US00RE44713E

(19) **United States**
(12) **Reissued Patent**
Jung

(10) **Patent Number: US RE44,713 E**
(45) **Date of Reissued Patent: Jan. 21, 2014**

(54) **WIRELESS CHARGER SYSTEM FOR BATTERY PACK SOLUTION AND CONTROLLING METHOD THEREOF**

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(21) Appl. No.: **13/708,480**

(22) Filed: **Dec. 7, 2012**

Related U.S. Patent Documents

Reissue of:

(64) Patent No.: **7,948,209**
Issued: **May 24, 2011**
Appl. No.: **12/093,520**
PCT Filed: **Sep. 13, 2007**
PCT No.: **PCT/KR2007/004418**
§ 371 (c)(1),
(2), (4) Date: **May 13, 2008**
PCT Pub. No.: **WO2009/011475**
PCT Pub. Date: **Jan. 22, 2009**

(30) **Foreign Application Priority Data**

Jul. 13, 2007 (KR) 10-2007-0070447
Sep. 12, 2007 (KR) 10-2007-0092615

(51) **Int. Cl.**
H02J 7/00 (2006.01)
H01F 27/42 (2006.01)
H04B 7/00 (2006.01)

(52) **U.S. Cl.**
USPC **320/108**; 307/104; 455/522

(58) **Field of Classification Search**
USPC 320/108; 307/104; 455/522
See application file for complete search history.

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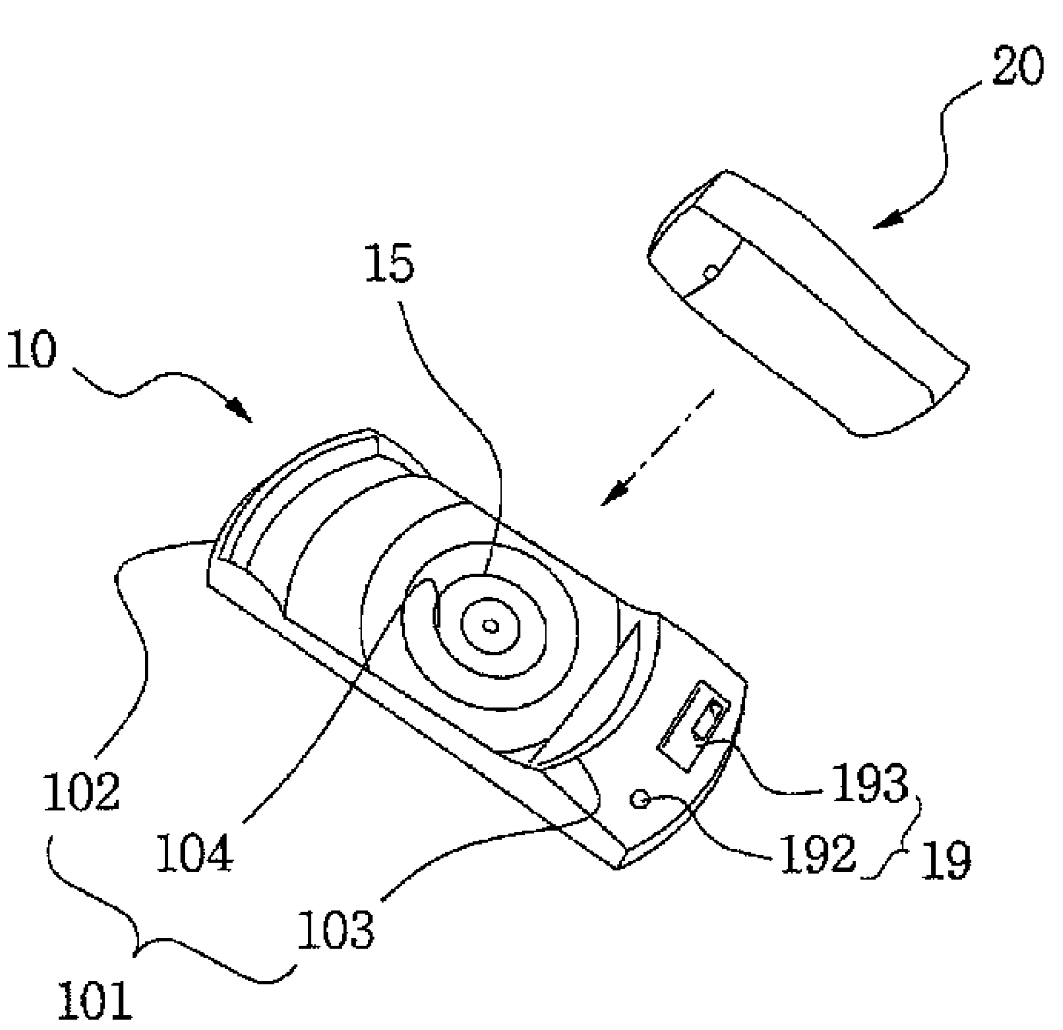
(57) **ABSTRACT**

A wireless charger system for a battery pack is disclosed. The wireless charger system in one exemplary embodiment may include a wireless charger apparatus for receiving an external power source to transmit a power signal via a charging power transmitter block and a battery pack for receiving a power signal from the wireless charger apparatus to charge power in a battery cell and supplying a power source to a portable terminal block. The wireless charger apparatus may also have an outer body composed of a resonant converter for supplying power to the battery pack and a wireless charger case having a central controller installed inside. The wireless charger case may have a protruded round portion formed around the rear edge and a display block provided as the sloped surface in the front portion thereof.

35 Claims, 14 Drawing Sheets

A



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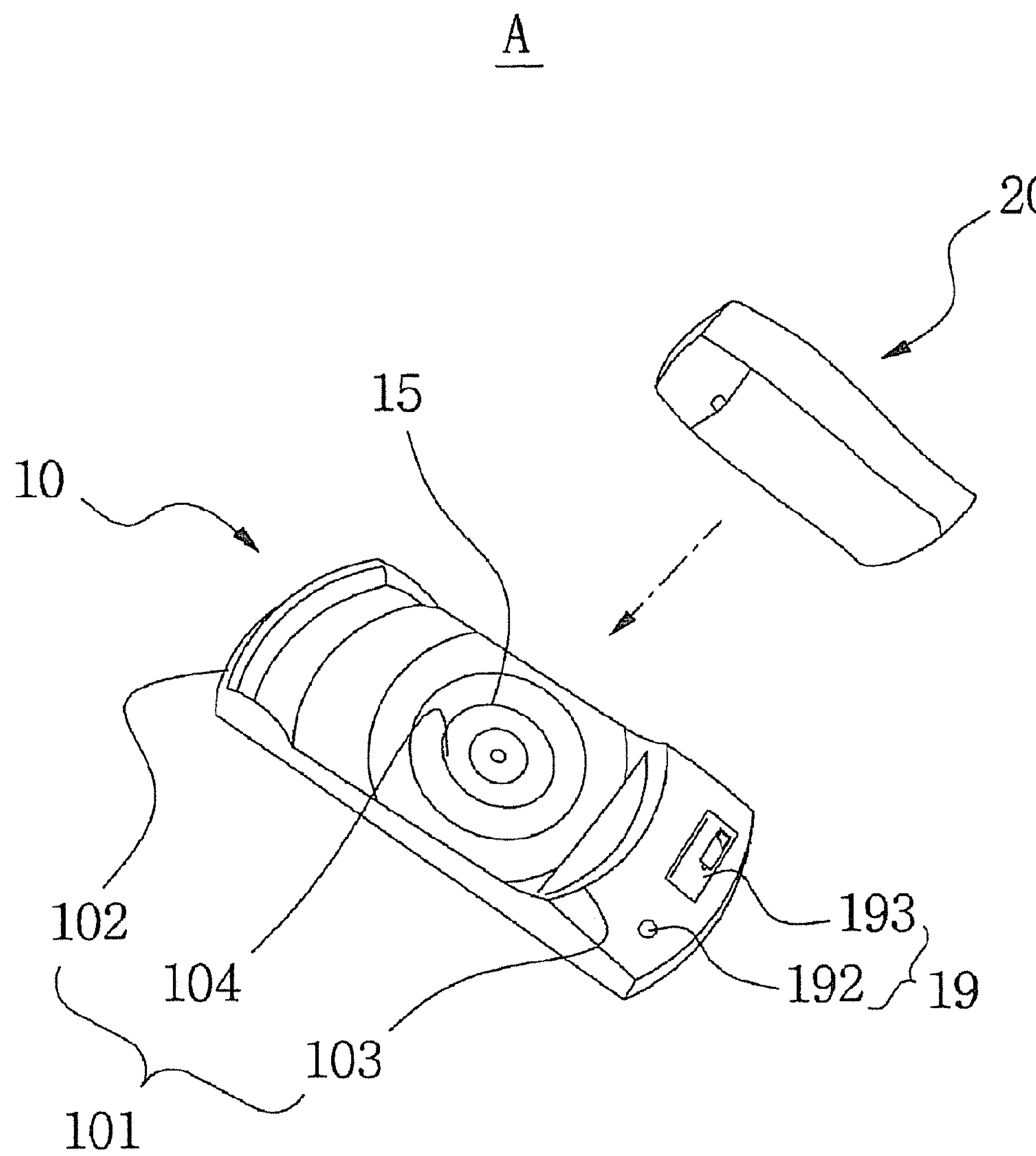


Fig. 1

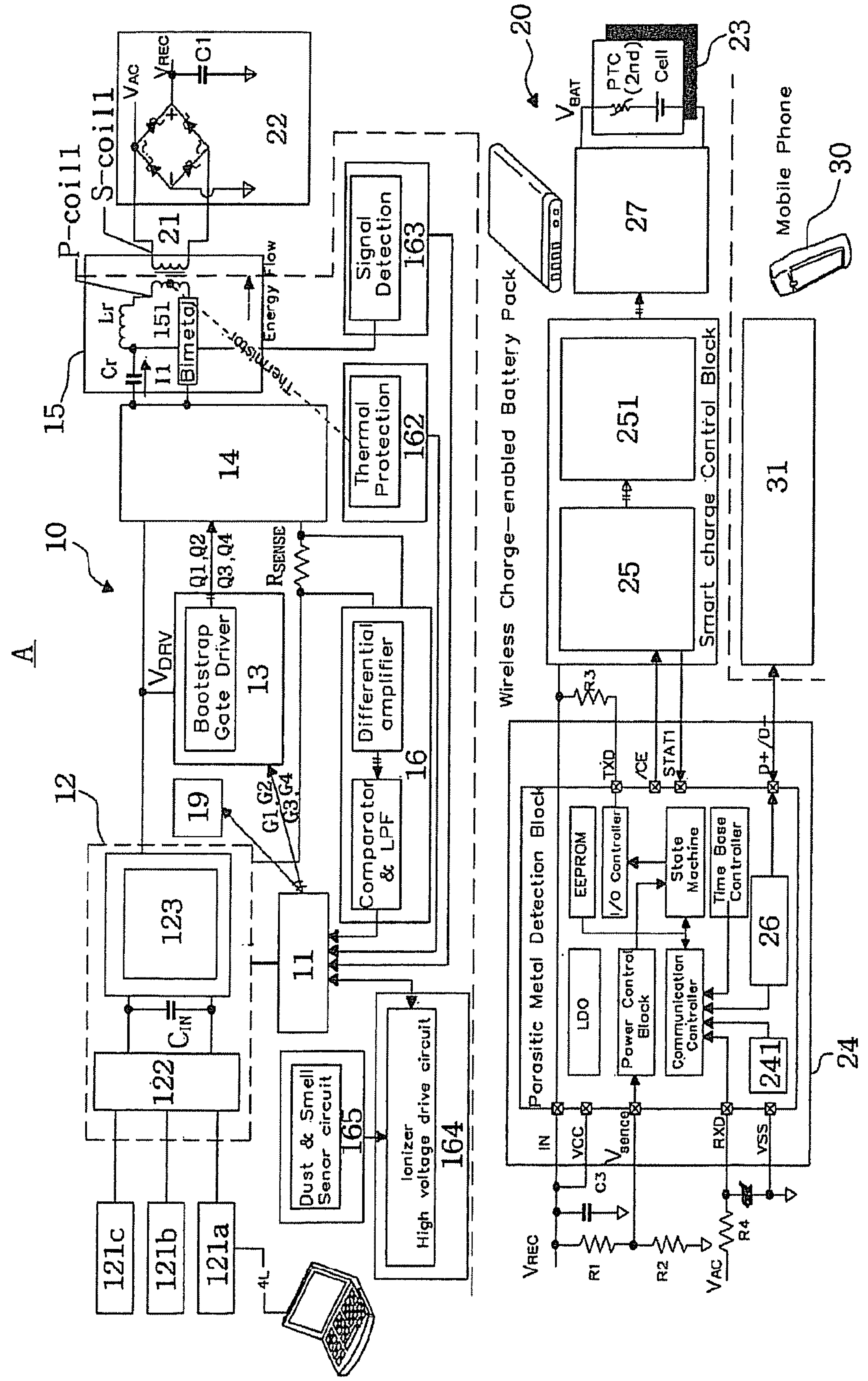

A
10
12
121a
121b
121c
4L
122
C_{IN}
123
11
19
G1,G2
G3,G4
V_{DRV}
Bootstrap Gate Driver
13
Q1,Q2
Q3,Q4
R_{SENSE}
14
15
Cr
Lr
I1
151
Bimetal
Thermistor
Energy Flow
P-coil1
S-coil1
21
V_{AC}
V_{REC}
C1
22
Differential amplifier
Comparator & LPF
16
Thermal Protection
162
Signal Detection
163
Ionizer High voltage drive circuit
164
Dust & Smell Senor circuit
165
20
Wireless Charge-enabled Battery Pack
V_{BAT}
PTC (2nd)
Cell
23
27
25
251
Smart charge Control Block
R3
TXD
/CE
STAT1
D+/D-
Parasitic Metal Detection Block
EEPROM
I/O Controller
State Machine
Time Base Controller
LDO
Power Control Block
Communication Controller
26
241
24
IN
VCC
V_{sense}
RXD
VSS
C3
R1
R2
R4
V_{REC}
V_{AC}
31
Mobile Phone
30

Fig. 2

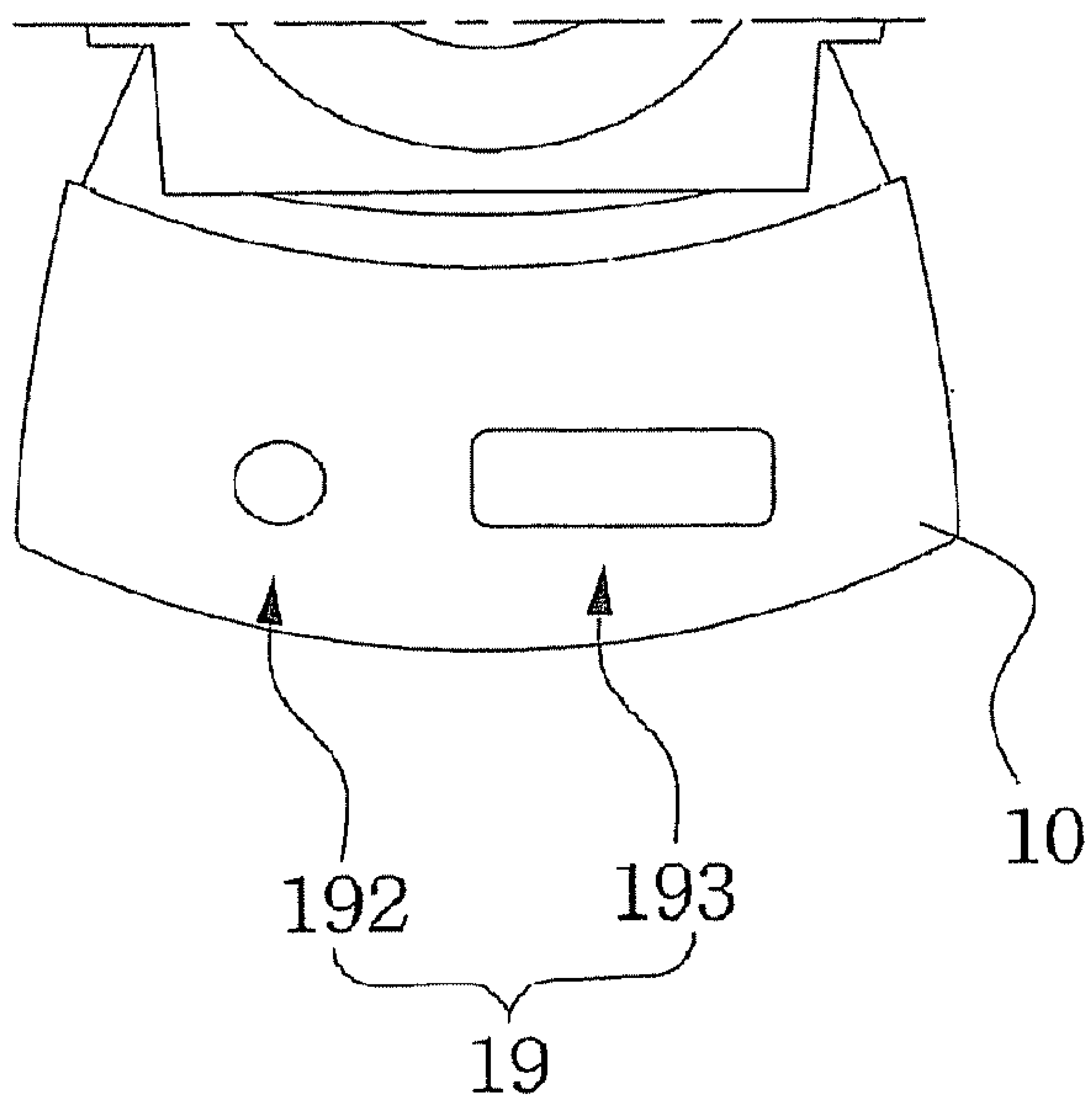


Fig. 3

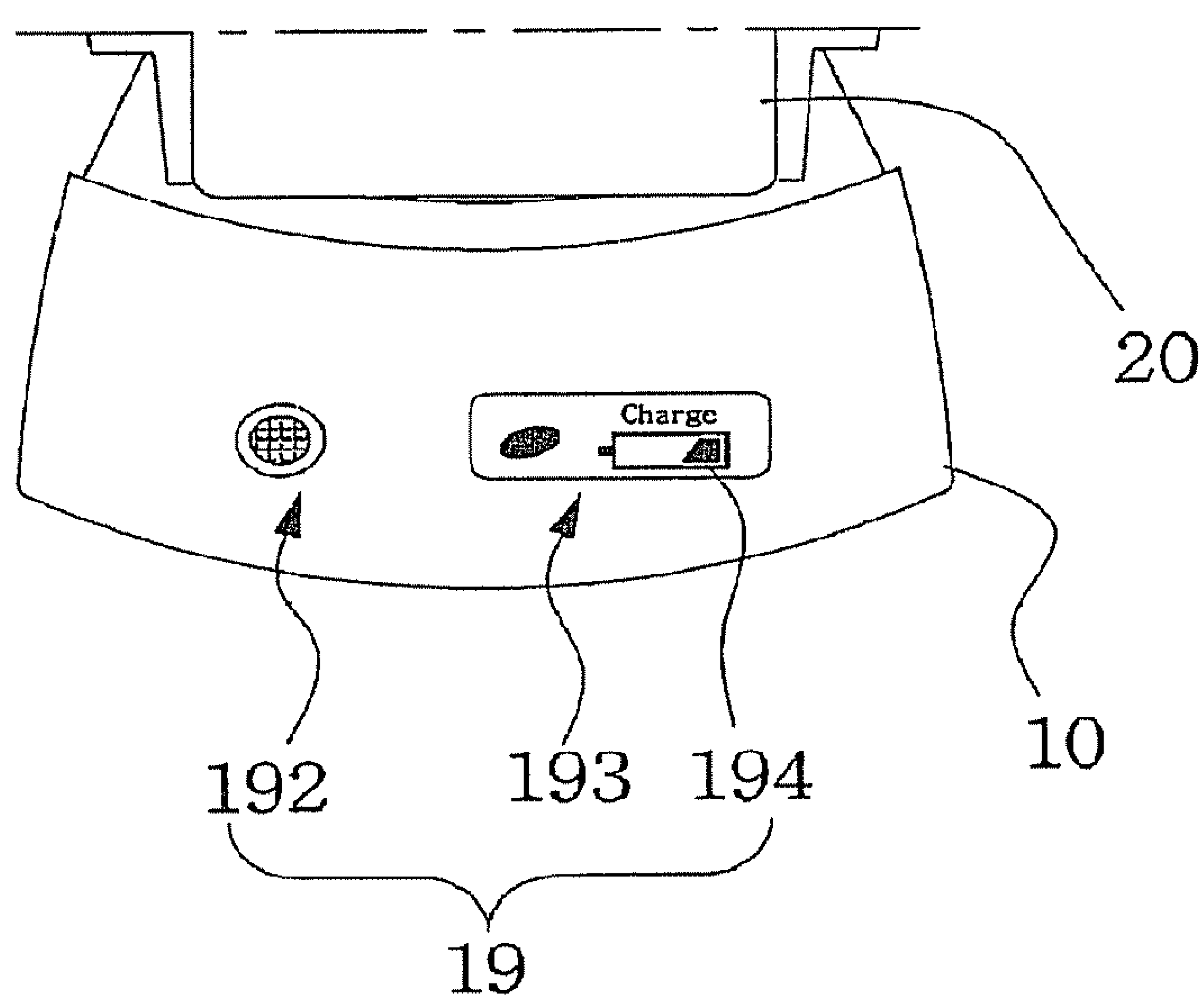


Fig. 4

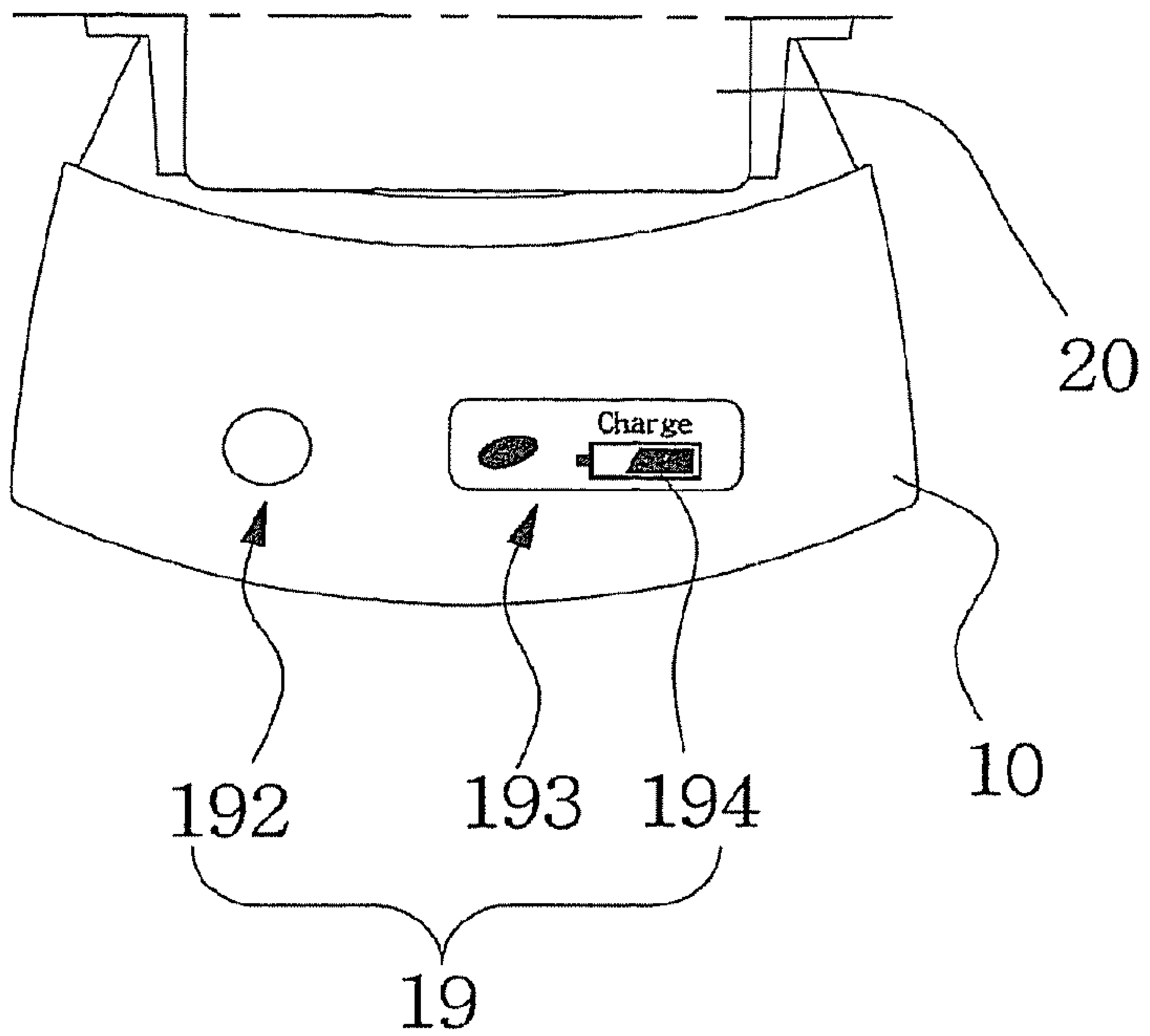


Fig. 5

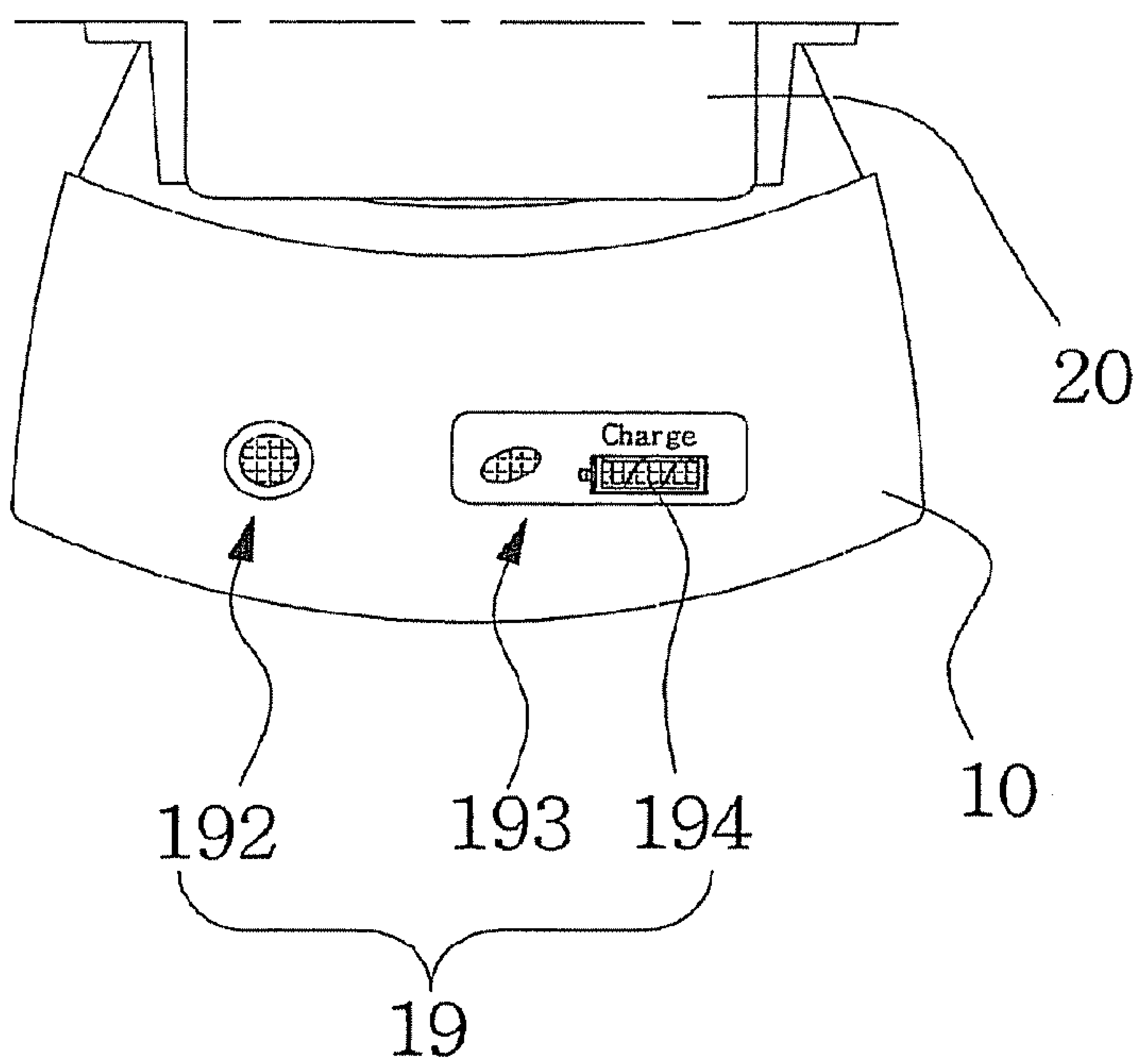


Fig. 6

Fig. 7

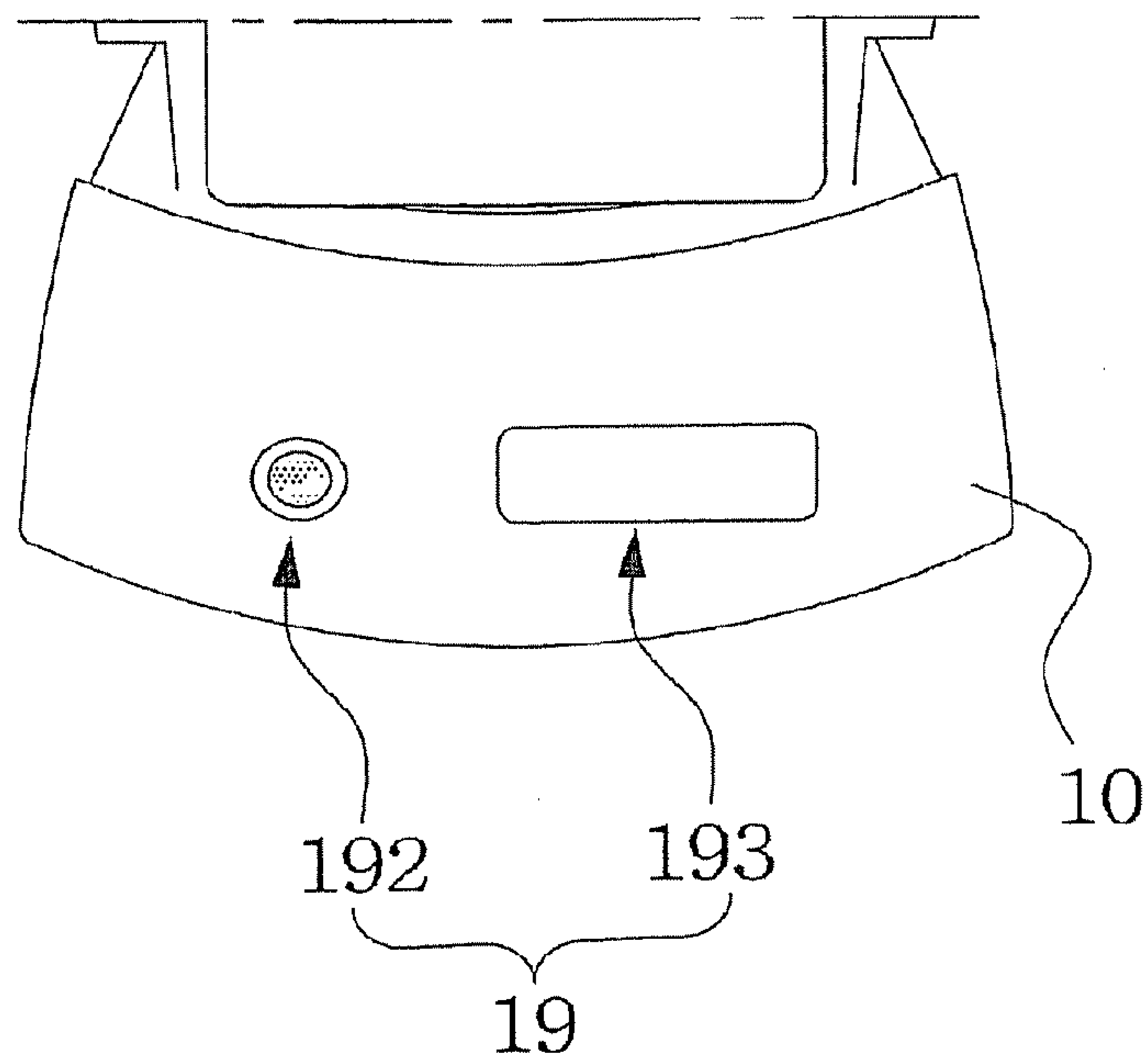


Fig. 8

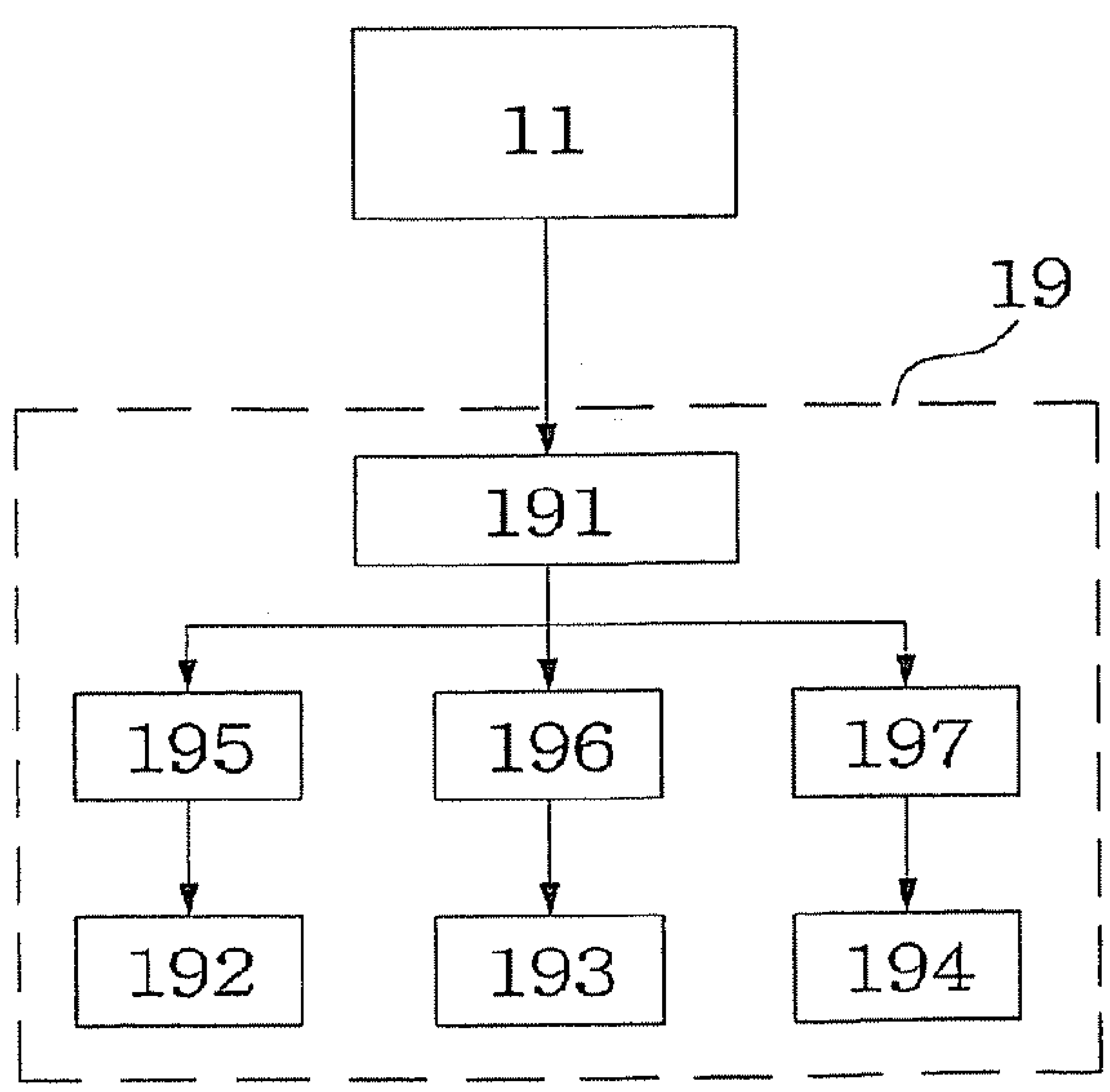


Fig. 9

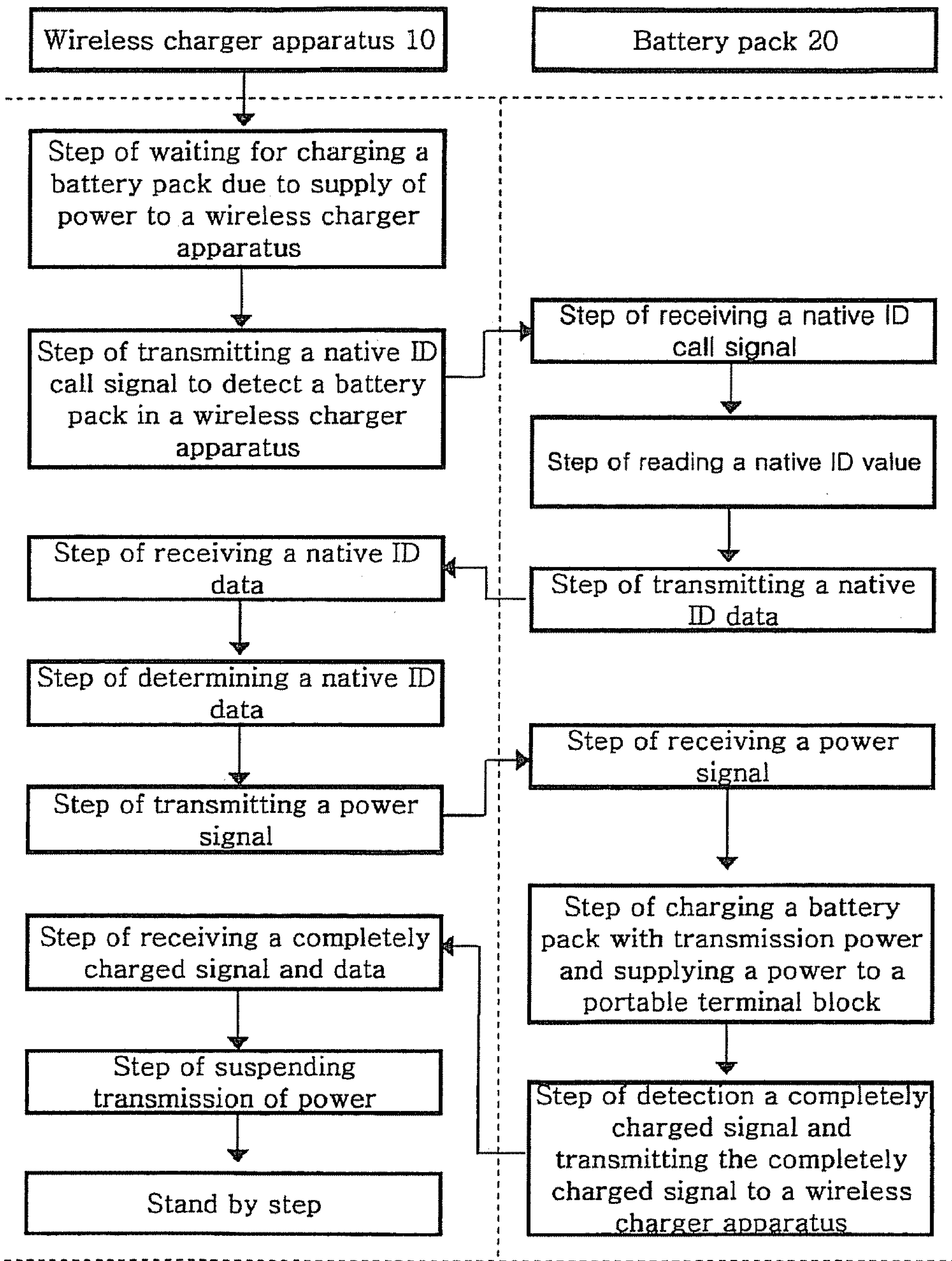

Wireless charger apparatus 10
Battery pack 20
Step of waiting for charging a battery pack due to supply of power to a wireless charger apparatus
Step of transmitting a native ID call signal to detect a battery pack in a wireless charger apparatus
Step of receiving a native ID call signal
Step of reading a native ID value
Step of receiving a native ID data
Step of transmitting a native ID data
Step of determining a native ID data
Step of transmitting a power signal
Step of receiving a power signal
Step of charging a battery pack with transmission power and supplying a power to a portable terminal block
Step of receiving a completely charged signal and data
Step of suspending transmission of power
Stand by step
Step of detection a completely charged signal and transmitting the completely charged signal to a wireless charger apparatus

Fig. 10

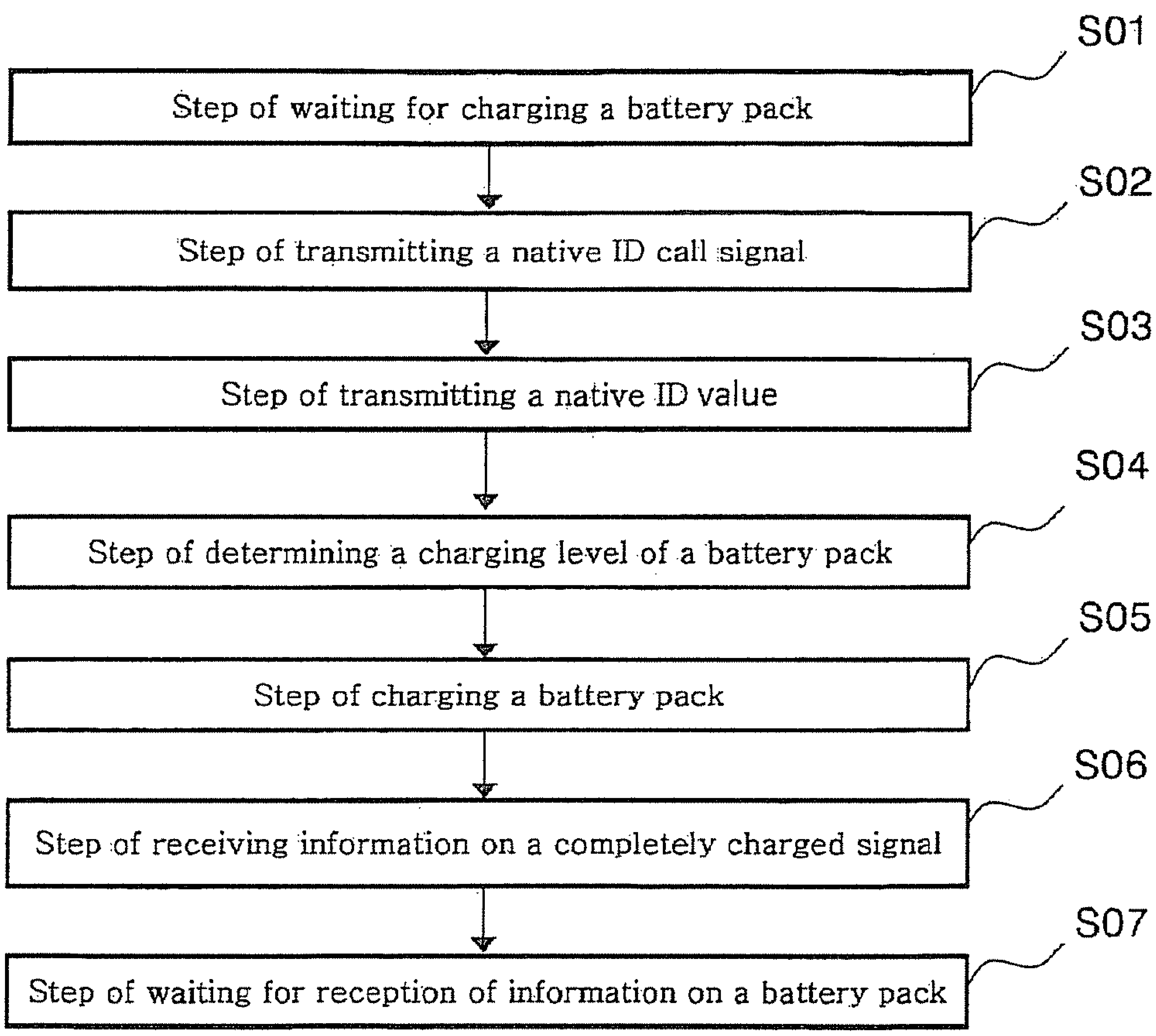

S01
Step of waiting for charging a battery pack
S02
Step of transmitting a native ID call signal
S03
Step of transmitting a native ID value
S04
Step of determining a charging level of a battery pack
S05
Step of charging a battery pack
S06
Step of receiving information on a completely charged signal
S07
Step of waiting for reception of information on a battery pack

Fig. 11

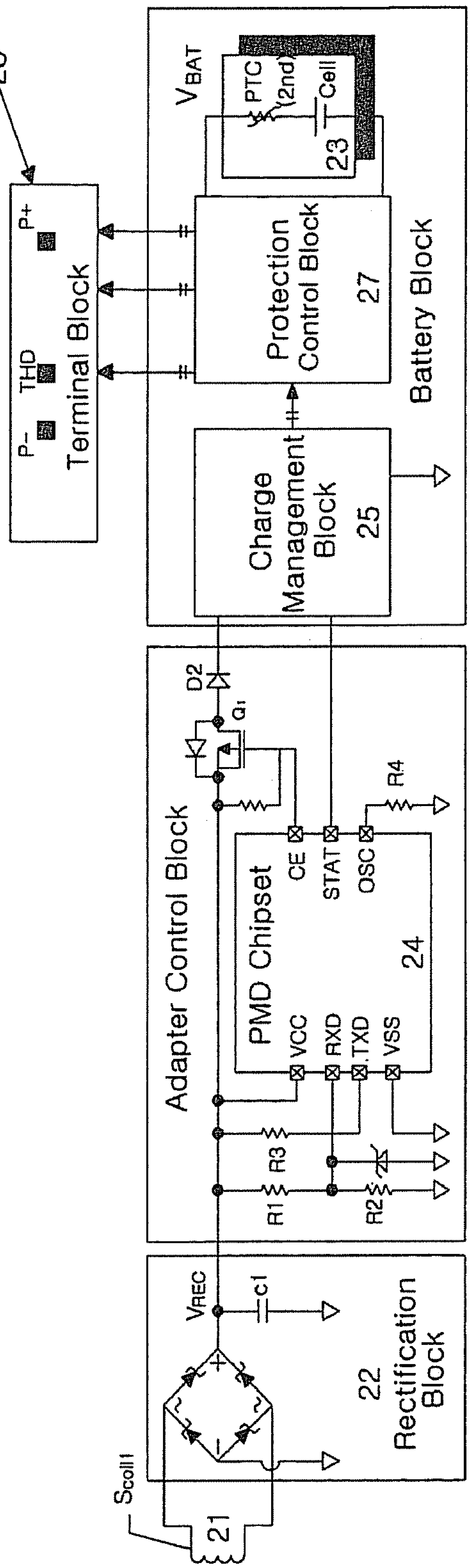

28
Terminal Block
P-
THD
P+
VBAT
PTC
(2nd)
Cell
23
Protection Control Block
27
Charge Management Block
25
Battery Block
Adapter Control Block
D2
Q1
R4
CE
STAT
OSC
PMD Chipset
24
VCC
RXD
TXD
VSS
R1
R3
R2
VREC
c1
22
Rectification Block
Scoil1
21

Fig. 12

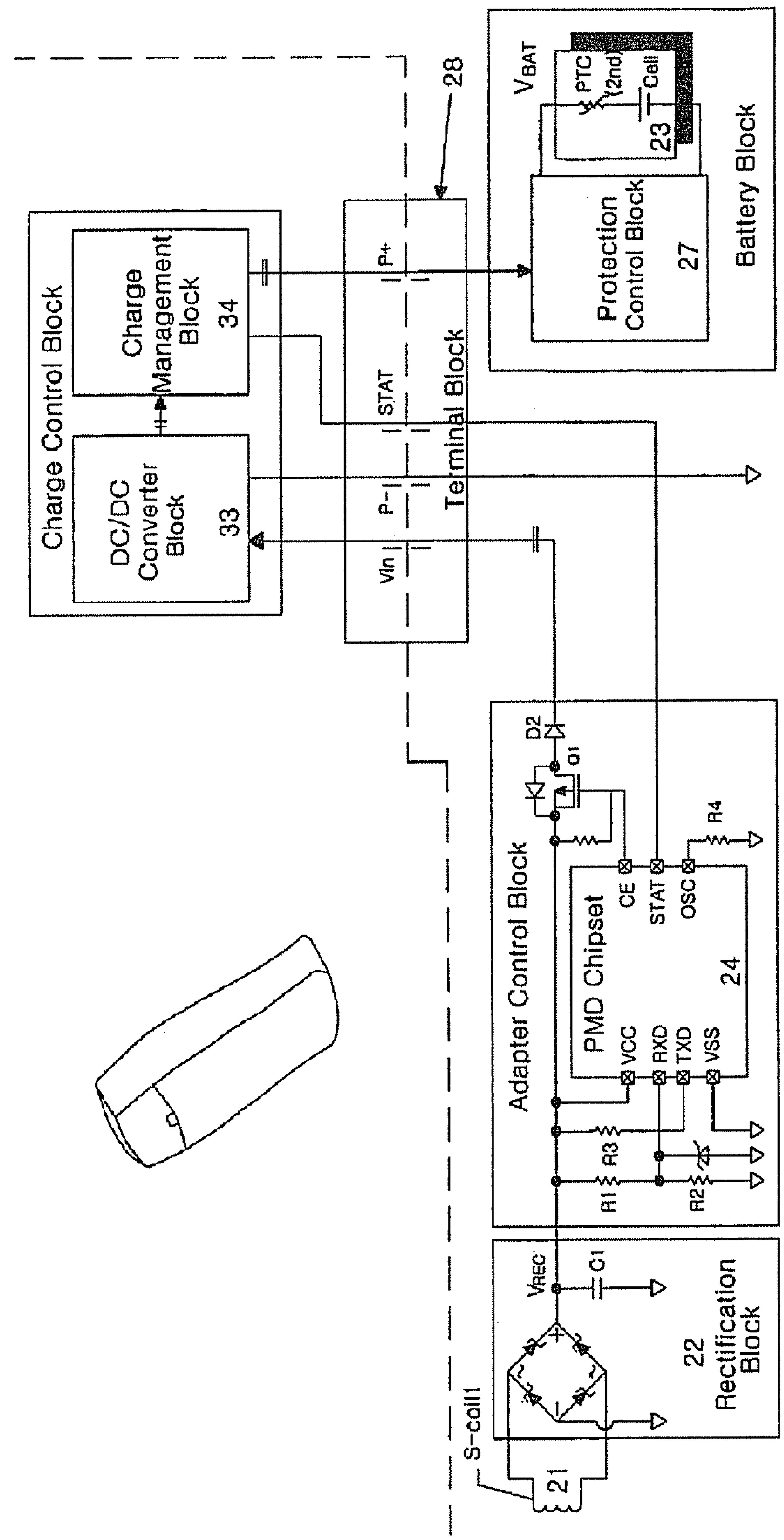

Charge Control Block
DC/DC Converter Block
33
Charge Management Block
34
28
Vin
P-
STAT
P+
Terminal Block
Protection Control Block
27
Battery Block
VBAT
PTC (2nd)
Cell
23
Adapter Control Block
PMD Chipset
24
VCC
RXD
TXD
VSS
CE
STAT
OSC
R1
R2
R3
R4
Q1
D2
VREC
C1
22
Rectification Block
S-coil1
21

Fig. 13

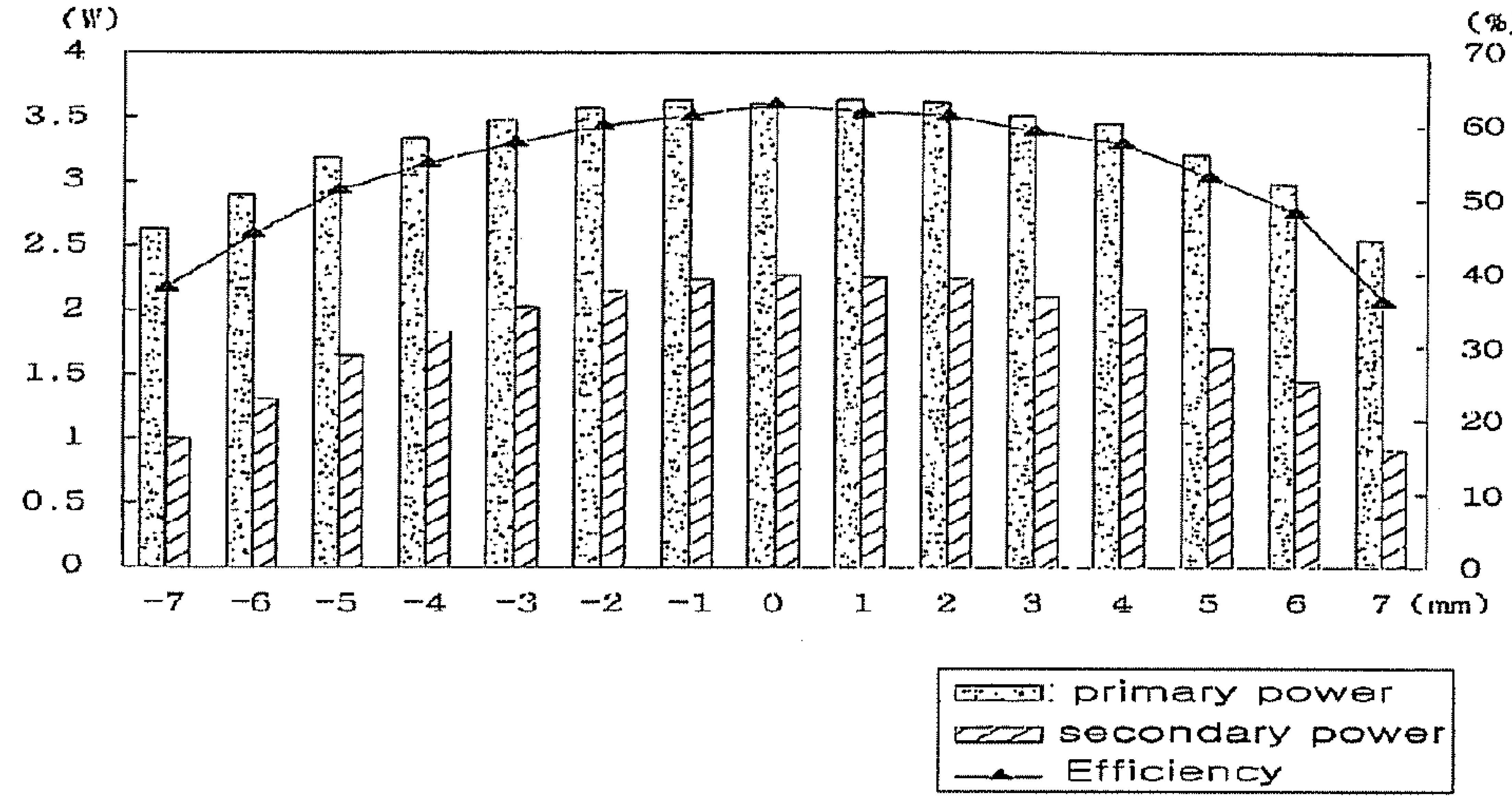

(W)
4
3.5
3
2.5
2
1.5
1
0.5
0
(%)
70
60
50
40
30
20
10
0
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 (mm)
primary power
secondary power
Efficiency

Fig. 14

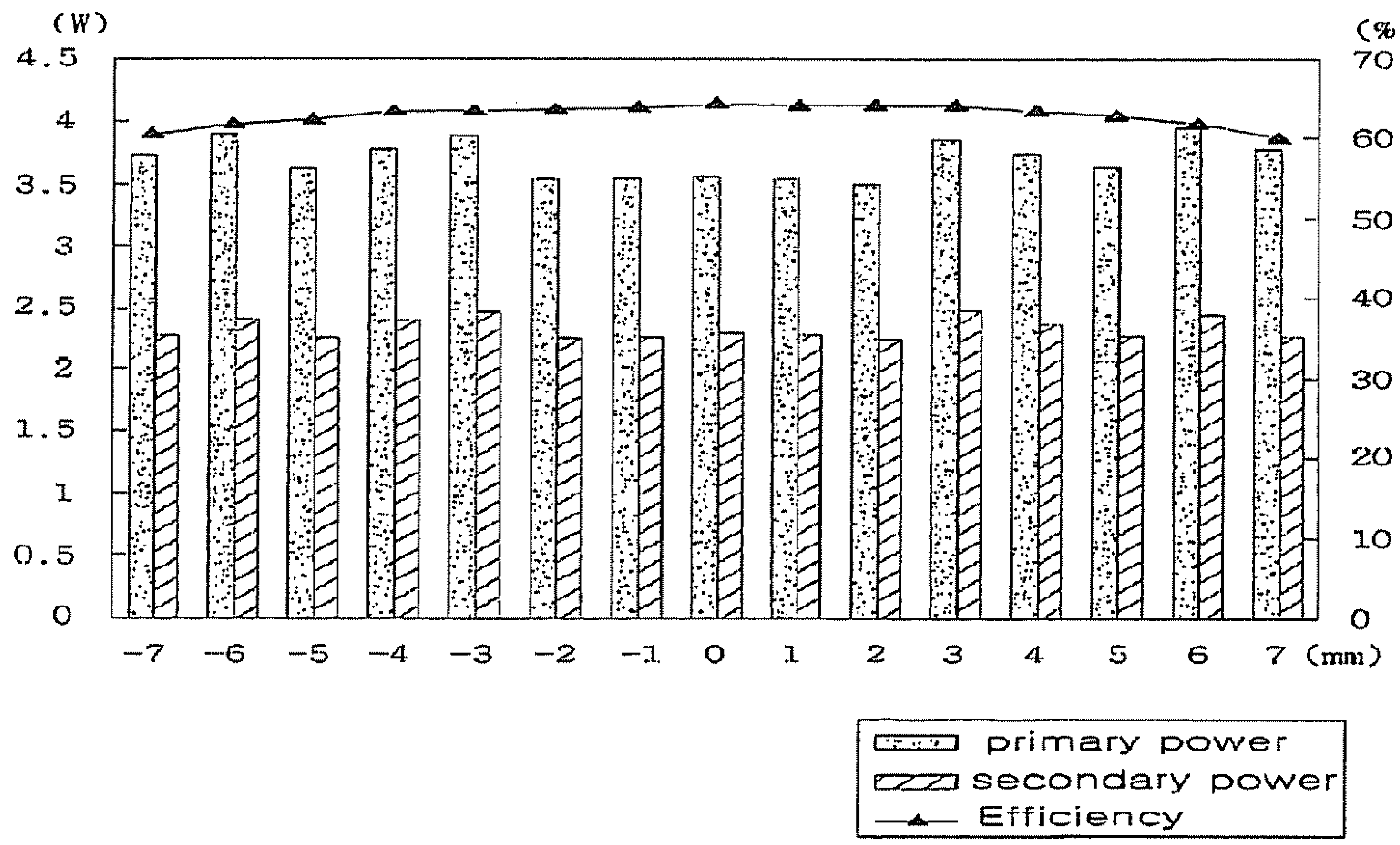
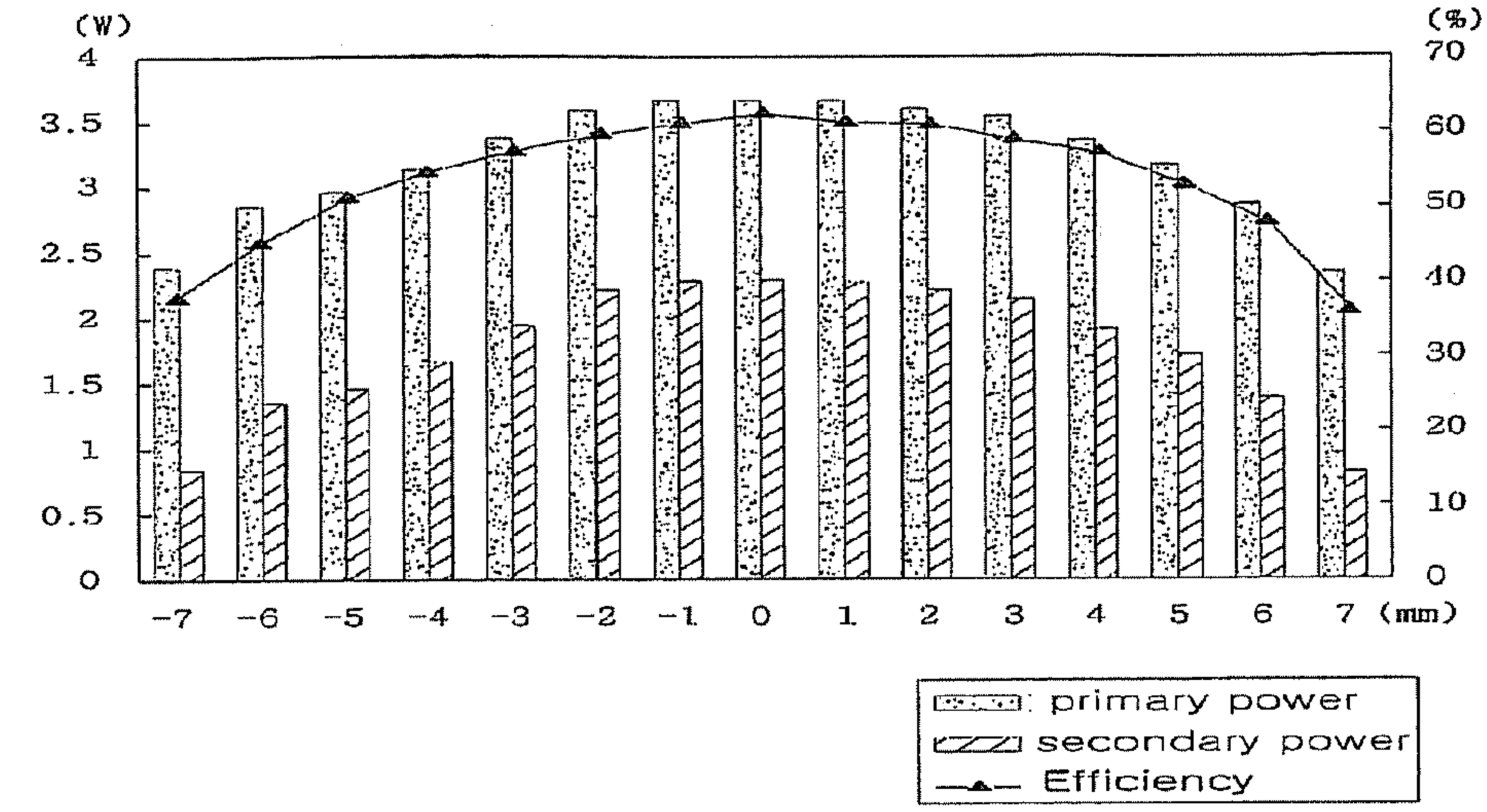

(W)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
(%)
70
60
50
40
30
20
10
0
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 (mm)
primary power
secondary power
Efficiency

Fig. 15


(W)
4
3.5
3
2.5
2
1.5
1
0.5
0
(%)
70
60
50
40
30
20
10
0
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 (mm)
primary power
secondary power
Efficiency

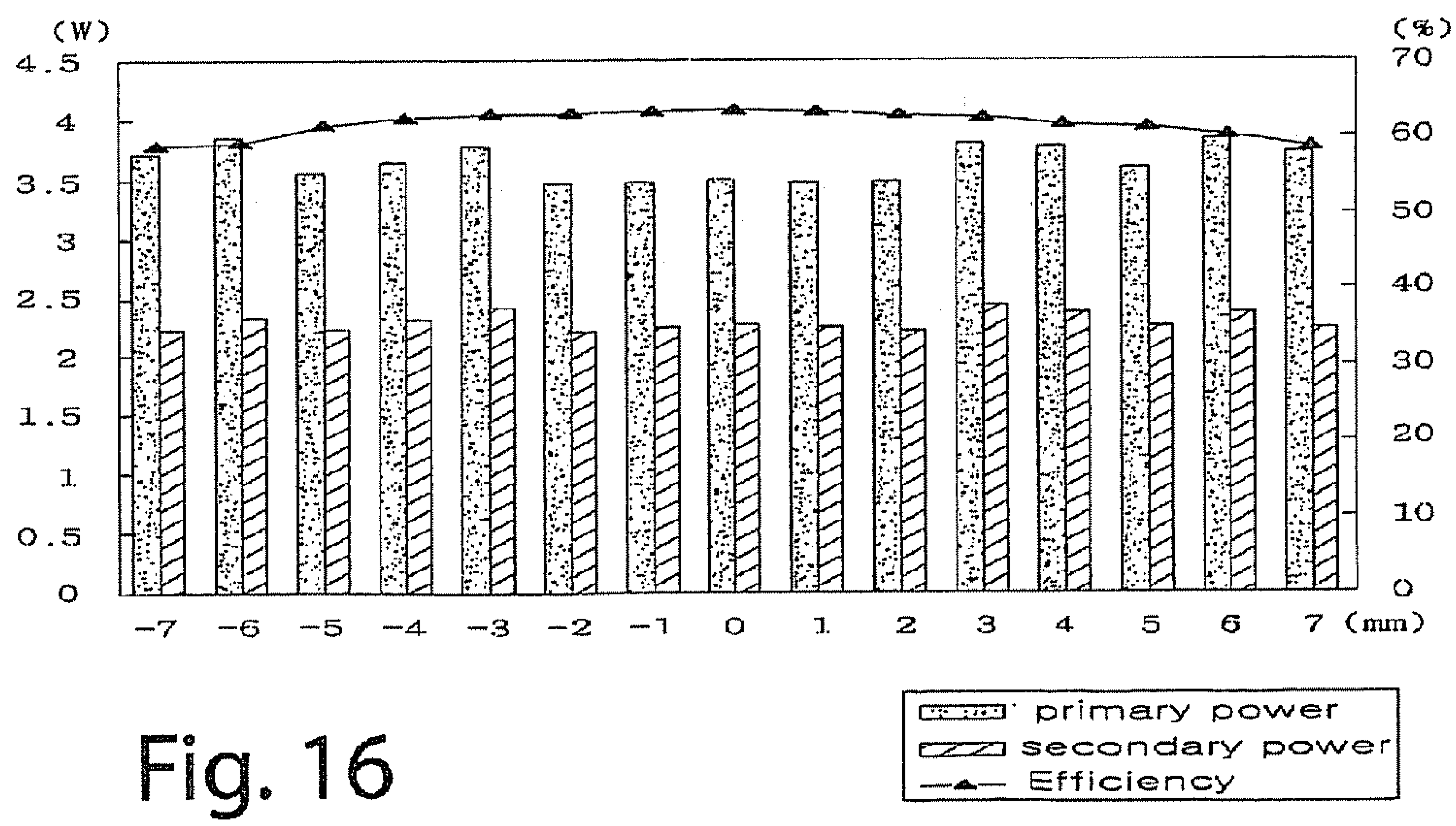
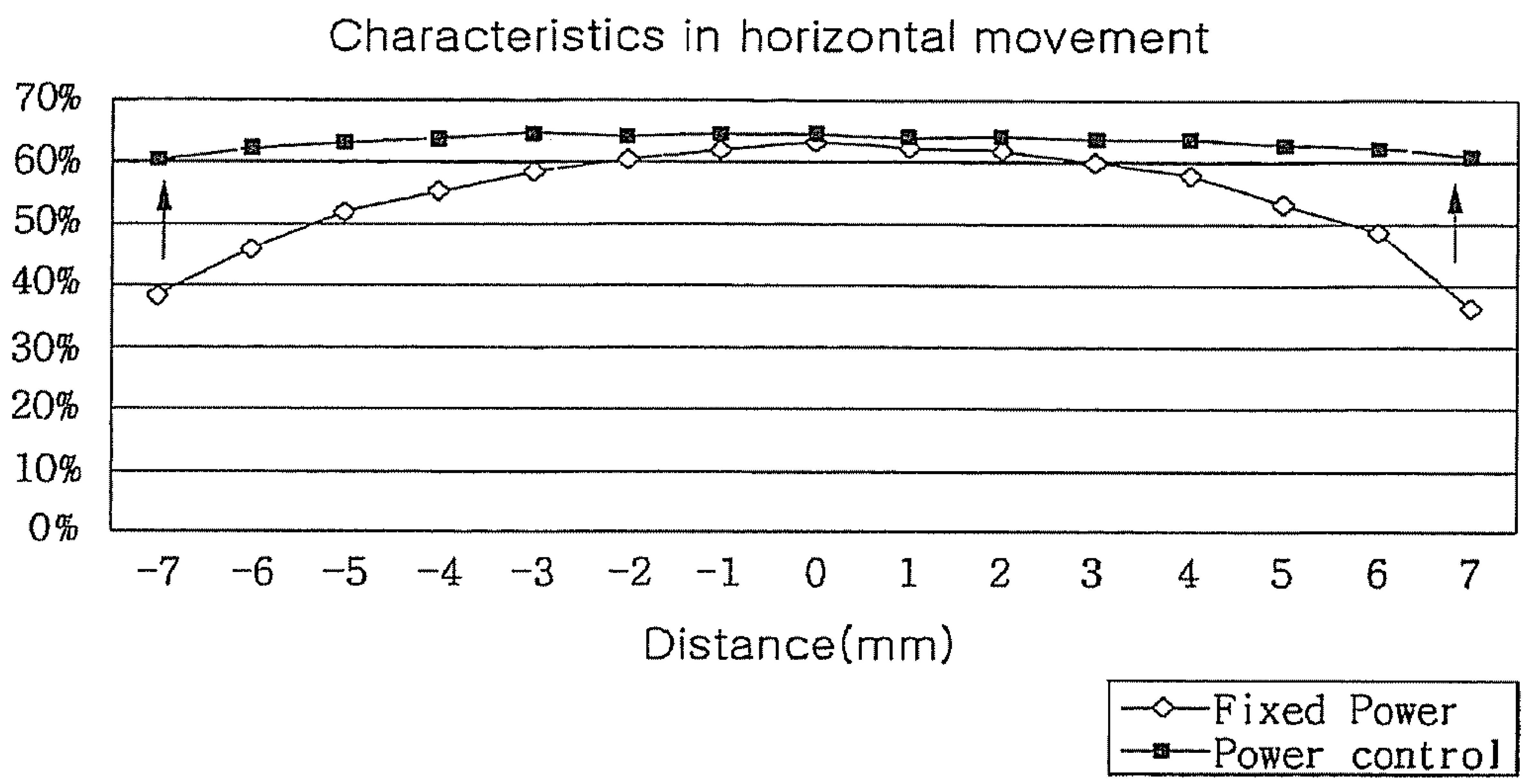

(W)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
(%)
70
60
50
40
30
20
10
0
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7 (mm)
primary power
secondary power
Efficiency

Fig. 16

Fig. 17


Characteristics in horizontal movement
70%
60%
50%
40%
30%
20%
10%
0%
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7
Distance(mm)
Fixed Power
Power control

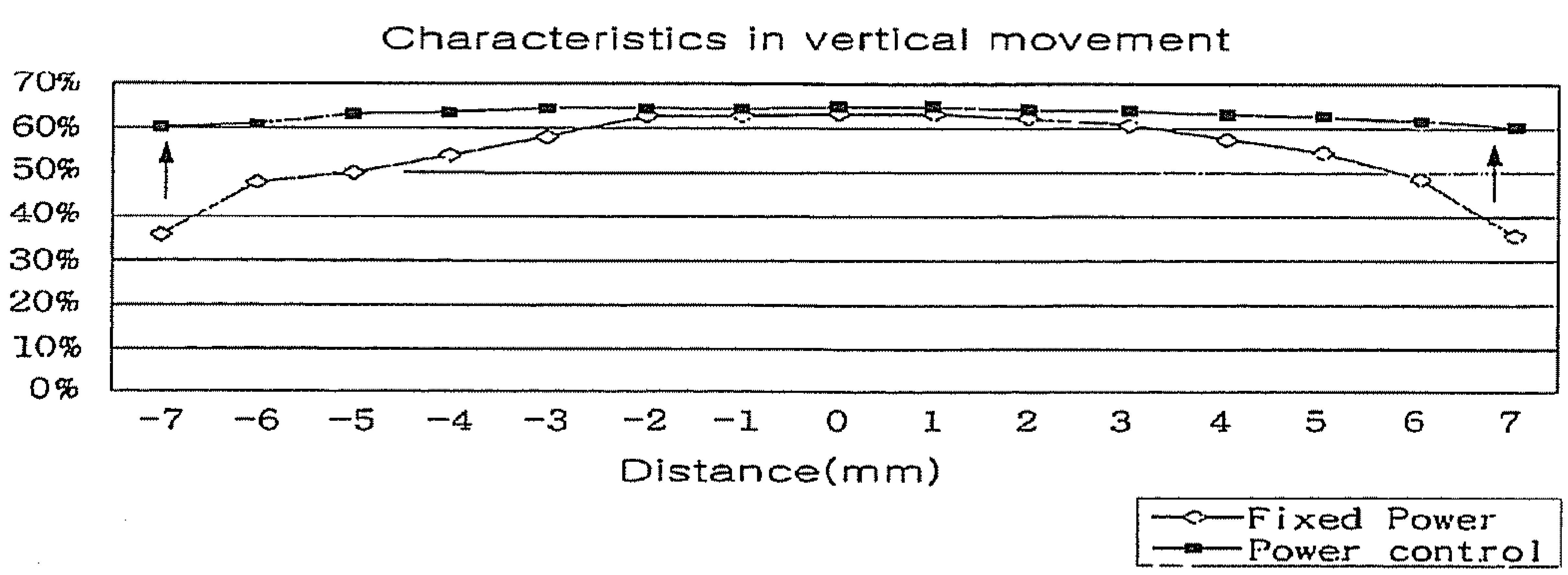
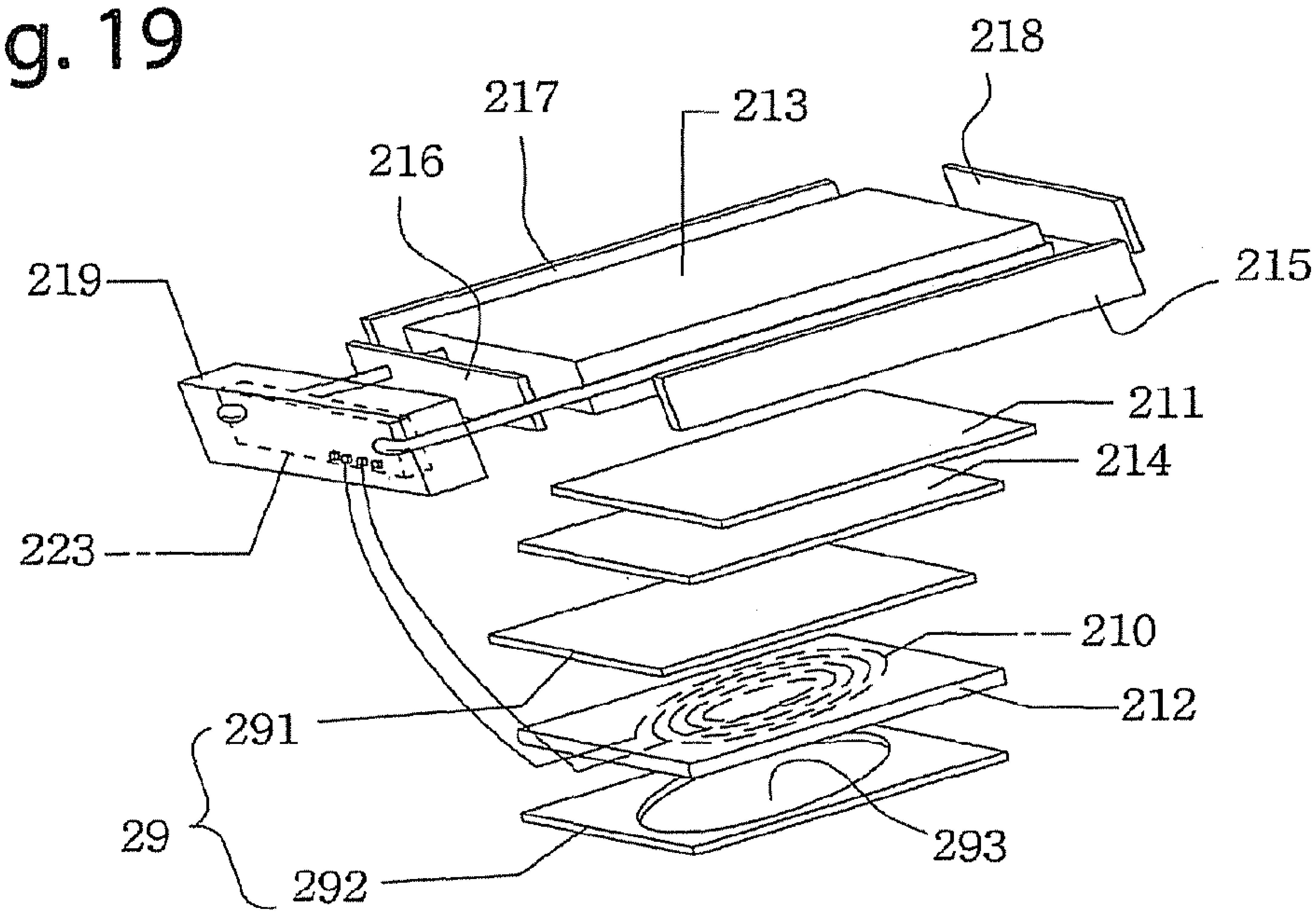

Characteristics in vertical movement
70%
60%
50%
40%
30%
20%
10%
0%
-7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7
Distance(mm)
Fixed Power
Power control

Fig. 18

Fig. 19


218
217
213
216
219
215
211
214
223
210
212
291
29
293
292

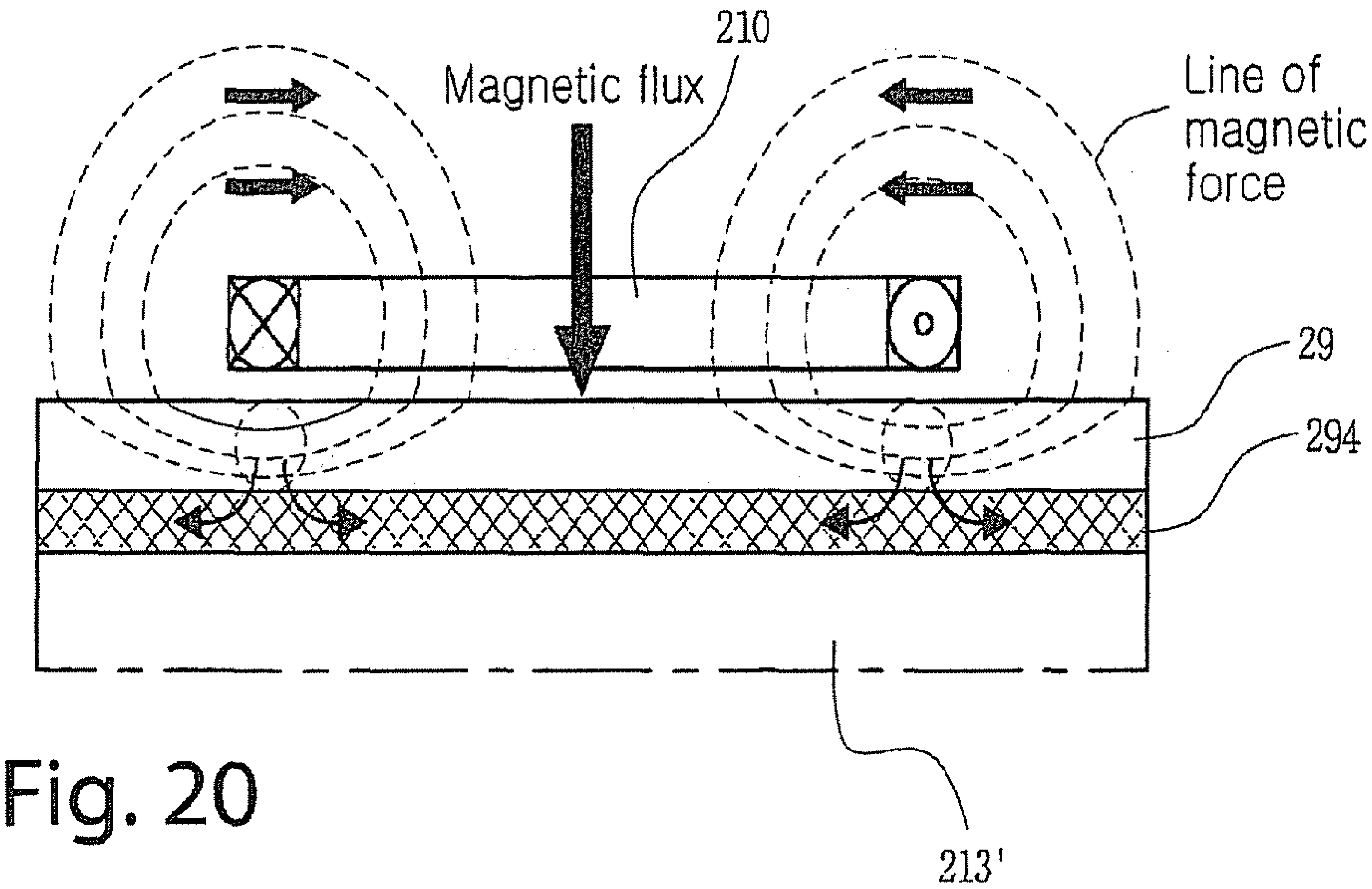
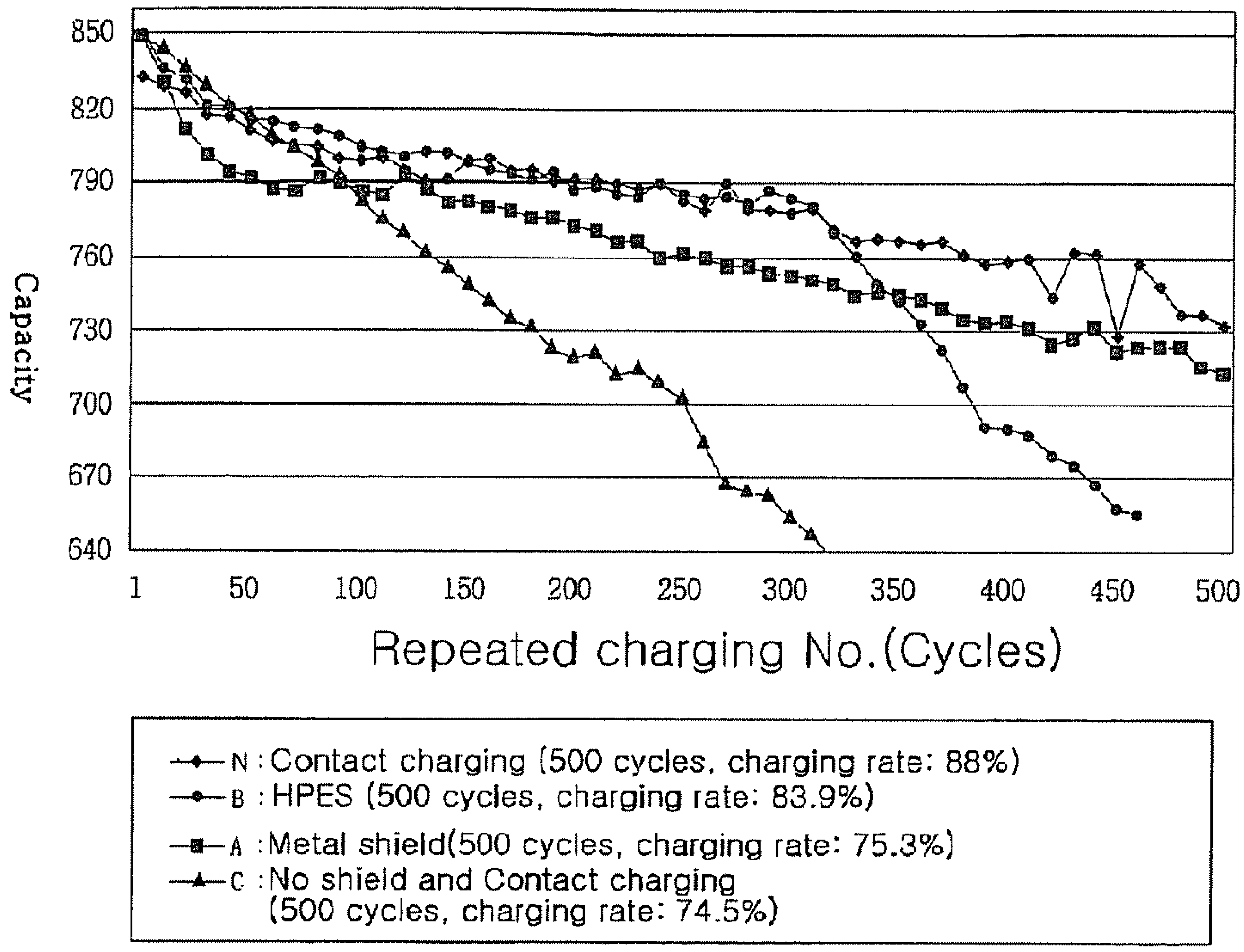

210
Magnetic flux
Line of
magnetic
force
29
294
213'

Fig. 20

Fig. 21


850
820
790
760
730
700
670
640
Capacity
1
50
100
150
200
250
300
350
400
450
500
Repeated charging No.(Cycles)
N : Contact charging (500 cycles, charging rate: 88%)
B : HPES (500 cycles, charging rate: 83.9%)
A : Metal shield(500 cycles, charging rate: 75.3%)
C : No shield and Contact charging (500 cycles, charging rate: 74.5%)

WIRELESS CHARGER SYSTEM FOR BATTERY PACK SOLUTION AND CONTROLLING METHOD THEREOF

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.

TECHNICAL FIELD

The present invention relates to a wireless charger system, and more particularly to a wireless charger system for a battery pack solution that is provided so that a wireless charger system composed of a wireless charger apparatus and a battery pack can supply a power source to a portable terminal block through the wireless power transmission.

BACKGROUND ART

In general, a battery pack functions to supply a power source of a portable terminal block, and is composed of a battery cell for storing electricity; and a charging circuit for charging and supplying the electricity.

As a charger for charging electricity in a battery pack for this portable terminal block, there is a terminal supply system in which electricity is received from a conventional power source and a power source is supplied to a battery pack via a power supply terminal. However, where the battery pack is attached/detached to/from the charger when a power source is supplied to this terminal supply system, an instant discharge phenomenon occurs due to the different potential difference of terminals disposed in both sides of the battery pack. Therefore, the battery pack has an increasing possibility to start fires as foreign substances are accumulated in the terminals. Also, the life span and performances of the charger and the battery pack may be deteriorated, for example spontaneous discharging in the presence of moisture.

In order to solve these problems regarding the terminal supply system, there has been developed a wireless charger. That is to say, this wireless charger is charged by a secondary coil inside the battery pack when a portable terminal block having a battery pack mounted inside is disposed upwardly in a primary coil of wireless charger. That is to say, electricity induced from an induced electromotive force is charged in the secondary coil by means of the magnetic field generated in the primary coil.

However, these conventional wireless chargers have no practical use since it is possible only to supply a power to a portable terminal block, but they have difficulty in use for other applications.

In particular, the conventional wireless chargers have problems that it is impossible to determine a charging level since they have no additional indicator, and it is also difficult to determine a state of the wireless chargers since a user does not discriminate a respective state in the charging level.

Furthermore, the wireless charger may be damaged due to the increased loss of power in the primary coil when metals are disposed adjacent to the magnetic field generated in the primary coil.

DISCLOSURE

Technical Problem

Accordingly, the present invention is designed to solve such drawbacks of the prior art, and therefore an object of the

present invention is to provide a wireless charger system for a battery pack solution that is provided so that a wireless charger system composed of a wireless charger apparatus and a battery pack can supply a power source to a portable terminal block through the wireless power transmission, wherein an input power such as a power for computers and notebook computers using a USB port, an external power used as a power outlet, a mobile power used as a cigar connection port in vehicles is easily supplied to a portable terminal block.

Also, another object of the present invention is to provide a wireless charger system capable of easily checking an operation state of the wireless power charging system from a display index of a display block in the wireless charger apparatus.

Technical Solution

According to an aspect of the present invention, there is provided a wireless charger system for battery pack solution including a wireless charger apparatus **10** for receiving a power source from the outside to transmit a power signal via a charging power transmitter block **15** in a wireless mode; and a battery pack **20** for receiving a power signal from the wireless charger apparatus **10** in a wireless mode to charge power in a battery cell and supplying a power source to a portable terminal block **30**, wherein the wireless charger apparatus **10** has an outer body composed of a resonant converter for supplying power to the battery pack and a wireless charger case **101** having a central controller installed inside; the wireless charger case **101** has a protruded round portion **102** formed around the rear edge and a display block **19** provided as a slop surface in the front portion **103** thereof; an a flat surface is formed between the protruded round portion **102** and the front portion **103** and a battery pack positioning block **104** formed therein, the battery pack positioning block **104** having a lower height than the protruded round portion **102** and the front portion **103**; and a primary core block **151** for transmitting power supplied to the battery pack **20** is installed inside the battery pack positioning block **104** to supply power to the battery pack **20** disposed on the battery pack positioning block **104**.

In this case, the wireless charger apparatus **10** may include a power receiver block **12** for receiving a power source from the outside; a resonant converter **14** for converting an output signal including a power signal and a data signal supplied from the power receiver block **12**, and transmitting the converted output signal to a charging power transmitter block **15** provided with a primary core block **151**; a gate driver **13** coupled to the power receiver block **12** to transmit an output signal including a data signal and a power signal to the resonant converter **14**, the gate driver being controlled by the central controller **11** and provided with a bootstrap gate drive; a current detector block **16** coupled between the power receiver block **12** and the resonant converter **14** to detect a data signal of the battery pack **20** through the transmission operation by means of the primary core block **151**; a central controller **11** for controlling the power receiver block **12**, the resonant converter **14**, the gate driver **13** and the current detector block **16**; and a display block **19** for displaying a state of the wireless charger apparatus **10** according to the control signal of the central controller **11**.

Here, the battery pack **20** may include a secondary rectification circuit block **22** for converting a power that is induced through a secondary core block **21** by an induced magnetic field generated by a primary core block **151** of the wireless charger apparatus **10**; a battery pack controller **24** coupled to the secondary rectification circuit block **22** to supply a charging power to a battery cell **23**, to process data transmitted/received by the primary core block **151** and the secondary core block **21** and to transmit data signals for a charging state of the battery pack **20**, an erroneous state of the battery pack **20** and a native ID signal value; a battery pack charging circuit block **25** for supplying power to the battery cell **23**, the power being supplied from the secondary rectification circuit block **22** under the control of the battery pack controller **24**, and supplying a power of the battery cell **23** to the portable terminal block **30**; a data input/output block **26** for transmitting/receiving data to/from a portable terminal block **30** under the control of the battery pack controller **24** relative to the data transmitted/received to/from the wireless charger apparatus **10**, and processing the data; and a charge monitoring circuit block **27** for checking a charging level of the battery cell **23** and transmitting a fully-charged or discharged signal to the battery pack controller **24**.

Also, the secondary core block **21** may have a core formed in a shape selected from the group consisting of a round shape, a rectangular shape, an oval shape and a polygonal shape; the battery pack **20** may be attachable/detachable to/from the portable terminal block **30** and may have an all-in-one hard pack shape in which a power source stored in the battery cell **23** is connected to a terminal block **28**; the secondary core block **21** may be formed integrally in the rear of the portable terminal block and may have a built-in shape in which a circuit configuration of the battery pack **20** is configured inside the portable terminal block **30** together, or the battery cell **23** may be formed in the battery pack **20** and may have a battery pack charging circuit block **34** coupled through the terminal block **28**, the battery pack charging circuit block **34** being provided inside the portable terminal block **30**.

In particular, the display block **19** may include a display signal receiver block **191** for receiving a control signal transmitted from the central controller **11**; a light emitting diode (LED) **192**, a liquid crystal display (LCD) panel **193** and an icon LCD **194**, all of which are coupled to the display signal receiver block **191** to be turned on according to the control signal transmitted from the central controller **11**; an LED driver **195** coupled to the display signal receiver block **191** to turn on the LED **192** according to the control signal transmitted from the central controller **11**; an LCD panel driver **196** coupled to the display signal receiver block **191** to turn on the LCD panel **193** according to the control signal transmitted from the central controller **11**; and an icon LCD driver **197** coupled to the display signal receiver block **191** to turn on the icon LCD **194** according to the control signal transmitted from the central controller **11**.

Furthermore, the LED **192** may emit light with a green or red color, the LCD panel **193** may emit light with a blue or green color, the icon LCD **194** may emit light with a blue or green color and be provided to emit the light with a charging level as much as notch marks on a scale according to the signal of the charging level transmitted from the battery pack **20**. Also, the LED driver **195** may be driven to turn on the LED **192** with a green or red color under the control of the central controller **11**, and the LCD panel driver **196** may be driven to turn on the LCD panel **193** with a blue or green color under the control of the central controller **11**. In addition, the icon LCD driver **197** may be provided to turn on the icon LCD **194** with a blue or green color under the control of the central controller **11** and emit the light with a charging level as much as notch marks on a scale according to the control signal depending on the charging level of the battery pack **20**.

According to another aspect of the present invention, there is provided a method for controlling a wireless charger system for battery pack solution including a wireless charger apparatus **10** for receiving a power source from the outside to transmit a power signal via a charging power transmitter block **15** in a wireless mode; and a battery pack **20** for receiving a power signal from the wireless charger apparatus **10** in a wireless mode to charge power in a battery cell and supplying a power source to a portable terminal block **30**, the method including: waiting for charging of an externally supplied power source by checking a state of the wireless charger apparatus **10** prior to performing a wireless charging through the charging power transmitter block **15** of the wireless charger apparatus **10** (S**01**); transmitting a call signal for native ID of the battery pack **20** to sense the battery pack **20** through the charging power transmitter block **15** of the wireless charger apparatus **10** (S**02**); transmitting information on a native ID value and a state of the battery pack via the secondary core block **21** of the battery pack **20** by receiving a call signal of the native ID transmitted from the wireless charger apparatus **10** in the battery pack **20**, the native ID value being store in a native ID transmission block **241** of the battery pack **20** (S**03**); determining the native ID value of the battery pack transmitted from the battery pack **20** and the state of the battery pack **20** (S**04**); charging a power in the battery pack **20** by transmitting a power via the charging power transmitter block **15** of the wireless charger apparatus **10** and receiving and charging the power in the battery pack **20** when the battery pack **20** is ready to be charged (S**05**); sensing a completely charged signal in the wireless charger apparatus **10** when the completely charged signal is transmitted from the battery pack **20** in the step of charging the battery pack (S**06**); and waiting for reception of the information on the charging level and the battery pack state from the battery pack **20** by suspending a charging operation in the central controller **11** of the wireless charger apparatus **10** when the information on the completely charged signal is received from the battery pack **20** (S**07**).

In this case, the step of waiting for charging of a power source (S**01**) include: transmitting a signal for a charging-standby state from the central controller **11** to the display block **19** to turn off the LED **192** and the LCD panel **193** (S**011**); the step of transmitting a call signal of the native ID (S**02**) may include: transmitting a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** so that the LED **192** and the LCD panel **193** can display a call state of the native ID (S**021**); the step of charging a battery pack (S**05**) may include: transmitting a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** so that the LED **192** and the LCD panel **193** can display a charging state (S**051**), the step of receiving information on the completely charged signal (S**06**) may include: transmitting a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** so that the LED **192** and the LCD panel **193** can display a completely charged state (S**061**), and the step of waiting for charging of a power source (S**01**) may further include: transmitting a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** so that the LED **192** and the LCD panel **193** can display an error state when a signal for foreign substances, which is different from a native ID value of the battery pack, is detected from the charging power transmitter block **15** of the wireless charger apparatus **10**.

Advantageous Effects

As described above, the wireless charger system for a battery pack solution, which is composed of a wireless charger apparatus and a battery pack, according to the present invention may be useful to supply a power source to a portable terminal block through the wireless power transmission, wherein input powers such as a power for computers and notebook computers using a USB port, an external power used as a power outlet, a mobile power used as a cigar connection port in vehicles are easily supplied to a portable terminal block.

In particular, the wireless charger system according to the present invention may be useful to easily operate the wireless power charging system and easily check an operation state of the wireless power charging system that is displayed on a display block since the display block is formed in the front portion of the wireless charger apparatus.

DESCRIPTION OF DRAWINGS

FIG. **1** is an exploded perspective view showing a wireless charger system according to the present invention.

FIG. **2** is a schematic configuration block view showing a wireless charger system according to the present invention.

FIGS. **3** to **7** are schematic illustrative views showing a display state on a display block of the wireless charger system according to the present invention.

FIG. **8** is a configuration block view showing the display block of the wireless charger system according to the present invention.

FIGS. **9** and **10** are flowcharts showing a method for controlling a wireless charger system according to the present invention.

FIGS. **11** and **12** are circuit configuration views showing a battery pack of the wireless charger system according to the present invention.

FIGS. **13** to **18** are graphs illustrating charging efficiencies according to the extent where a battery pack goes away from the wireless charger system according to the present invention.

FIGS. **19** and **20** are an exploded perspective view and a side cross-sectional view showing a configuration of the battery pack according to the present invention.

FIG. **21** is a graph showing charging efficiencies obtained through repeated charging/discharging experiments on the battery pack according to the present invention.

BEST MODE

Hereinafter, exemplary embodiments of the present invention will be described in more detail with reference to the accompanying drawings.

FIG. **1** is an exploded perspective view showing a wireless charger system according to the present invention, FIG. **2** is a schematic configuration block view showing a wireless charger system according to the present invention, and FIGS. **3** to **7** are schematic illustrative views showing a display state on a display block of the wireless charger system according to the present invention. Also, FIG. **8** is a configuration block view showing the display block of the wireless charger system according to the present invention, FIGS. **9** and **10** are flowcharts showing a method for controlling a wireless charger system according to the present invention, respectively. In addition, FIGS. **11** and **12** are circuit configuration views showing a battery pack of the wireless charger system according to the present invention.

Also, FIGS. **13** to **18** are graphs illustrating charging efficiencies according to the extent where a battery pack goes away from the wireless charger system according to the present invention, FIGS. **19** and **20** are an exploded perspective view and a side cross-sectional view showing a configuration of the battery pack according to the present invention, respectively, and FIG. **21** is a graph showing charging efficiencies obtained through repeated charging/discharging experiments on the battery pack according to the present invention.

That is to say, the wireless charger system (A) for a battery pack solution according to the present invention includes a wireless charger apparatus **10** for receiving a power source from the outside and transmitting a power signal via a charging power transmitter block **15** in a wireless mode; and a battery pack **20** for receiving a power signal from the wireless charger apparatus **10** in a wireless mode to charge a battery cell with a power and supplying a power source to a portable terminal block **30**, as shown in FIGS. **1** to **21**.

For the wireless charger system (A), the expression 'battery pack solution' means that the wireless charger system (A) is used to supply a power source to the portable terminal block **30**, wherein a wireless charger apparatus **10** and a portable terminal block are configured on the basis of the battery pack according to the present invention, and a power source is supplied through their systematic relation to stably supply and charge a power source.

The above-mentioned wireless charger system (A) for a battery pack solution is provided with a wireless charger apparatus **10** for supplying a power to the battery pack **20** as shown in FIGS. **1** and **2**, wherein the wireless charger apparatus **10** is provided with a power receiver block for receiving a power source from the outside, and converts a power of the power receiver block **12** and transmits the converted power from the charging power transmitter block **15** in a wireless mode.

In particular, the wireless charger apparatus **10** has an outer body composed of a resonant converter for supplying power to the battery pack **20** and a wireless charger case **101** having a central controller installed inside.

And, the wireless charger case **101** has a protruded round portion **102** formed around the rear thereof, a front portion **103** formed around the front thereof, and a battery pack positioning block **104** formed between the protruded round portion **102** and the front portion **103**. Therefore, the protruded round portion **102** is formed to surround the rear edge of the wireless charger case **101**, and a display block **19** is provided in the front portion **103** that is a slop surface formed in the front thereof.

Also, the battery pack positioning block **104** has a flat surface formed between the protruded round portion **102** and the front portion **103**, and is formed with a lower height than the protruded round portion **102** and the front portion **103**. Therefore, it is possible to prevent the battery pack **20** disposed on the battery pack positioning block **104** from being detached out when the battery pack **20** is on charge. In addition, a fixing belt, which is attachable/detachable with a velcro tape, may further provided to prevent the battery pack **20** from being shaken on charge.

As a result, the fixing belt is provided so that a power can be supplied to the battery pack **20** that is disposed on the battery pack positioning block **104** having a primary core block **151** installed inside, the primary core block **151** functioning to transmit a power supplied to the battery pack **20**.

Also, according to the concrete configuration of the power receiver block **12** in the wireless charger apparatus **10**, the power receiver block **12** may include a USB receiver port **121**a for receiving a power and a control signal from USB ports of notebook computers or computers; a power outlet **121**b for receiving a conventional power source from the outside; and a cigar connection port **121**c coupled to a cigar jack of an automobile to receive a power in motions. Also, the power receiver block **12** is provided with an input power processor block **122** for converting a suitable power to the wireless charger apparatus **10** according to the current types that is coupled to the USB receiver port **121**a, the power outlet **121**b and the cigar connection port **121**c to supply a power thereto. And, the power receiver block **12** is provided with a power control block **123** for control a power transmitted from the USB receiver port **121**a, the power outlet **121**b, and the cigar connection port **121**c to control an input power, and also control a power supplied to components of the central controller **11**, the charging power transmitter block **15** and the wireless charger apparatus **10**.

In addition, the wireless charger system (A) is provided with a resonant converter **14** for converting an output signal including a power signal and a data signal, both of which are supplied from the power receiver block **12**, and supplies a power signal and a data signal from the resonant converter **14** to the charging power transmitter block **15** provided with a primary core block **151**.

Also, one side of the gate driver **13** provided with a bootstrap gate drive is coupled to the power receiver block **12** to transmit the output signal including a data signal and a power signal to the resonant converter **14** formed in the other side of the gate driver **13**, and controlled by the central controller **11**.

In addition, the wireless charger system (A) is provided with a current detector block **16** coupled between the power receiver block **12** and the resonant converter **14** to detect a data signal of the battery pack **20** through the transmission operation by the primary core block **151**. And, the wireless charger apparatus **10** is controlled by the central controller **11** for controlling the power receiver block **12**, the resonant converter **14**, the gate driver **13** and the current detector block **16**.

Additionally, the wireless charger system (A) includes a display block **19** for displaying a state of the wireless charger apparatus **10** according to the control signal of the central controller **11**.

Also, the battery pack **20** of the wireless charger system (A) for a battery pack solution is configured, as follows. That is to say, the battery pack **20** includes a secondary rectification circuit block **22** for converting an induced electromotive force so as to receives a power from the wireless charger apparatus **10** in a wireless mode, the induced electromotive force being generated in the secondary core block **21** by means of the induced magnetic field that is generated by the primary core block **151** of the wireless charger apparatus **10**, as shown in FIG. **1**.

Also, the battery pack **20** according to the present invention includes a battery pack controller **24**, a battery pack charging circuit block **25**, a data input/output block **26**, a charge monitoring circuit block **27**, and the like. In this case, the battery pack controller **24** functions to control the entire operation of the battery pack **20**. Here, the battery pack controller **24** is coupled to the secondary rectification circuit block **22** to supply a charging power to the battery cell **23** and process data that is transmitted/received by the primary core block **151** and the secondary core block **21**. Therefore, the battery pack controller **24** functions to transmit a data signal toward the wireless charger apparatus **10**, the data signal including a charging state of the battery pack **20**, an error state of the battery pack **20** and a signal value of the native ID.

Additionally, the battery pack charging circuit block **25** is controlled under the control of the battery pack controller **24** and provided to supply a power, supplied from the secondary rectification circuit block **22**, to the battery cell **23** and supply a power of the battery cell **23** to the portable terminal block **30**. Also, the battery pack **20** is also provided with a charge detector block **251** for detecting a charging level of the battery cell **23**.

Also, the data input/output block **26** function to transmit/receive data to/from a data terminal processor block **31** of a portable terminal block **30** under the control of the battery pack controller **24** relative to the data transmitted/received to/from the wireless charger apparatus **10**, and process the data.

Furthermore, the charge monitoring circuit block **27** functions to check a charging level of the battery cell **23** and transmit a fully-charged or discharged signal to the battery pack controller **24**.

The battery pack **20** used in the wireless charger system (A) as configured thus may have a shape of an all-in-one hard pack, a built-in shape and a semi-inner pack according to the attachment and detachment to/from the portable terminal block **30**. Here, the all-in-one hard pack may control a charging level in the battery pack without any limitation on the portable terminal block and generate a native ID to transmit the presence of foreign substances to the wireless charger apparatus. In this case the all-in-one hard pack is referred to as a battery pack having a configuration where a power may be supplied to the portable terminal block power. Also, the built-in shape means that the above-mentioned battery pack is provided inside the portable terminal block, and the semi-inner pack means that the above-mentioned battery pack is detached from the portable terminal block, or coupled to the portable terminal block, thereby facilitating the charging and supply of the power.

That is to say, the battery pack **20** configured as shown in FIG. **11** may be used with its being attached/detached to/from the portable terminal block **30**, and its charging may be carried out by disposing the battery pack **20**, in the form of the all-in-one hard pack, on the battery pack positioning block **104** of the wireless charger apparatus **10**. Main components of the battery pack **20** include a secondary core block **21** driven in a coil or core manner, a secondary rectification circuit block **22** for rectifying an induced electromotive force of the secondary core block **21**; a battery cell **23**; a battery pack charging circuit block **25**; a charge monitoring circuit block **27** for monitoring and protecting a charging level of the battery pack during the charging operation of the battery pack (including a protection circuit module (PCM) circuit for preventing overcharging of the battery pack); and a terminal block **28** coupled to the charge monitoring circuit block **27** to supply a power source to the portable terminal block **30**. Of course, the battery pack controller **24** monitors and controls the communication with the wireless charger apparatus **10**, the supply of a power source to the portable terminal block **30**, the charging level of the battery cell **23**, the operation of the battery pack **20**, etc. Therefore, the battery pack controller **24** may be configured so that LDO (Low Drop Out), ID (TX and RX communication), FET drives, battery charging state-input (empty or full signal) functions, oscillators, and port for enabling/disabling the charging circuit can be installed inside the battery pack controller **24**.

Also, the main components of the battery pack may be provided so that they can be configured in a built-in shape by forming the battery pack integrally with the portable terminal block. That is to say, the secondary core block and the magnetic field shielding plate are formed integrally in a case cover disposed in the rear of the portable terminal block (a core may be injection-molded so that it can be formed integrally with a cover, or a protection case may be manufactured and provided in the core using an ultrasonic welding process), a secondary rectification circuit block and a wireless native ID recognition circuit are additionally formed as an inner circuit of the portable terminal block, and a DC/DC converter and a charging circuit installed inside the portable terminal block may be used by itself. For this purpose, the battery pack may be provided in a built-in shape.

In particular, the battery pack **20** may be provided in the form of a semi-inner pack in the present invention as shown in FIG. **12**. That is to say, the battery pack **20** may include a secondary core block **21** driven in a coil or core manner; a secondary rectification circuit block **22** coupled to the secondary core block **21**; a battery cell **23** (positive temperature coefficient (PTC) circuit installed inside); and a terminal block **28** coupled to the portable terminal block. Also, the battery pack controller **24** may be configured so that LDO (Low Drop Out), ID (TX and RX communication), FET drives, battery charging state-input (empty or full signal) functions, oscillators, and port for enabling/disabling the charging circuit can be installed inside the battery pack controller **24**. Therefore, the portable terminal block **30** coupled to the terminal block **28** may be provided with a GSM charging control block that may control a charging level of the battery cell **23** while receiving a power source from the battery cell **23** or the battery pack controller **24** of the battery pack **20**. This GSM charging control block may include a GSMDC/DC converter **33** (DC/DC converter block); and a GSM charging control block **34** coupled to the charge monitoring circuit block **27** that is coupled to a GSMDC/DC converter **33** to monitor a charging level of the battery cell **23**. For the battery pack **20** in this form of a semi-inner pack, since the portable terminal block **30** is provided with circuits including the GSMDC/DC converter and the GSM charging control block, the portable terminal block coupled to the battery pack **20**, in the form of an attachable/detachable semi-inner pack, through the terminal block is referred to as a 'GSM portable terminal block.'

Therefore, when the GSM portable terminal block having the battery pack **20** installed inside in the form of a wireless charging semi-inner pack is put on the battery pack positioning block **104** of the wireless charger apparatus **10**, an induced magnetic field is formed in the wireless charger apparatus **10** to transmit a power to the battery pack in the secondary core block. Therefore, the battery pack **20** receives an AC induced electromotive force from the secondary core block **21**, rectifies the AC induced electromotive force into a DC induced electromotive force in the secondary rectification circuit block **22**, and transmits the DC induced electromotive force to the battery pack controller **24**.

Therefore, a power may be regularly and stably received and charged in the battery pack controller by transmitting a signal for adjusting a power transmitted from the wireless charger to a constant voltage level. For example, assume that a voltage of a received power is set to a reference voltage of 5V. In this case, when the voltage of the received power exceeds 5.5V, a power save code signal is generated to reduce a power in the wireless charger **10**, and therefore a parameter (frequency) of an induced magnetic field generated in the primary core block **151** is adjusted in the wireless charger apparatus **10** so that the power transmitted from the battery pack can be reset to a voltage of about 5V. Then, when the continuously received power is under the optimum voltage conditions such as 5V in the battery pack controller **24**, information on the optimum voltage conditions is transmitted to the wireless charger apparatus **10**, and a charging operation is then carried out in the wireless charger apparatus **10** until the completely charged signal is received from the wireless charger apparatus **10**.

For this charging operation, when the information received from the wireless charger apparatus **10** is not a predetermined information on the native ID of the battery pack **20**, an error is caused by recognizing as if foreign substances are put on the wireless charger apparatus **10**.

The wireless charger system (A) according to the present invention, as configured thus, includes a wireless charger apparatus **10** and a battery pack **20**, which are provided to operate the wireless charger system (A). Therefore, the display block **19** displays a state controlled according to the operation of the wireless charger apparatus **10**, which allows a user to see the state.

That is to say, the wireless charger system is provided with a display signal receiver block **191** for receiving a control signal transmitted from the central controller **11** of the wireless charger apparatus **10**. Here, the display signal receiver block **191** is coupled to the display signal receiver block **191** to turn on or off the LED **192**, the LCD panel **193** and the icon LCD **194** according to the control signal transmitted from the central controller **11**.

For this purpose, the display signal receiver block **191** includes an LED driver **195** coupled to the display signal receiver block **191** to turn on the LED **192** according to the control signal transmitted from the central controller **11**; an LCD panel driver **196** coupled to the display signal receiver block **191** to turn on the LCD panel **193** according to the control signal transmitted from the central controller **11**; and an icon LCD driver **197** coupled to the display signal receiver block **191** to turn on the icon LCD **194** according to the control signal transmitted from the central controller **11**.

According to the detailed configuration of the display signal receiver block **191**, the LED **192** is provided to emit light with a green or red color, the LCD panel **193** is provided to emit light with a blue or green color, and the icon LCD **194** is provided to emit light with a charging level as much as notch marks on a scale according to the signal of the charging level transmitted from the battery pack **20**.

For this purpose, the LED driver **195** drives the LED **192** to be turned on with a green or red color under the control of the central controller **11**, the LCD panel driver **196** drives the LCD panel **193** to be turned on with a blue or green color under the control of the central controller **11**, and the icon LCD driver **197** is provided to turn on the icon LCD **194** with a blue or green color under the control of the central controller **11**, and to emit the light as much as notch marks on a scale according to the control signal due to the charging level of the battery pack **20**.

Referring to the operation of the wireless charger system (A) for a battery pack solution according to the present invention as configured thus, the wireless charger system (A) is provided with a wireless charger apparatus **10** for receiving a power source from the outside and transmitting a power signal via the charging power transmitter block **15** in a wireless mode, and also provided with a battery pack **20** for receiving a power signal from the wireless charger apparatus **10** in a wireless mode to charge the battery cell with a power and supplying a power source to the portable terminal block **30**, and therefore the wireless charger system is controlled in the following steps.

That is to say, a state of the wireless charger apparatus **10** is checked and the charging operation is in a standby mode prior to charging externally supplies power sources in a wireless mode through the charging power transmitter block **15** of the wireless charger apparatus **10** (S**01**). Then, a call signal for a native ID of the battery pack **20** is transmitted to sense the battery pack **20** through the charging power transmitter block **15** of the wireless charger apparatus **10** (S**02**).

Subsequently, the signal for the native ID transmitted from the wireless charger apparatus **10** is received in the battery pack **20** to transmit information on a native ID value and the state of the battery pack via the secondary core block **21** of the battery pack **20** (S**03**), the native ID value being stored in the native ID transmission block **241** of the battery pack **20**.

As described above, a state of the battery pack **20** is determined by determining the native ID value of the battery pack transmitted from the battery pack **20** (S**04**).

Then, when the battery pack **20** is detected and ready to be charged, a power is transmitted via the charging power transmitter block **15** of the wireless charger apparatus **10**, and therefore the battery pack **20** is charged by receiving a power (S**05**).

Also, the battery pack **20** is charged in the step of charging the battery pack. When the charging of the battery cell is completed, a signal, such as a state displaying the charging is completed in the battery pack, is transmitted to the wireless charger apparatus **10**, and the signal is sensed in the wireless charger apparatus **10** (S**06**).

Also, when the information on the completely charged signal is received from the battery pack **20**, the charging operation is suspended under the control of the central controller **11** of the wireless charger apparatus **10**, and waiting to receive information on the charging level from the battery pack **20** and the state of the battery pack (S**07**).

In the step of waiting for information on the battery pack, it is checked that battery pack **20** is continuously sensed. When the battery pack is not sensed, a call signal is continuously transmitted to check that there is a newly sensed battery pack. Then, when a new battery pack is sensed, a native ID value of the battery pack is called, and then a normal operation and a charging level of the battery pack are determined when the native ID value is proven to be a suitable battery pack ID. Then, when the charging of the battery pack is completed, the battery pack is continuously in a standby mode. On the contrary, when the charging of the battery pack is proven to be required, a charging operation of the wireless charger apparatus **10** is carried out.

For the wireless charger system (A) for a battery pack solution according to the present invention as configured thus, an operation of the display block **19** of the front portion **103** according to the operations of the wireless charger apparatus **10** and the battery pack **20** will be described in detail, as follows.

That is to say, the step of waiting for the charging of a battery pack (S**01**) including a step of displaying a charging-standby state (S**011**). In this step (S**011**), a signal for the charging-standby state is transmitted from the central controller **11** to the display block **19** to turn off the LED **192** and the LCD panel **193**, as shown in FIG. **3**. Therefore, the LED **192**, the LCD panel **193** and the icon LCD **194** are displayed as a turn-off state.

Also, the step of transmitting a call signal for a native ID (S**02**) includes a step of displaying a native ID call state (S**021**). In this step (S**021**), the LED **192** and the LCD panel **193** transmit a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** to display a native ID call state, as shown in FIG. **4**. Therefore, the LED **192** is turned on with a green (LED green) color, and the LCD panel **193** is turned on with a blue (LCD blue) color.

In addition, the step of charging a battery pack (S**05**) includes a step of displaying a charging state. In this case, the LED **192** and the LCD panel **193** transmit a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** to display a charging state, as shown in FIG. **5**. Therefore, the LED is turned off, and the LCD panel **193** is displayed with a blue color. And, the icon LCD **194** is displayed with a blue color, but notch marks are increased one by one according to the charging state from a period that the notch marks are not displayed according to the charging of the battery cell as the power is consumed. Therefore, the notch marks in the charging level are displayed from 0 through one, two to three, and therefore it is possible to check the charging state according to the notch marks.

In the similar manner, the step of receiving information on a completely charged signal (S**06**) includes a step of displaying a completely charged state (S**061**). In this case, the LED **192** and the LCD panel **193** transmit a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** so that the battery pack **20** can be displayed in a completely charged state, as shown in FIG. **6**. Therefore, the LED **192** is turned off/on with a green color (LED green blinking), and the LCD panel **193** is turned off/on with a green color (LCD green blinking). Also, the icon LCD **194** is turned off/on with a green color together with the LCD panel **193**, and all of the notch marks are turned off/on at the same time.

Also, the step of waiting for the charging of a battery pack (S**01**) further includes a step of displaying an error signal (S**012**). In this case, the LED **192** and the LCD panel **193** transmits a control signal to the LED driver **195**, the LCD panel driver **196** and the icon LCD driver **197** to display an error state when a signal for foreign substances, which is different from the native ID value of the battery pack, is sensed from the charging power transmitter block **15** of the wireless charger apparatus **10**, as shown in FIG. **7**. Therefore, the LED **192** is turned on with a red color (LED red), and the LCD panel **193** is turned off (LCD off). Therefore, it is possible to allow a user to easily observe the operation of the display block **19** with the naked eye in the front of the display block **19**, the display block **19** being formed in the front portion **103** of the wireless charger apparatus **10**, and also to check the operation of the wireless charger system (A).

TABLE 1

	Display blocks			
Status	LED	LCD panel	icon LCD	Particulars
Standby mode	OFF	OFF	OFF	Normal, substances detected in standby mode
ID call mode	GREEN	BLUE	BLUE	ID detected when a battery pack is put on a charger
Charging mode	OFF	BLUE	BLUE (notch marks)	Display that a battery pack is on charge
Completely charged mode	GREEN	GREEN	GREEN	Display that a battery pack is fully charged
Display mode of error signals	RED	OFF	OFF	Erroneous Temp., ID error, alarming the detection of foreign substances

In FIGS. **3** to **7**, it is shown that a turn-off state is represented by a blank figure in Table 1, GREEN is represented by slashes of vertical/horizontal line segments, BLUE is represented by a filled black color, and RED is represented by filled dots.

The configuration and operation of the wireless charger system (A) for a battery pack solution according to the present invention, as configured thus, will be described in detail, as follows.

That is to say, for the wireless charger system (A) for a battery pack solution according to the present invention, an input power source of the wireless charger apparatus **10** may includes a conventional external input power source, a cigar power source that may be received in motion of vehicles, and a power source for a USB port input that may be received from computers and notebook computers. The wireless charger apparatus **10** receiving the input power source includes a battery pack for supplying a power source to a portable terminal block; and an apparatus for transmitting a power in a wireless mode using an induced electromotive force. Here, the portable terminal block may include mobile phones, PDA, MP3 players, DAB, DMB terminals, PMP, Handheld terminals, etc.

In particular, when foreign substances such as metals other than the battery pack (a pack having secondary wireless charger module installed inside) of the portable terminal block to be charged are put on the charging power transmitter block that is a charger block of the wireless charger apparatus **10**, the charging power transmitter block has a function to sense the foreign substances and suspend the wireless charging operation, and also has a function to recognize the battery pack of the portable terminal block to check a charging state. Also, the charging power transmitter block functions to prevent an overload when a wireless charging apparatus is taken into action, and also has a temperature protection function.

Also, the battery pack **20** includes a rectification circuit block, a native ID transmission block **241**, a charging circuit block, a protection circuit block, a battery cell, etc. Here, the battery pack **20** may be installed inside the portable terminal block, and also be charged when it is detached from the portable terminal block.

That is to say, an induced magnetic field is generated in a charging module of a primary core block by using a DC input source power source into which a power source for USB ports of computers, and a power source inputted from an AC adapter, a cigar Jack and the like are converted. Therefore, a voltage is always adjusted to a constant voltage level in a rectifier end of the secondary core block that is the battery pack.

Therefore, a power is controlled in the primary wireless charger apparatus **10** by using a frequency automatic variable algorithm, but an induced magnetic field is formed with an LC resonance by performing a switching operation every certain time. This mode is referred to as a standby mode. The primary wireless charger apparatus **10** waits for a response from the secondary battery pack by means of the induced magnetic field. In this case, the primary wireless charger apparatus **10** waits for an acknowledge response signal from the secondary battery pack by transmitting a request (FSK signal) signal in a standby mode. Therefore, when a response signal from the secondary battery pack is not received, a standby mode in which a request (FSK) signal is transmitted is continuously carried out. Then, when a response signal from the battery pack is detected by the signal detector block **163** coupled to the primary core block **151**, the signal detector block **163** analyzes the response signal to determine whether a charging operation is carried out.

The induced magnetic field, which is transmitted by the standby mode as described above, may be transmitted via the charging power transmitter block **15** formed on the wireless charger apparatus **10**. In this case, the battery pack is not properly disposed in the charging power transmitter block **15**, and a response to the load modulation is not generated as a signal such as a normal signal from the battery pack when foreign substances such as metals are put on the charging power transmitter block **15**. The wireless charger apparatus **10** is provided with a temperature detector block **162** so as to prevent the wireless charger apparatus **10**, particularly a primary core block, from being overheated by the metal foreign substances as the reaction of the abnormal response generated when the foreign substances are put on the charging power transmitter block **15**. And, the temperature detected by the temperature detector block **162** is transmitted to the central controller to adjust the intensity of the induced magnetic field according to the overheating of the primary core block.

Also, when overcurrent and overvoltage are detected by the current detector block **16** for detecting a current flow of the wireless charger apparatus **10**, the current flow may be intercepted or adjusted by the central controller **11**. When an abnormal state is detected by the temperature detector block **162** and the current detector block **16** in the wireless charger apparatus **10** as described above, the abnormal state is converted into the step of displaying an error signal in the central controller **11**, and then displayed on the display block **19**. In addition, when dusts or bed smells are caused, a dust sensor circuit **165** senses the dusts or bed smells, and therefore it is possible to remove the dusts or bed smells by generating ions in the ionizer transmission block **164**.

Also, an induced magnetic field is formed in the primary core block **151** of the wireless charger apparatus **10**, and then sensed in the secondary core block **21** of the battery pack **20**, as shown in FIG. **2**. Accordingly, an AC power derived from a coil is rectified into a DC power in the secondary rectification circuit block **22** during a period that an AC power is turned on, and a power source is supplied to the battery pack controller **24** (adapter control block). Therefore, when the battery pack controller **24** receives a primary frequency shift keying (FSK) code from a RXD signal line, and the primary FSK code is matched with a code signal of the native ID transmission block **241**, the primary FSK code is recognized as an acknowledge to generate a native ID data value of the native ID transmission block **241**. Then, the native ID data value is transmitted to a primary side through the load modulation, and the native ID data value of the battery pack transmitted via the primary core block **151** is detected to be a normal signal in the signal detector block **163** of the wireless charger apparatus **10**. And, a signal is transmitted to the central controller **11** to determine whether the native ID data value is a normal native ID data value. In this case, when the native ID data value is a normal native ID data value, the power receiver block **12**, the gate driver **13**, the resonant converter **14** and the like are controlled so that they can be switched in a full-power mode for the entire period to generate an AC power. Therefore, a wireless induced magnetic field is generated in the charging power transmitter block **15**. Of course, the induced magnetic field is transmitted together with a frequency when the induced magnetic field is transmitted from the charging power transmitter block **15** in this manner, and therefore an induced magnetic field is generated when a signal is transmitted/received between the wireless charger apparatus **10** and the battery pack **20**. Also, the central controller **11** performs the step of charging a battery pack by displaying a charging state on the display block **19**.

Also, when the native ID data value is not proven to be a normal native ID data value, the native ID data is recognized as a foreign substance to transmit an error signal (a step of displaying an error signal). Of course, the battery pack is controlled not to transmit a power. And, the battery pack is maintained to a standby mode in which the normal native ID data value of the battery pack is requested (a step of waiting for charging of a battery pack).

In addition, a power signal transmitted by the primary core block **151** of the wireless charger apparatus is transmitted via the secondary core block **21** of the battery pack, and this power signal is used as Vsense to sense the intensity of an input voltage. Therefore, when the signal detector block **163** detects, for example, a voltage of the received power to be a stable voltage of about 5V, the signal detector block **163** maintains the voltage of the received power to a constant voltage level. And, when a voltage of the received power is received as a low voltage value or a too high voltage value, information on the voltage adjustment is used as load modulation. In this case, the information is transmitted to the wireless charger apparatus **10** to maintain a constant voltage level. As a result, when the information on the voltage adjustment is adjusted to a constant voltage level, an operation of a charging IC in the battery pack charging circuit block **25** is in an active state to charge the battery cell **23** with a power. When the battery cell **23** of the battery pack **20** is charged with a power transmitted from the wireless charger apparatus **10** as described above, the battery cell **23** is stably charged by determining the stability of the battery cell **23** in the charge monitoring circuit block **27** in charging the battery cell **23**.

Also, the charge detector block **251** senses a charging level of the battery cell **23**. Therefore, when the battery cell **23** is completely charged, the charge detector block **251** senses the completely charged state to recognize the completely charged state as an active high signal and transmits the active high signal to the battery pack controller **24**. Here, the active high signal is transmitted to the primary core block **151**, and then transmitted to the wireless charger apparatus **10** together with the native ID code value. Then, the central controller **11** of the wireless charger apparatus **10** is converted into a standby mode by suspending the charging operation, and displays the completely charged state on the display block **19** (a step of receiving information on a completely charged signal).

During the charging operation of the wireless charger system (A) for a battery pack solution that is composed of the wireless charger apparatus **10** and the battery pack **20**, when the power transmitted from the battery pack **20** has a lower voltage value than the reference voltage as a position of the battery pack **20** disposed on the charging power transmitter block **15** of the wireless charger apparatus **10** is changed to another position, a signal is transmitted to the wireless charger apparatus **10** to supplement this voltage value. For example, where it is assumed that the reference voltage is set to 5V and the reference deviation value is set to 0.5V, the battery pack controller **24** controls a transmission signal to be boosted by about 0.5V when a voltage of less than 4.5V is received due to the movement of the battery pack **20**. Then, the wireless charger apparatus **10** enhances a transmission power of the primary core block to boost a voltage by 0.5V and transmits the boosted induced magnetic field. Therefore, an oscillation frequency is changed, for example, in a manner for enhancing a transmission power that is outputted from the wireless charger apparatus **10**.

When the transmission power transmitted from the wireless charger apparatus **10** is enhanced as described above, charging efficiencies to the changes in distance of the battery pack **20** from the battery pack positioning block that is a cradle of the wireless charger apparatus **10** are shown in FIGS. **13** to **18**. That is to say, FIGS. **13** to **16** show the results of a primary power (W) in the wireless charger apparatus and secondary power (W) and efficiency (%) in the battery pack when a secondary reference power of the battery pack is set to about 2.5 W and a position of the battery pack moves by −7 mm ~7 mm in a horizontal direction and a vertical direction, respectively. Here, the efficiency (%) is represented by an efficiency of an output power to a primary input power of the wireless charger apparatus ((secondary power/primary power)*100), the output power being applied to a secondary side of the battery pack.

Also, the compensation of the transmission power is adjusted to 0.5 W according to the present invention, and therefore FIGS. **13** and **15** show graphs that is plotted in a secondary power of 2~2.5 W in the case of the battery pack, which indicates the charging efficiency when the battery pack is charged without the changed in frequency in the wireless charger apparatus **10** relative to the changes in horizontal distances and vertical distances of the wireless charger apparatus **10** and the battery pack **20**. That is to say, when the battery pack **20** moves in a horizontal distance or a vertical distance relative to the wireless charger apparatus **10**, a secondary power of the battery pack **20** drops as the secondary power goes away from the center, which leads to the decreasing efficiency.

Therefore, from FIGS. **14** and **16**, it is revealed that the wireless charger apparatus **10** receives information on the change in the power received from the battery pack, and thus controls a power by changing a frequency as the battery pack **20** moves from the battery pack positioning block, which is a cradle disposed on the wireless battery pack **10**, in a horizontal distance and a vertical distance respectively, compared to FIGS. **13** and **15**. In this case, it is seen that the power is transmitted stably, and therefore the transmission efficiency of the power is good.

Also, FIG. **17** shows a graph plotting an efficiency to the movement of the battery pack **20** in a horizontal direction, and FIG. **18** shows a graph plotting an efficiency to the movement of the battery pack **20** in a vertical direction. Here, it is revealed that the efficiency is better when there is a change in frequency (an upper rectangular dots graph, POWER CONTROL) than when there is no change in frequency (a lower curve graph, FIXED POWER).

According to the wireless charger system (A) for a battery pack solution that is composed of the wireless charger apparatus **10** and the battery pack **20**, a power source is supplied to the portable terminal block **30**, wherein an input power such as a power for computers and notebook computers using a USB port, an external power used as a power outlet, a mobile power used as a cigar connection port in vehicles is easily supplied to a portable terminal block.

In particular, a charging state may be easily checked through the display state on the display block **19** of the wireless charger apparatus **10** according to the operation of the wireless power charging system (A).

In addition, the wireless charger system according to the present invention is provided with a shielding member to protect the battery pack from the magnetic field generated by the primary core block **151** of the wireless charger apparatus **10** and the secondary core block **210** of the battery pack **20**, as shown in FIGS. **19** to **21**.

First of all, FIG. **19** is an exploded perspective view showing a configuration of a wireless battery pack **20** having a wireless power receiver module. Here, a battery pack composed of coil, fine metal, thin aluminum film (foil, etc.), lithium ion or lithium polymer has no effect on cells since a thin aluminum film is introduced into the battery pack to completely cut off the magnetic field, which allow the cells to be charged/discharged at cell cycles of 500 or more. Here, the shapes of the core include all kinds of cores. That is to say, the shapes of the core may include a rectangular shape, a round shape or an oval shape, and various cores such as a winding coil, a spiral core and the like may be provided herein. In this case, the wireless battery pack **20** having a wireless power receiver module includes a wireless power receiver circuit including a battery pack controller **24** and a charging circuit block **25**, both of which are formed in one side of the charging battery cell **213**, and the wireless power receiver circuit **223** may include a shielding member **219** for preventing a surrounding magnetic field.

Also, the wireless battery pack **20** is provided with shielding plates **214**, **215**, **216**, **217** and **218** provided in the bottom, the front, the rear, the left side and the right side of the charging battery cell **213** to protect the charging battery cell **213** from the magnetic field of the primary core block and the secondary core block **210** by shielding the magnetic field.

Then, since the five regions, for example, the front, the rear, the left side, the right side and the bottom of the charging battery cell **213** are provided respectively with the shielding plates **214**, **215**, **216**, **217** and **218** to cut off the magnetic field generated by the primary core block and the secondary core block **210**, it is possible to prevent damage of the charging battery cell **213** from the magnetic field. Therefore, an additional shielding plate may be provided in an upper surface of the charging battery cell **213**, when necessary. In this case, it is desirable when temperature is not increased due to the completely closed surroundings of the charging battery cell **213**.

As described above, the shielding plates **214**, **215**, **216**, **217** and **218** and the shielding member **219** may be formed of thin discs including Al, Cu, Ni Alloy metals.

Also, a magnetic plate **29** is formed between the shielding plates **214** and the charge receiver module **212** to facilitate the induction of the magnetic field induced from the secondary sore **210**, the shielding plates **214** formed in the bottom of the charging battery cell **213**. This magnetic plate **29** includes amorphous ferrites, Mn—Zn (50 parts by weight:50 parts by weight), Ni—Fe (80 parts by weight:20 parts by weight), fine metals (Fe—Si—Cu—Nb), etc.

The magnetic plate **29** may be composed of an upper magnetic plate **291** formed between the shielding plates **214** and the charge receiver module **212**; and a lower magnetic plate **252** disposed in a lower portion of the charge receiver module **212**. Therefore, the lower magnetic plate **292** has a lower plate thorough hole as a thorough hole passed through the center thereof. This shape of the lower plate thorough hole **293** is preferably formed with the same shape as the core of the secondary core block **210**. For example, FIG. **19** shows that the lower plate thorough hole **293** of the lower magnetic plate **292** is formed with a round shape since the secondary core block **210** is formed of a round core. However, when the core is formed with a rectangular shape or a polygonal shape, the lower plate thorough hole **293** is preferably formed with the same shape. Therefore, an induced electromotive force is easily generated in the secondary core block **210** due to the presence of the lower plate thorough hole **293**, the secondary core block **210** being that is present within the induced magnetic field, and the signal may be transmitted/received in an easy manner.

Also, the magnetic plate **29** is provided with an insulating plate **211** that is provided between the shielding plates **214** and the charging battery cell **210** to insulate the charging battery cell **210**, the shielding plates **214** being formed in the bottom of the charging battery cell **210**. Since this insulating plate **211** is formed in the form of a mesh or thin film that is made of Ni—Cu, the heat of the shielding plates **214** is not delivered to the charging battery cell **213**.

As another example of the magnetic field shielding member, the magnetic plate **29** is provided with a magnetic plate **29** (a primary HPES: Hanrim Postech Electro-magnetic shield) formed between an aluminum-based battery cell case **213'** and the secondary core block **210** as shown in FIG. **20**, the aluminum-based battery cell case **213'** constituting an outer body of the battery cell **213**. In this case, a shield mesh member **294** is further provided as a secondary HPES between the magnetic plate **29** (i.e., a primary HPES) and the battery cell case **213**.' The magnetic plate **19** as a primary HPES and the shield mesh member **294** as a secondary HPES may be composed of the same components as in the above-mentioned shielding member.

It is known that most of the magnetic field is shielded by the magnetic plate **29** that is a primary HPES. As shown in FIG. **20**, it is revealed that a line of magnetic force does not affect a battery cell since the line of magnetic force is bent by the magnetic plate **29** that is a shielding plate. As a result, the heat is generated in a peak region by the line of magnetic force, and then radiated out by the metallic magnetic plate **29**. In addition, the shield mesh member **294** as a secondary HPES is formed by coating a metal mesh with a coating agent selected from the group consisting of amorphous ferrites, Mn—Zn (50 parts by weight:50 parts by weight), Ni—Fe (80 parts by weight:20 parts by weight), or fine metals (Fe—Si—Cu—Nb). Therefore, the secondary HPES functions to shield the magnetic field that is not shielded by the magnetic plate **29** that is a primary HPES. An eddy current is formed by excessive line of magnetic force in the metal mesh of the shield mesh member **294** that is a secondary HPES. In this case, the battery pack should be affected by the magnetic field that is generated by the primary core block and the secondary core block due to the presence of the eddy current formed in the metal mesh. In this experiment, it is revealed that about 90% of the magnetic field is shielded by the magnetic plate **29** that is a primary HPES, and about 10% of the magnetic field is shielded by the shield mesh member **294** that is a secondary HPES.

The battery pack **20** including the magnetic plate **29** as a primary HPES and the shield mesh member **294** as a secondary HPES is used to repeat a charging experiment (500 cycles) for the charging efficiency. FIG. **21** shows a graph that is plotted using an 80% efficiency curve as the reference curve (hereinafter, referred to as “standard efficiency line segment” (D)), the 80% efficiency curve being obtained through the repeated charging/discharging of a battery pack at 500 cycles and referred to as a stable charging efficiency. First, when the battery pack **20** is generally charged through electrical contacts without the exposure to the magnetic field (a graph represented by “N” in FIG. **21**), the experiment of the battery pack **20** is carried out so that the charging capacities can be plotted over the standard efficiency line segment, which indicates that the charging/discharging efficiency is stable in the battery pack.

Accordingly, for the battery pack **20** according to the present invention, it is shown that the charging/discharging efficiency by the magnetic plate **29** as a primary HPES and the shield mesh member **294** as a secondary HPES (a graph represented by “A” in FIG. **21**) is stable with an efficiency of 83.9% on the basis of 500-cycle charging/discharging experiment.

However, when the secondary HPES is not used in the battery pack **20**, it is shown that the charging/discharging efficiency (a graph represented by “B” in FIG. **21**) is rather low with an efficiency of 75.3% on the basis of 460-cycle charging/discharging experiment. When the primary HPES and the secondary HPES are not used in the battery pack **20**, it is shown that the charging/discharging efficiency (a graph represented by “C” in FIG. **21**) is very low with an efficiency of 74.5% in the charging/discharging experiment at 340 cycles that are far away below the 500 cycles. However, it is revealed that the battery pack **20** according to the present invention shows a highly excellent charging/discharging efficiency.

While the present invention has been shown and described in connection with the exemplary embodiments, it will be apparent to those skilled in the art that modifications and variations can be made without departing from the spirit and scope of the invention as defined by the appended claims.

The invention claimed is:

1. A wireless charger system for battery pack solution, comprising:

a wireless charger apparatus for receiving a power source from the outside to transmit a power signal via a charging power transmitter block in a wireless mode; and

a battery pack for receiving a power signal from the wireless charger apparatus in a wireless mode to charge power in a battery cell and supplying a power source to a portable terminal block,

wherein the wireless charger apparatus has an outer body composed of a resonant converter for supplying power to the battery pack and a wireless charger case having a central controller installed inside,

wherein the wireless charger case has a protruded round portion formed around a rear edge and a display block provided as a sloped surface in a front portion thereof, wherein a flat surface is formed between the protruded round portion and the front portion and a battery pack positioning block formed therein, the battery pack positioning block having a lower height than the protruded round portion and the front portion, and

wherein a primary core block for transmitting power supplied to the battery pack is installed inside the battery pack positioning block to supply power to the battery pack disposed on the battery pack positioning block.

2. The wireless charger system according to claim **1**, wherein the wireless charger apparatus comprises:

a power receiver block for receiving a power source from the outside;

a resonant converter for converting an output signal including a power signal and a data signal supplied from the power receiver block and transmitting the converted output signal to a charging power transmitter block provided with a primary core block;

a gate driver coupled to the power receiver block to transmit an output signal including a data signal and a power signal to the resonant converter, the gate driver being controlled by the central controller and provided with a bootstrap gate drive;

a current detector block coupled between the power receiver block and the resonant converter to detect a data signal of the battery pack through the transmission operation by means of the primary core block;

a central controller for controlling the power receiver block, the resonant converter, the gate driver and the current detector block; and

a display block for displaying a state of the wireless charger apparatus according to the control signal of the central controller.

3. The wireless charger system according to claim **1**, wherein the battery pack comprises:

a secondary rectification circuit block for converting a power that is induced through a secondary core block by an induced magnetic field generated by a primary core block of the wireless charger apparatus;

a battery pack controller coupled to the secondary rectification circuit block to supply a charging power to a battery cell, to process data transmitted/received by the primary core block and the secondary core block and to transmit data signals for a charging state of the battery pack, an erroneous state of the battery pack and a native ID signal value;

a battery pack charging circuit block for supplying power to the battery cell, the power being supplied from the secondary rectification circuit block under the control of the battery pack controller, and supplying a power of the battery cell to the portable terminal block;

a data input/output block for transmitting/receiving data to/from a portable terminal block under the control of the battery pack controller relative to the data transmitted/received to/from the wireless charger apparatus, and processing the data; and

a charge monitoring circuit block for checking a charging level of the battery cell and transmitting a fully-charged or discharged signal to the battery pack controller.

4. The wireless charger system according to claim **3**, wherein the secondary core block has a core formed in a shape selected from the group consisting of a round shape, a rectangular shape, an oval shape and a polygonal shape,

wherein the battery pack is attachable/detachable to/from the portable terminal block and has an all-in-one hard pack shape in which a power source stored in the battery cell is connected to a terminal block,

wherein the secondary core block is formed integrally in the rear of the portable terminal block and has a built-in shape in which a circuit configuration of the battery pack is configured inside the portable terminal block together, or

wherein the battery cell is formed in the battery pack and has a battery pack charging circuit block coupled through the terminal block, the battery pack charging circuit block **34** being provided inside the portable terminal block.

5. The wireless charger system according to claim **1**, wherein the display block comprises:

a display signal receiver block for receiving a control signal transmitted from the central controller;

a light emitting diode (LED), a liquid crystal display (LCD) panel and an icon LCD, all of which are turned on according to the control signal transmitted from the central controller;

an LED driver coupled to the display signal receiver block to turn on the LED according to the control signal transmitted from the central controller;

an LCD panel driver coupled to the display signal receiver block to turn on the LCD panel according to the control signal transmitted from the central controller; and

an icon LCD driver coupled to the display signal receiver block to turn on the icon LCD according to the control signal transmitted from the central controller.

6. The wireless charger system according to any one of claims **1** to **5**, wherein the battery pack comprises:

a charge receiver module having a secondary core block coiled therein;

shielding plates surrounding the bottom, the front, the rear and the left and right sides of the charging battery cell and made of Al, Cu, or Ni Alloy metals to protect the charging battery cell from the magnetic field;

a magnetic plate provided between the shielding plates and the charge receiver module and containing ferrites, Mn—Zn (50 parts by weight:50 parts by weight), Ni—Fe (80 parts by weight:20 parts by weight), or fine metals (Fe—Si—Cu—Nb) to induce an induced magnetic field into the secondary core block;

an insulating plate formed between the shielding plates and the charging battery cell and formed of mesh made of NI—Cu or an insulator to transfer heat of the shielding plates to the charging battery cell, the insulator being able to emit heat and decrease thermal conductivity; and

a shielding member surrounding a wireless power receiver circuit of the battery pack including a battery pack controller and a charging circuit block and including Al, Cu, or Ni Alloy metals to shield the magnetic field for the wireless power receiver circuit,

wherein the magnetic plate includes an upper magnetic plate formed between the shielding plates and the charge receiver module; and a lower magnetic plate disposed in a lower portion of the charge receiver module.

7. The wireless charger system according to any one of claims **1** to **5**,

wherein the battery pack includes a magnetic plate that is a primary shielding member and a shield mesh member that is a secondary shielding member, both of the shielding members being formed between a battery cell case of the battery cell and the secondary core block, and the magnetic plate and the shield mesh member contain ferrites, Mn—Zn (50 parts by weight:50 parts by weight), Ni—Fe (80 parts by weight:20 parts by weight), or fine metals (Fe—Si—Cu—Nb) and the shield mesh member is formed in a mesh shape.

8. A method for controlling a wireless charger system for battery pack solution, comprising a wireless charger apparatus for receiving a power source from the outside to transmit a power signal via a charging power transmitter block in a wireless mode; and a battery pack for receiving a power signal from the wireless charger apparatus in a wireless mode to charge power in a battery cell and supplying a power source to a portable terminal block, the method comprising:

waiting for charging of an externally supplied power source by checking a state of the wireless charger apparatus prior to performing a wireless charging through the charging power transmitter block of the wireless charger apparatus;

transmitting a call signal for native ID of the battery pack to sense the battery pack through the charging power transmitter block of the wireless charger apparatus;

transmitting information on a native ID value and a state of the battery pack via the secondary core block of the battery pack by receiving a call signal of the native ID transmitted from the wireless charger apparatus in the battery pack, the native ID value being stored in a native ID transmission block of the battery pack;

determining the native ID value of the battery pack transmitted from the battery pack and the state of the battery pack;

charging a power in the battery pack by receiving a power via the charging power transmitter block of the wireless charger apparatus when the battery pack is ready to be charged;

sensing a completely charged signal in the wireless charger apparatus when the completely charged signal is transmitted from the battery pack in the step of charging the battery pack; and

waiting for reception of the information on the charging level and the battery pack state from the battery pack by suspending a charging operation in the central controller of the wireless charger apparatus when the information on the completely charged signal is received from the battery pack.

9. A method for receiving a power signal in a receiver of a wireless charger system, wherein the system comprises a wireless charger apparatus which generates a magnetic field, and the receiver magnetically coupled with the wireless charger apparatus so that the power signal is received inductively by the receiver, the method comprising:

receiving, from the wireless charger apparatus in a standby mode, an initial signal used by the wireless charger apparatus to detect the presence of the receiver;

transmitting, to the wireless charger apparatus in an ID call mode, information on a native ID of the receiver;

receiving, in a charging mode, the power signal transferred from the wireless charger apparatus; and

transmitting, to the wireless charger apparatus, a data signal comprising at least one of a charging state, an error state, and a completely charged state of a battery.

10. The method of claim 9, further comprising:

rectifying the power signal into a DC power signal,

wherein the DC power signal is supplied to the battery.

11. The method of claim 9, wherein the wireless charger apparatus differentiates, in the standby mode, the receiver from a foreign substance.

12. The method of claim 9, further comprising:

displaying the at least one of the charging state, the error state, and the completely charged state of the battery.

13. A receiver for receiving a power signal in a wireless charger system, wherein the system comprises a wireless charger apparatus which generates a magnetic field, and the receiver magnetically coupled with the wireless charger apparatus so that the power signal is received inductively by the receiver, the receiver comprising:

a secondary core block which receives, from the wireless charger apparatus in a standby mode, an initial signal used for the wireless charger apparatus to detect the presence of the receiver;

a native ID transmission block which transmits, to the wireless charger apparatus in an ID call mode, information on a native ID of the receiver in response to the initial signal; and

a controller which transmits, to the wireless charger apparatus, a data signal comprising at least one of a charging state, an error state, and a completely charged state of a battery,

wherein the secondary core block receives, in a charging mode, the power signal transferred from the wireless charger apparatus.

14. The receiver of claim 13, further comprising:

a rectification circuit block which rectifies the power signal into a DC power signal, and which supplies the DC power signal to the battery.

15. The receiver of claim 13, further comprising:

a display block which displays the at least one of the charging state, the error state, the completely charged state of the battery.

16. A method for transmitting a power signal to a wireless charger apparatus of a wireless charger system, wherein the system comprises the wireless charger apparatus which generates a magnetic field, and a receiver magnetically coupled with the wireless charger apparatus so that the power signal is transmitted inductively to the receiver, the method comprising:

detecting, in a standby mode, the presence of the receiver by transmitting an initial signal to the receiver;

receiving, in an ID call mode, from the receiver, information on a native ID of the receiver;

transmitting, in a charging mode, the power signal to the receiver; and *receiving, from the receiver, a data signal comprising at least one of a charging state, an error state, and a completely charged state of a battery.*

17. The method of claim 16, wherein the initial signal is transmitted continuously until the wireless charger apparatus receives an acknowledge response signal from the receiver.

18. The method of claim 17, further comprising:

differentiating the receiver from a foreign substance based on the acknowledge response signal.

19. The method of claim 18, further comprising:

when the foreign substance is detected, suspending the transmitting of the power signal to the receiver.

20. A wireless charger apparatus for transmitting a power signal in a wireless charger system, wherein the system comprises the wireless charger apparatus which generates a magnetic field, and a receiver magnetically coupled with the wireless charger apparatus so that the power signal is transmitted inductively to the receiver, the wireless charger apparatus comprising:

a signal detector block which detects, in a standby mode, the presence of the receiver by transmitting an initial signal to the receiver and by receiving, in an ID call mode, from the receiver, information on a native ID of the receiver;

a primary core block which transmits, in a charging mode, the power signal to the receiver; and

a current detector block which receives, from the receiver, a data signal comprising at least one of a charging state, an error state, and a completely charged state of a battery.

21. The wireless charger apparatus of claim 20, wherein the signal detector block transmits the initial signal continuously until the signal detector block receives an acknowledge response signal from the receiver.

22. The wireless charger apparatus of claim 21, wherein the wireless charger apparatus differentiates the receiver from a foreign substance based on the acknowledge response signal.

23. The wireless charger apparatus of claim 22, further comprising:

a central controller which, when the foreign substance is detected, suspends the transmitting of the power signal to the receiver.

24. A method for receiving a power signal at a receiver in a wireless charger system, wherein the system comprises a wireless charger apparatus which generates a magnetic field, and the receiver magnetically coupled with the wireless charger apparatus so that the power signal is received inductively by the receiver, the method comprising:

detecting whether a voltage level of the power signal received from the wireless charger apparatus exceeds a reference voltage value or not; and

transmitting, to the wireless charger apparatus, a signal which adjusts the power signal, wherein the signal comprises a power save code signal which reduces the power signal when the voltage level exceeds the reference voltage value, and

receiving, from the wireless charger apparatus, a reduced power signal comprising a parameter which is changed from a parameter of the power signal based on the power save code signal.

25. The method of claim 24, wherein the parameter comprises a frequency, and the frequency is changed in a manner which reduces the power signal.

26. The method of claim 25, wherein the frequency is changed by using a frequency automatic variable algorithm.

27. A receiver for receiving a power signal in a wireless charger system, wherein the system comprises a wireless charger apparatus which generates a magnetic field, and the receiver magnetically coupled with the wireless charger apparatus so that the power signal is received inductively by the receiver, the receiver comprising:

a secondary core block which receives the power signal from the wireless charger apparatus; and

a controller which detects whether a voltage level of the power signal exceeds a reference voltage value or not, and which transmits, to the wireless charger apparatus, a signal for adjusting the power signal, wherein the signal comprises a power save code signal which reduces the power signal when the voltage level exceeds the reference voltage value;

wherein the secondary core block receives, from the wireless charger apparatus, a reduced power signal comprising a parameter which is changed from a parameter of the power signal based on the power save code signal.

28. The receiver of claim 27, wherein the parameter includes a frequency and the wireless charger apparatus changes the frequency in a manner which reduces the power signal.

29. The receiver of claim 28, wherein the wireless charger apparatus changes the frequency by using a frequency automatic variable algorithm.

30. A method for transmitting a power signal to a wireless charger apparatus in a wireless charger system, wherein the system comprises the wireless charger apparatus which generates a magnetic field, and a receiver magnetically coupled with the wireless charger apparatus so that the power signal is transmitted inductively to the receiver, the method comprising:

transmitting the power signal to the receiver using the magnetic field;

receiving a signal which adjusts the power signal from the power receiver, wherein the signal comprises a power save code signal which reduces the power signal when a voltage level in the power receiver exceeds a reference voltage value; and

changing a parameter which induces the magnetic field based on the power save code signal.

31. The method of claim 30, wherein the parameter comprises a frequency and the frequency is changed in a manner which reduces the power signal.

32. The method of claim 31, wherein the frequency is changed by using a frequency automatic variable algorithm.

33. A wireless charger apparatus for transmitting a power signal in a wireless charger system, wherein the system comprises the wireless charger apparatus which generates a magnetic field, and a receiver magnetically coupled with the wireless charger apparatus so that the power signal is transmitted inductively to the receiver, the wireless charger apparatus comprising:

a primary core block which transmits the power signal to the receiver using the magnetic field,

wherein the wireless charger apparatus is which receives, from the power receiver, a signal which adjusts the power signal,

wherein the signal comprises a power save code signal which reduces the power signal when a voltage level in the power receiver exceeds a reference voltage value, and which changes a parameter which induces the magnetic field based on the power save code signal.

34. The wireless charger apparatus of claim 33, wherein the parameter comprises a frequency and the wireless charger apparatus changes the frequency in a manner which reduces the power signal.

35. The wireless charger apparatus of claim 34, wherein the wireless charger apparatus changes the frequency by using a frequency automatic variable algorithm.

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