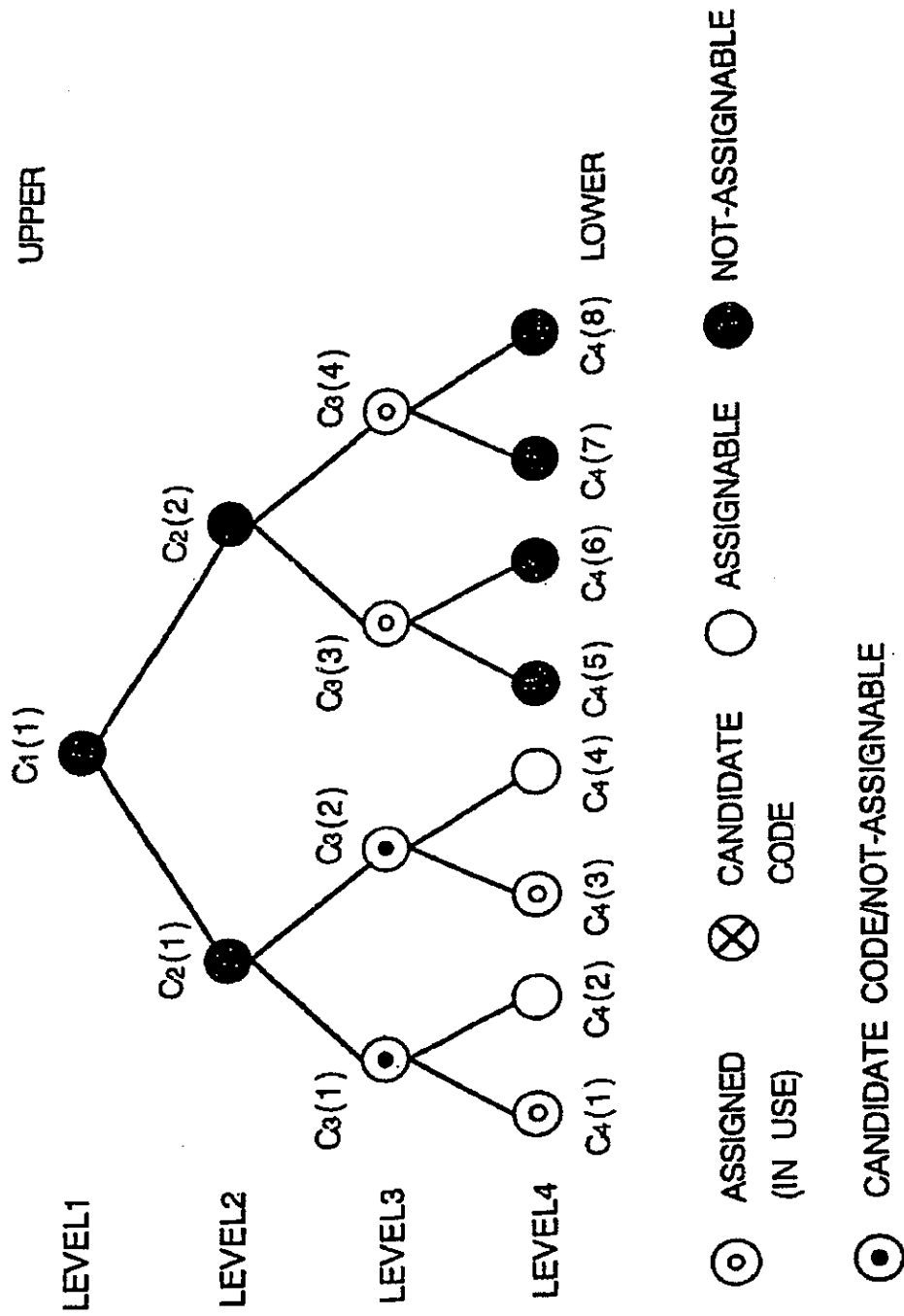


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Fig.8

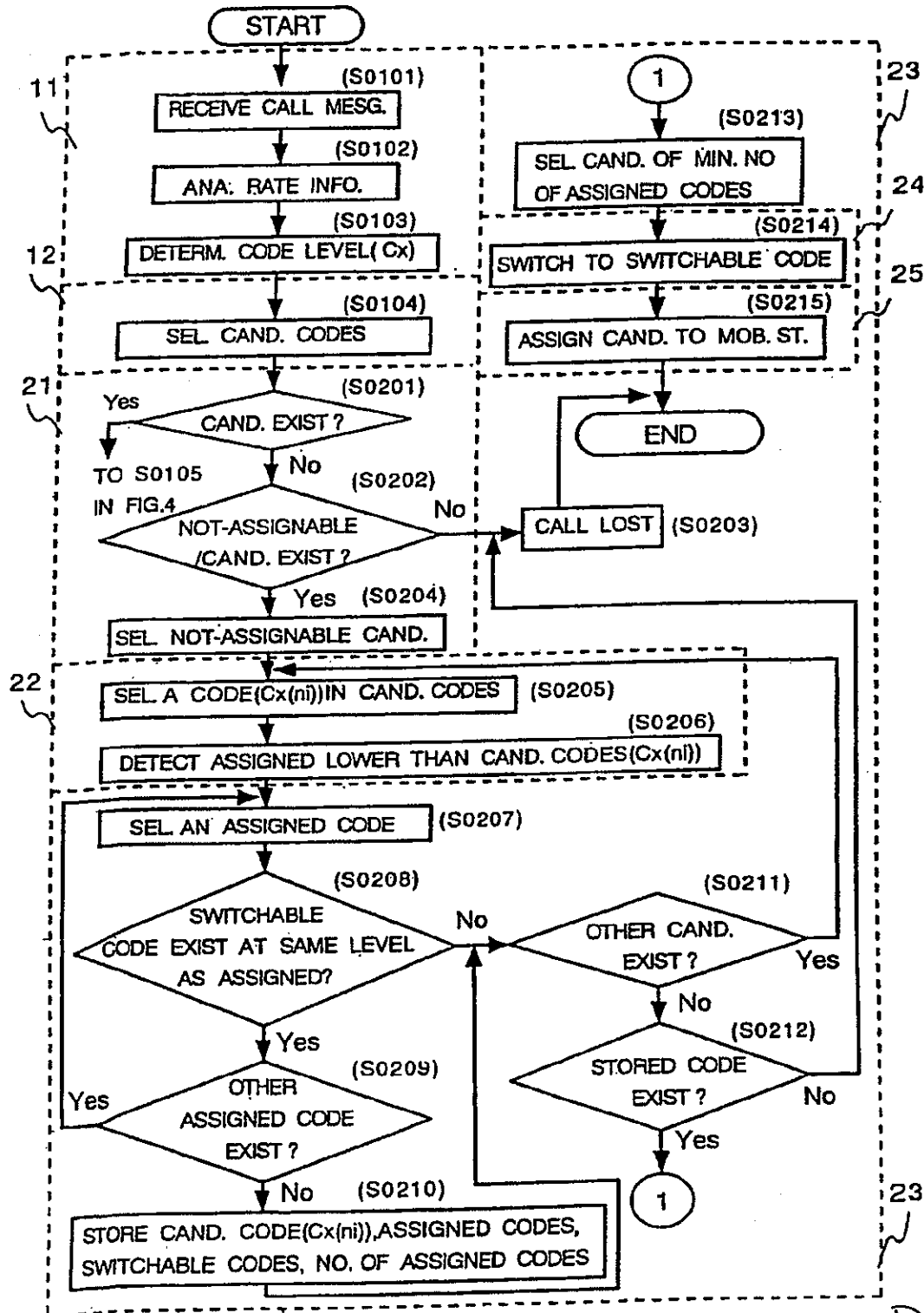


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Fig.9

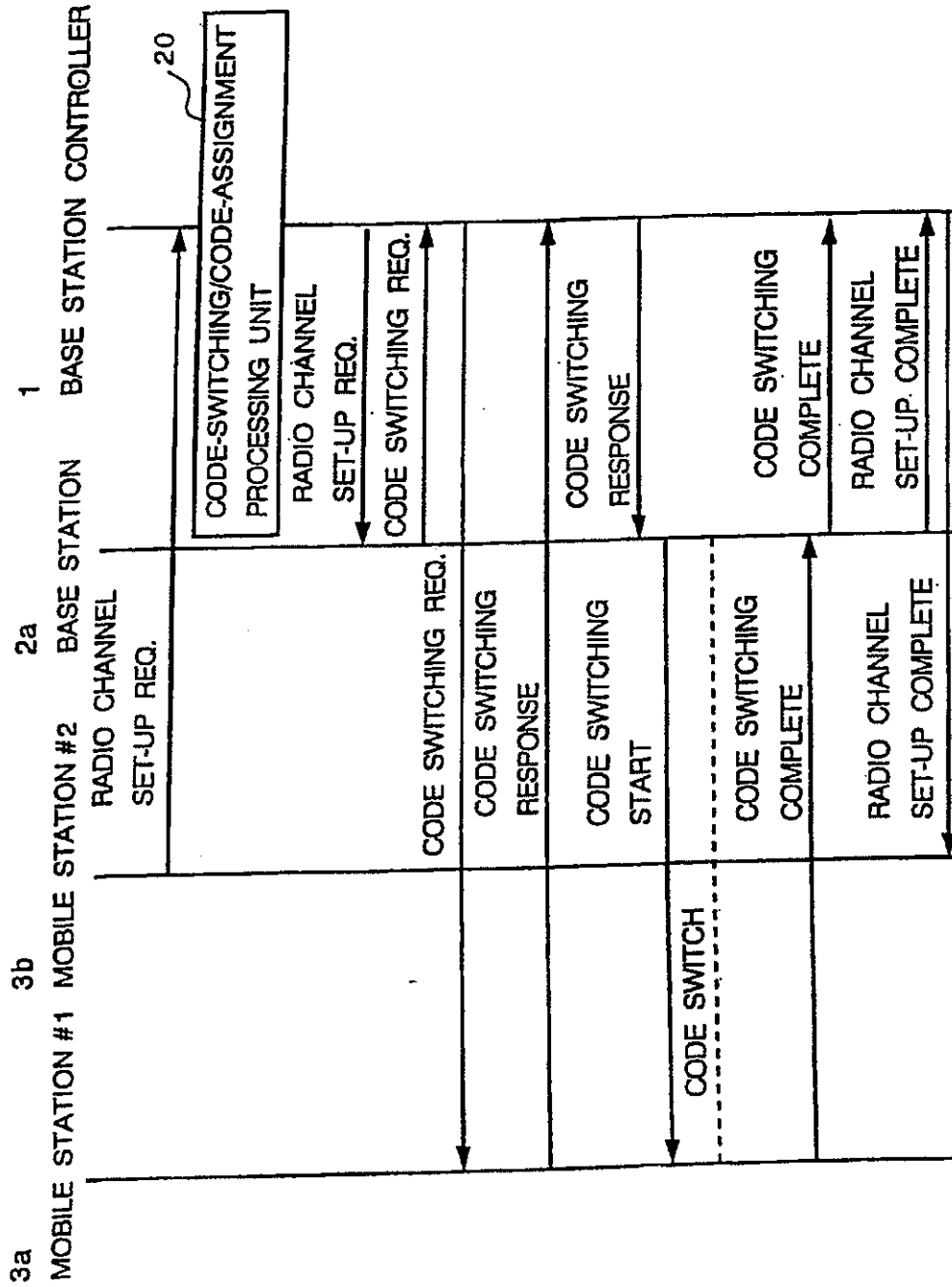


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Fig.10

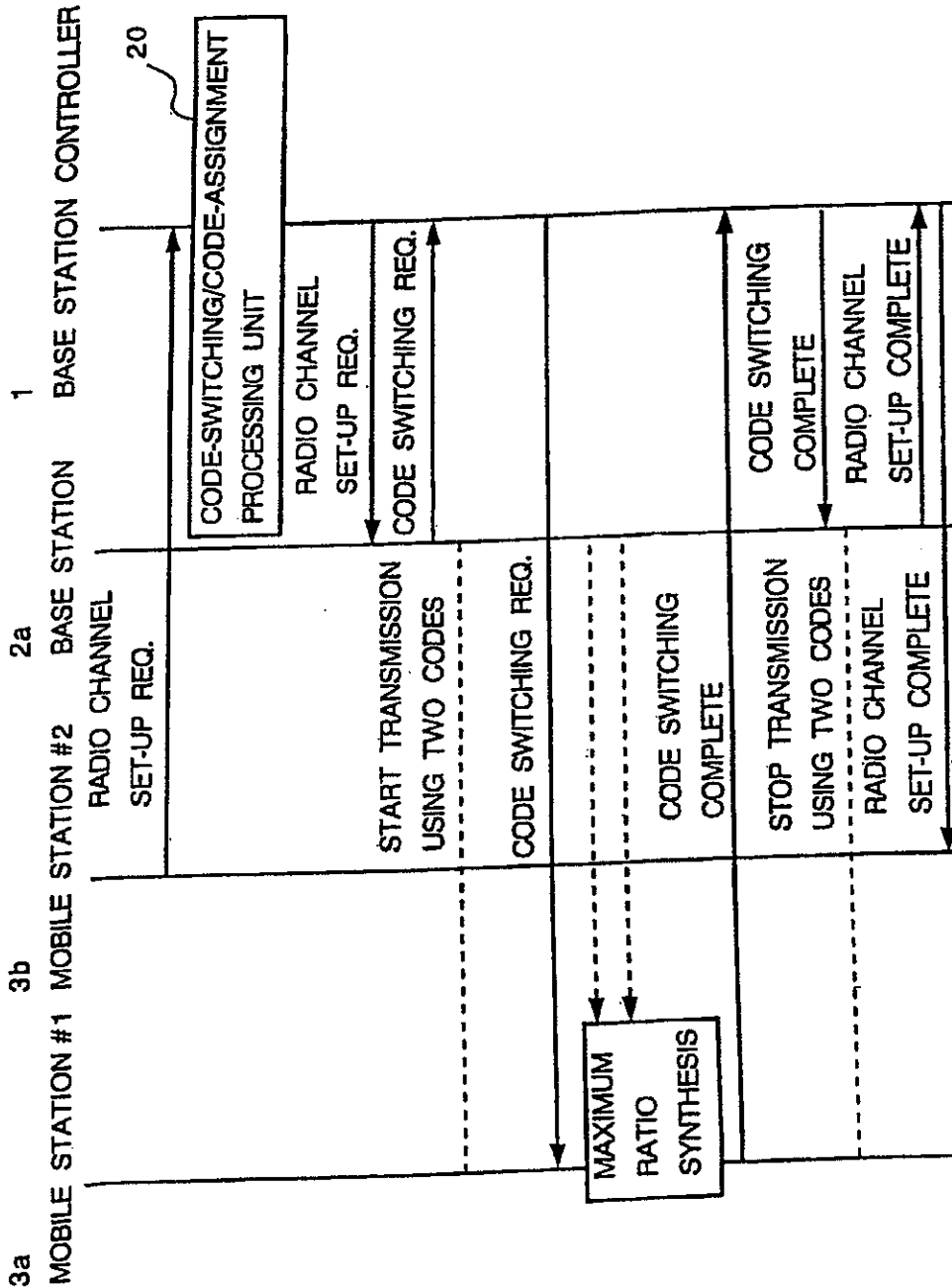


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Fig.11 RELATED ART

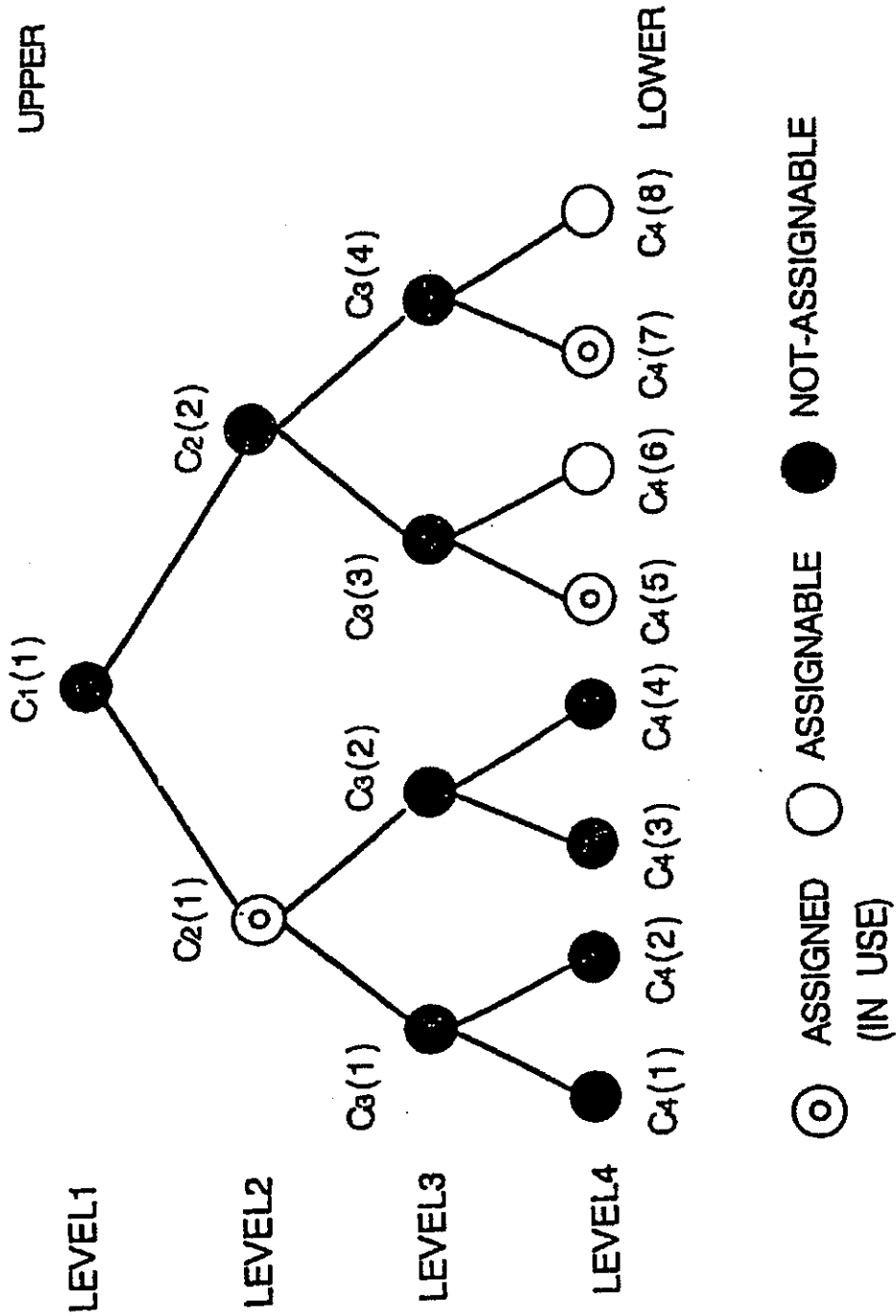


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Fig.12

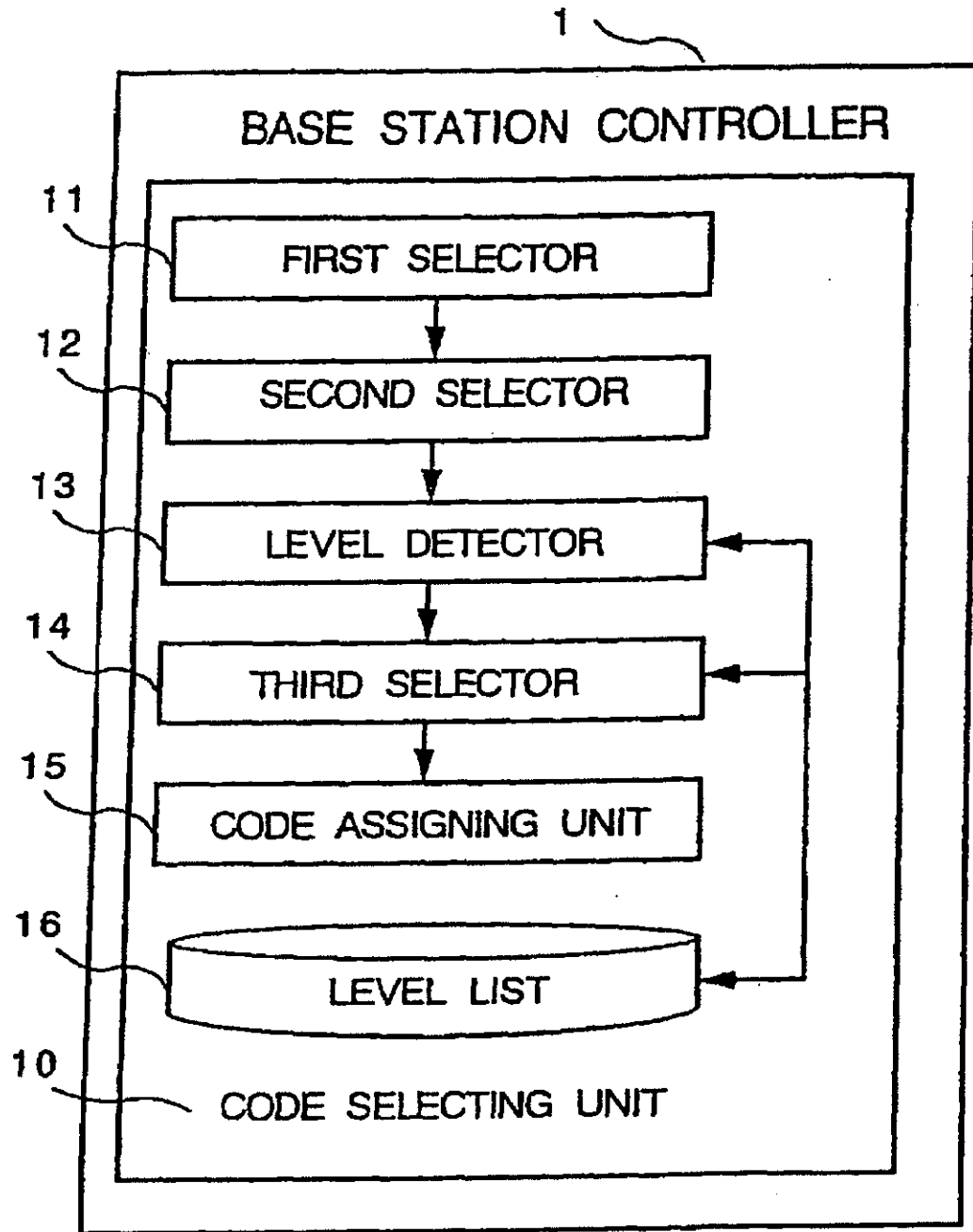


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Fig.13

16 : LEVEL LIST

CANDIDATE CODE	UPPER NOT-ASSIGNABLE CODE	LEVEL
C ₃ (1)	C ₂ (1)	LEVEL2
C ₃ (3)	C ₁ (1)	LEVEL1
C ₃ (4)	C ₁ (1)	LEVEL1

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