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*Rondevoo Technologies, LLC*

**UNITED STATES DISTRICT COURT**
**FOR THE CENTRAL DISTRICT OF CALIFORNIA**
**WESTERN DIVISION**

| | |
|---|---|
| Rondevoo Technologies, LLC,<br><br>**Plaintiff,**<br><br>v.<br><br>Kyocera International, Inc.,<br><br>**Defendant.** | Case No. 2:19-cv-03709<br><br>**AMENDED COMPLAINT – JURY TRIAL DEMANDED** |

Plaintiff Rondevoo Technologies, LLC ("Rondevoo") complains of Kyocera International, Inc. ("Kyocera" or "Defendant") and alleges the following:

**Parties**

1. Plaintiff Rondevoo Technologies, LLC is a corporation organized and existing under the laws of California and maintains its principal place of business at 35 Hugus Alley, Suite 210, Pasadena, CA 91103.

2. Defendant Kyocera International, Inc. is a corporation organized and existing under the laws of California that maintains its principal place of business at 8611 Balboa Avenue, San Diego, CA 92123.

## JURISDICTION

3. This is an action for patent infringement arising under the patent laws of the United States, Title 35 of the United States Code.

4. This Court has exclusive subject matter jurisdiction under 28 U.S.C. §§ 1331 and 1338(a).

5. This Court has personal jurisdiction over Kyocera because, upon information and belief, it has engaged in systematic and continuous business activities in the Central District of California and is incorporated in California. Further, Kyocera has committed acts of patent infringement giving rise to this action within this Judicial District.

## VENUE

6. Venue is proper in this Judicial District under 28 U.S.C. § 1400(b) because Kyocera has committed acts of patent infringement in this Judicial District and is incorporated in California.

7. Venue is proper in this Judicial District under 28 U.S.C. § 1391(b)(3) because HMD Global Corporation is subject to the Court's personal jurisdiction.

## THE PATENT-IN-SUIT

8. Rondevoo is the assignee of all right, title and interest in United States Patent No. 6,377,685 (the "'685 Patent," "Patent-in-Suit"), including all rights to enforce and prosecute actions for infringement and to collect damages for all relevant times against infringers of the '685 Patent. Accordingly, Rondevoo possesses the exclusive right and standing to prosecute the present action for infringement of the Patent-in-Suit by Kyocera.

**The ’685 Patent**

9. On April 23, 2002, the United States Patent and Trademark Office issued the ’685 Patent. The ’685 Patent is titled “Cluster Key Arrangement.” The application leading to the ’685 Patent was filed on April 23, 1999. A true and correct copy of the ’685 Patent is attached hereto as Exhibit A and incorporated herein by reference.

10. The ’685 Patent is valid and enforceable.

11. The inventors recognized that there was a need for improving cluster key arrangements for mobile devices such as cell-phones. Ex. A, 1:5–67.

12. The invention in the ’685 Patent provides an improved cluster key arrangement system. Ex. A, 6:39–52.

13. To this end, the inventors recognized the importance of developing not only button-based cluster key arrangements, but also electronically configured cluster key arrangements. Ex. A, 6:39-41 (“The cluster key arrangement may be mechanically configured or electronically configured.”).

**KNOWLEDGE OF INFRINGEMENT**

14. Defendant knew the existence of the ’685 Patent since at least the publication of U.S. Patent Application Nos. 20110169765A1 (the “’765 Application”), 20110181538A1 (the “’538 Application”) and 20110181539A1 (the “’539 Application”) which was filed by Kyocera Limited and referenced the ’685 Patent as a prior art reference. A copy of the ’765 Application is attached hereto as Exhibit B, a copy of the ’538 Application is attached hereto as Exhibit C and the ’539 Application is attached hereto as Exhibit D.

15. Despite being aware of the ’685 Patent and that manufacturing and selling smartphones might infringe the ’685 Patent, none of the Defendant ever sought a license to use the technology described in the ’685 Patent.

16. As of the date of filing, Defendant has continued to make, sell, and/or offer to sell the Kyocera Dura Force Pro 2.

**COUNT I: INFRINGEMENT OF THE '685 PATENT**

17. Rondevoo incorporates the above paragraphs herein by reference.

18. **Direct Infringement.** Upon information and belief, Defendant, acting solely and/or jointly, has been and continues to directly infringe at least Claim 1 of the '685 Patent in this District and elsewhere in the United States by providing a system for "[a] cluster key arrangement," for example, the Kyocera Dura Force Pro 2, which include special characters, such as accented letters, that are selected from a primary key. *See* Figure 1, available at: https://www.kyoceramobile.com/duraforce-pro-2/.


*Figure 1. The Kyocera Dura Force Pro 2 includes special characters, such as accented letters, that are selected from a primary key.*

1. The Kyocera Dura Force Pro 2 has claim element 1(a): "at least one cluster key." For example, the Kyocera Dura Force Pro 2 has a touchscreen keyboard with a button before and after it is

selected. *See* Figure 2, available at: https://www.kyoceramobile.com/duraforce-pro-2/DuraForce-PRO-2-User-Guide-Verizon_en.pdf.


*Figure 2. The Kyocera Dura Force Pro 2 has a touchscreen keyboard with a button before and after it is selected.*

19. The Kyocera Dura Force Pro 2 has claim element 1(b): "said cluster key comprising a single primary key." For example, the Kyocera Dura Force Pro 2 allows any of the lettered keys to be the primary key as it appears on the primary keyboard. If the primary key is touched and let go before the duration of time, the letter is selected. *See* Figure 2.

20. The Kyocera Dura Force Pro 2 has claim element 1(c): "said cluster key comprising at least one secondary key, said secondary key being located immediately adjacent to said primary key of said cluster key." For example, the Kyocera Dura Force Pro 2 has an

electronic keyboard containing character variants, which occurs after a primary key is selected and after the primary key is touched and held for a duration of time. When the primary key is held down for the duration of time, a number of accented characters appear for selection. The accented key is immediately adjacent to the primary key letter. *See* Figure 2.

21. The Kyocera Dura Force Pro 2 has claim element 1(d): "mutual exclusivity selecting means for selecting said primary key or said secondary key in a mutually exclusive manner." For example, the Kyocera Dura Force Pro 2 electronic keyboard allows the user to select its primary keys by tapping the primary key and permits the user to select its secondary keys by holding the corresponding primary key for a duration of time, and then dragging up to the character adjacent to the primary key in the bar appearing above the primary key. *See* Fig. 2.

22. The Kyocera Dura Force Pro 2 has claim element 1(e): "wherein when both said primary key and said secondary key have met a threshold for actuation close in time to each other, said mutual exclusivity selecting means includes the use of a difference between said primary and said secondary key other than a difference in order of activation of said primary and said secondary key to select between said primary and said secondary key." For example, the Kyocera Dura Force Pro 2 has the primary and secondary keys directly adjacent to one another. The threshold actuation time between primary and secondary keys is virtually zero and determines whether the primary or secondary key is actuated based on the position of the finger or stylus on the touch screen. *See* Fig. 2.

23. The Kyocera Dura Force Pro 2 has claim element 1(f): "each of said primary and secondary keys is individually actuable." For example, the Kyocera Dura Force Pro 2 electronic keyboard allows the user to select either its primary or secondary keys, independently of each other. *See* Fig. 2.

24. The Kyocera Dura Force Pro 2 has claim element 1(g): "each of said primary key and said secondary key upon actuation move in a direction substantially parallel to the motion of the other of said primary and said secondary key upon actuation." For example, the primary and secondary keys of the Kyocera Dura Force Pro 2 are connected to mutually parallel vertical conductors. *See* Fig. 2.

25. The Kyocera Dura Force Pro 2 has claim element 1(h): "each of said primary key and said secondary key has an associated electrical contact, activation of each said electrical contact sends a signal which indicates an input from said cluster key arrangement, and said mutual exclusivity selecting means selects between said primary key and said secondary key during preprocessing prior to activation of any of said electrical contacts." For example, the primary and secondary keys of the Kyocera Dura Force Pro 2 are each associated with an electrical contact through the touchscreen. Prior to activation of the key selected, the mutual exclusivity selecting means shows which key is selected based on which key is highlighted. *See* Fig. 2.

26. **Induced Infringement.** Upon information and belief, Defendant, acting solely and/or jointly, has also actively induced, and continues to induce, the infringement of at least Claim 1 of the '685 Patent by actively inducing their customers, including merchants and end-users to use the Kyocera Dura Force Pro 2 in an infringing manner as described above. Upon information and belief, Defendant has specifically intended that its customers use the Kyocera Dura Force Pro 2 in a manner that infringes at least Claim 1 of the '685 Patent by, at a minimum, providing access to support for, training and instructions for, the Kyocera Dura Force Pro 2 to its customers to enable them to infringe at least Claim 1 of the '685 Patent, as described above. Even where performance of the steps required to infringe at least Claim 1 of the '685 Patent is accomplished by Defendant and Defendant's customer jointly Defendant's actions have solely caused all of the steps to be performed.

27. Rondevoo is entitled to recover damages adequate to compensate it for such infringement in an amount no less than a reasonable royalty under 35 U.S.C. § 284.

**PRAYER FOR RELIEF**

WHEREFORE, Rondevoo asks this Court to enter judgment against Defendant, granting the following relief:

A. A declaration that Defendant has infringed the Patent-in-Suit;

B. An award of damages to compensate Rondevoo for Defendant's direct infringement of the Patent-in-Suit;

C. An accounting of all damages and infringements not presented at trial;

D. An award of damages, including trebling of all damages, sufficient to remedy Defendant's willful infringement of the Patent-in-Suit under 35 U.S.C. § 284;

E. A declaration that this case is exceptional, and an award to Rondevoo of reasonable attorneys' fees, expenses and costs under 35 U.S.C. § 285;

F. An award of prejudgment and post-judgment interest; and

G. Such other relief as this Court or jury may deem proper and just.

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**Counsel for Plaintiff**

**Demand for Jury Trial**

Under Rule 38(b) of the Federal Rules of Civil Procedure, Rondevoo respectfully requests a trial by jury on all issues so triable.

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**Counsel for Plaintiff**

# Exhibit A

US006377685B1

(12) **United States Patent**
**Krishnan**

(10) **Patent No.: US 6,377,685 B1**
(45) **Date of Patent: Apr. 23, 2002**

(54) **CLUSTER KEY ARRANGEMENT**

(76) Inventor: **Ravi C. Krishnan**, 10112 Parkwood Ter., Bethesda, MD (US) 20814

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

(21) Appl. No.: **09/296,809**

(22) Filed: **Apr. 23, 1999**

(51) **Int. Cl.**[7] ..... **H04M 1/00**
(52) **U.S. Cl.** ..... **379/433.07**; 379/368
(58) **Field of Search** ..... 379/368, 369, 379/370, 433.06, 433.07; 455/405; 200/5 A

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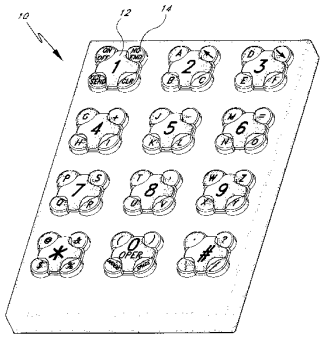
*Primary Examiner*—Jack Chiang
(74) *Attorney, Agent, or Firm*—Richard C. Litman

(57) **ABSTRACT**

A cluster key arrangement may be mechanically configured or electronically configured. The cluster key arrangement may include twelve cluster keys configured in an arrangement of three columns by four rows, such as conventionally found on standard telephones. The cluster key arrangement may also be configured for use on cellular/mobile telephones, television remote controls, other handheld data entry devices, automotive controls, desktop/wall-mounted/cordless telephones, combination telephone recorders, Personal Digital Assistants, and other electronic devices. The mechanically or electronically configured cluster keys provide a user with the ability to select one of a plurality of key elements representing numbers, letters, symbols, functions, etc., in a mutually exclusive manner.

**39 Claims, 11 Drawing Sheets**



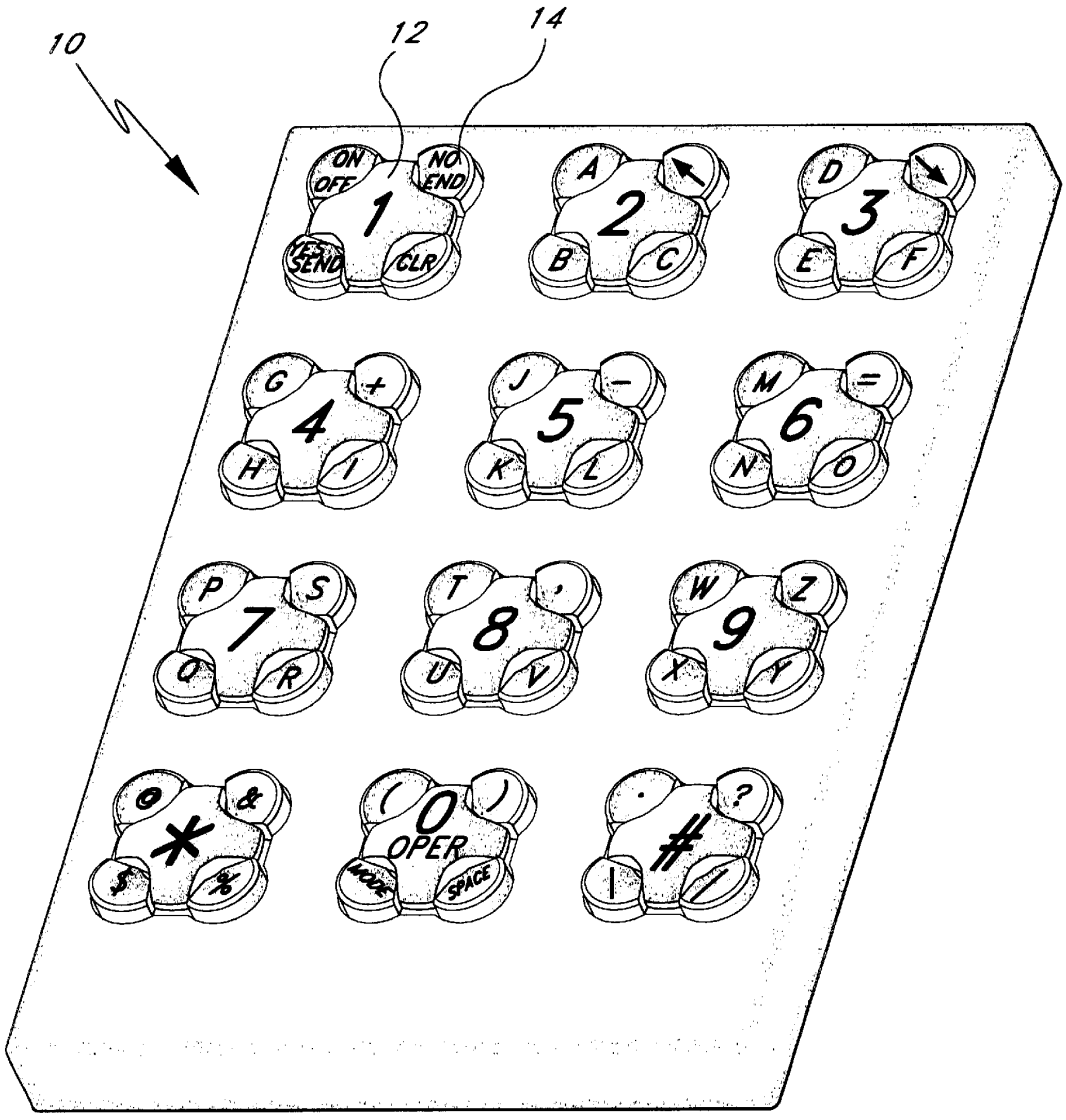

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*Fig. 1*

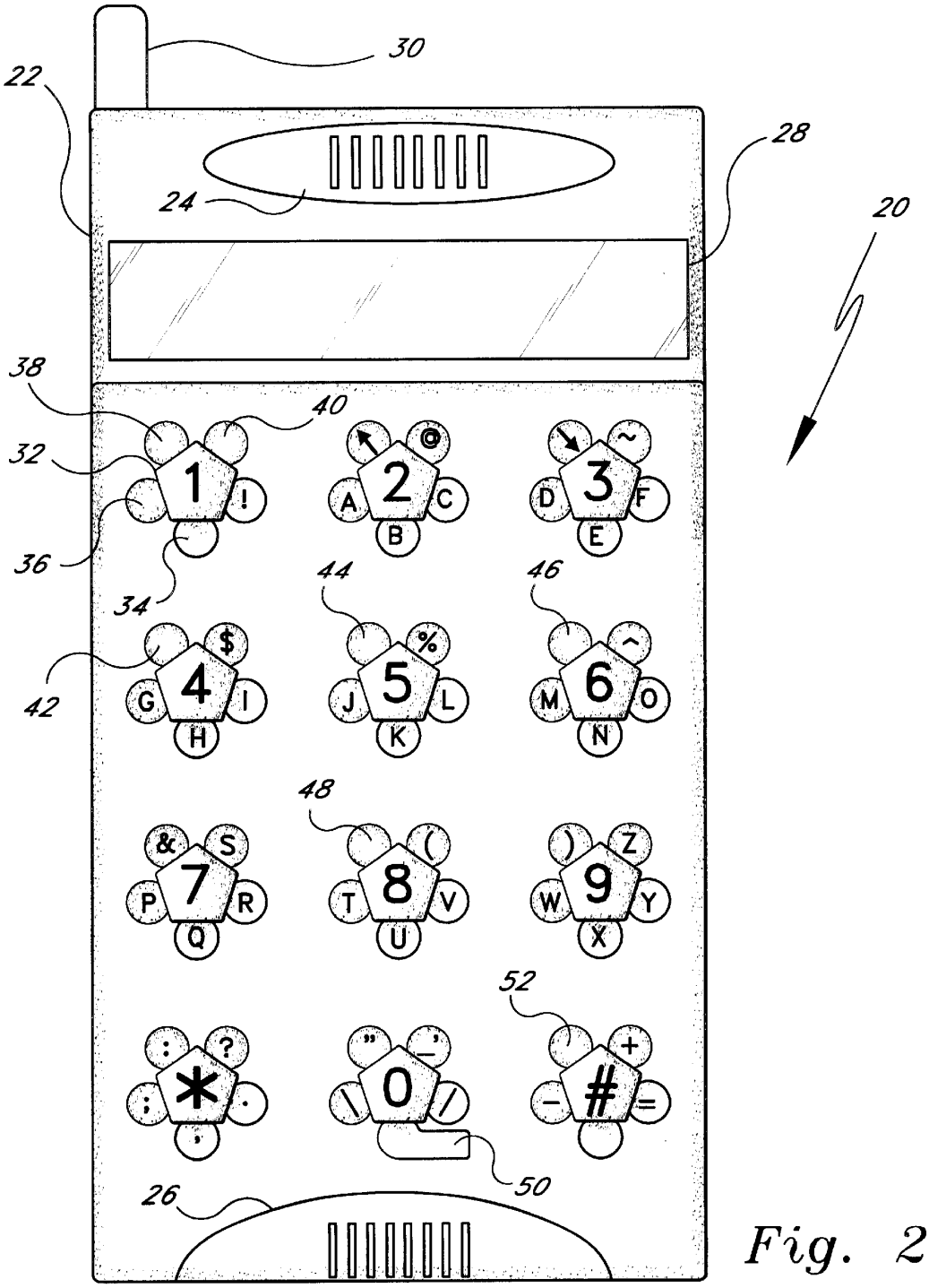


Fig. 2

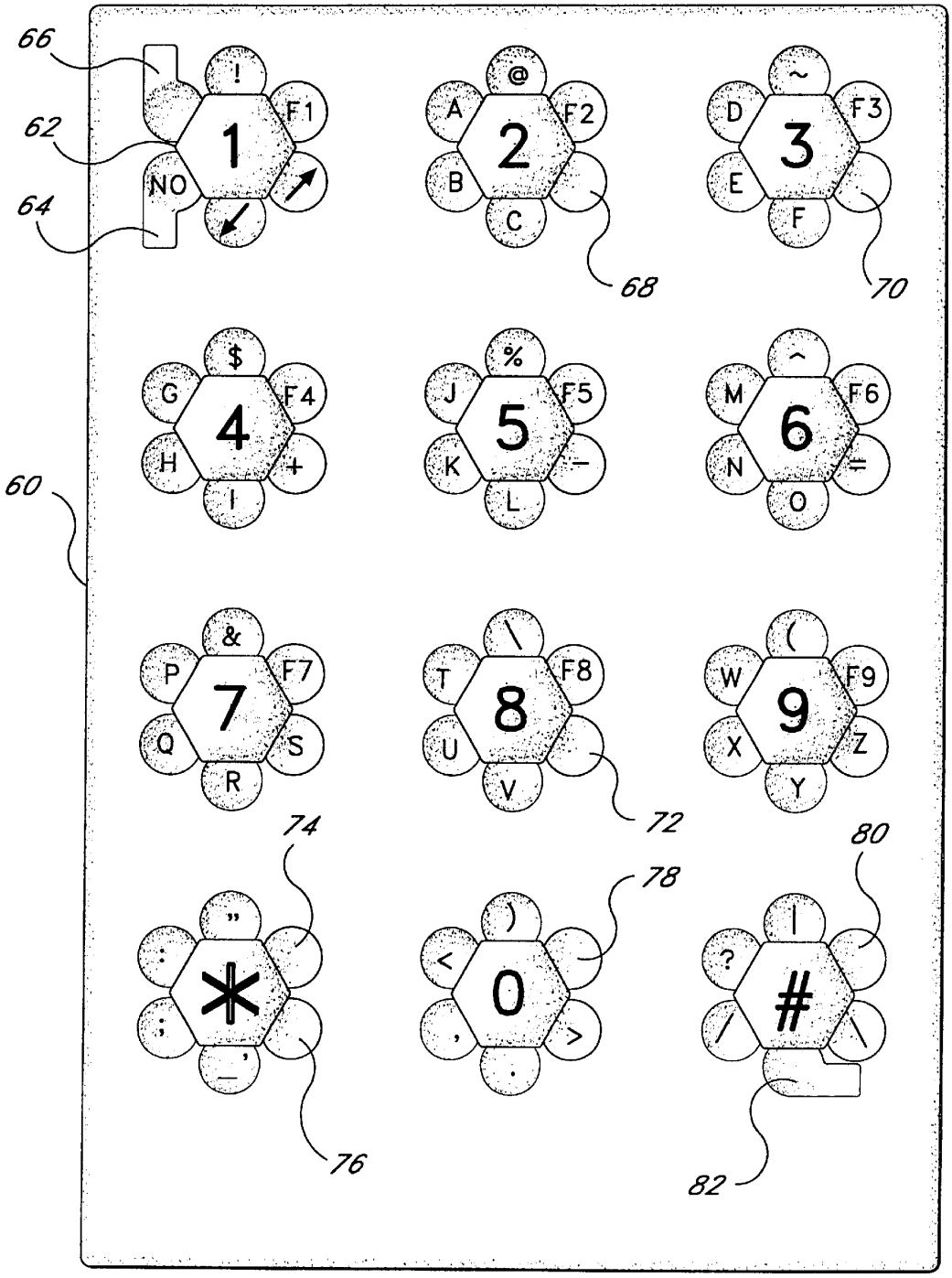
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*Fig. 3*

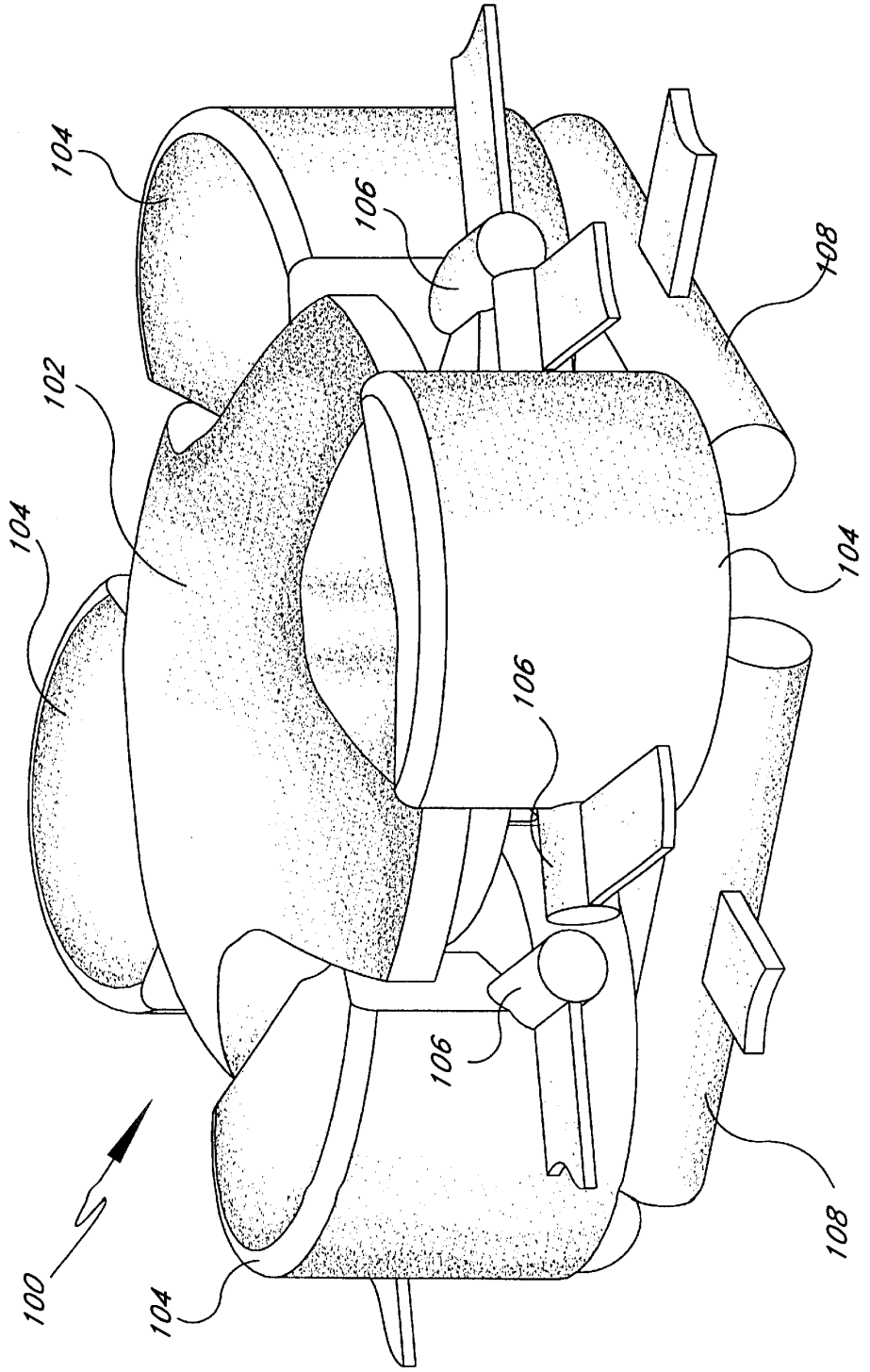


Fig. 4

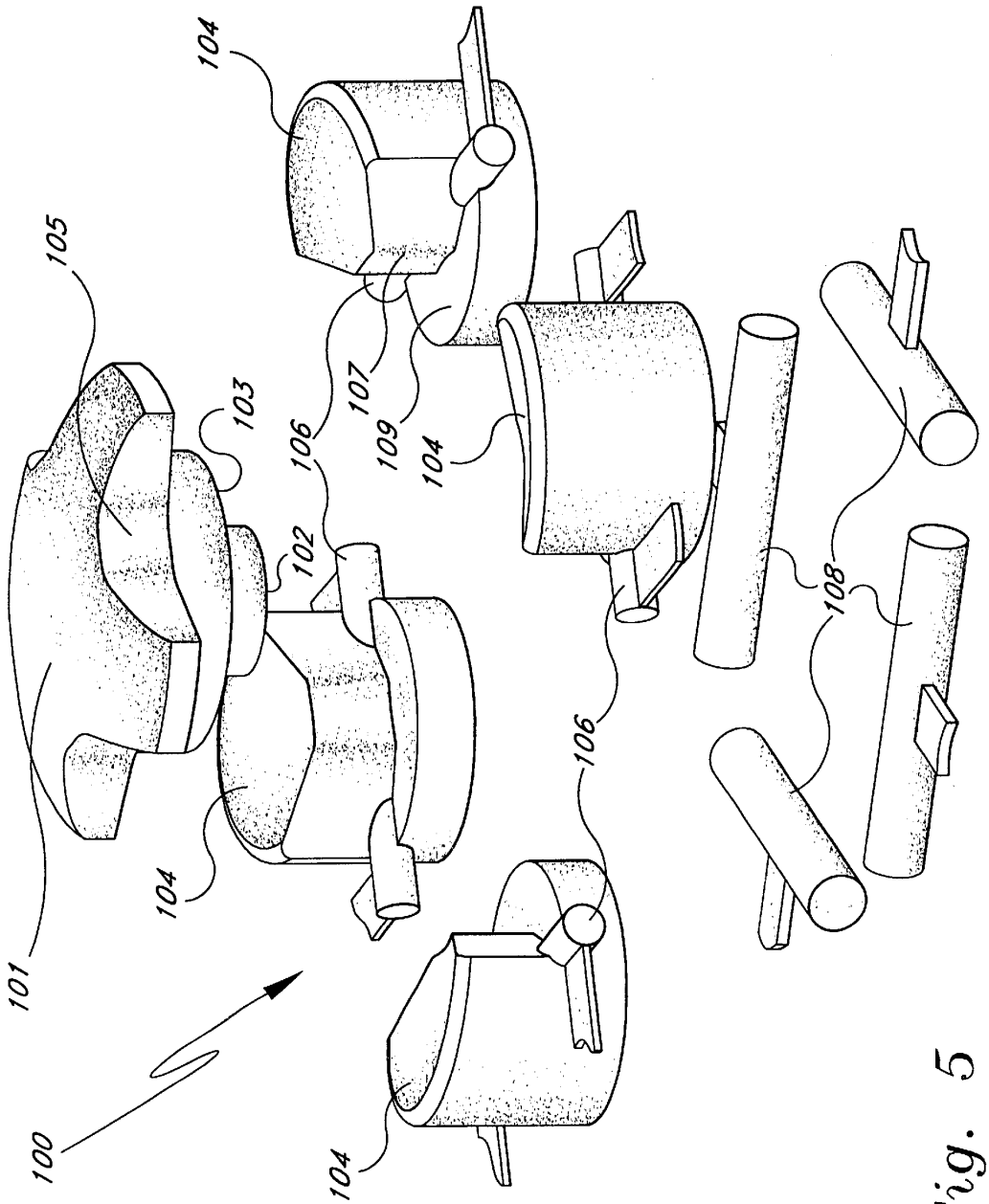


Fig. 5

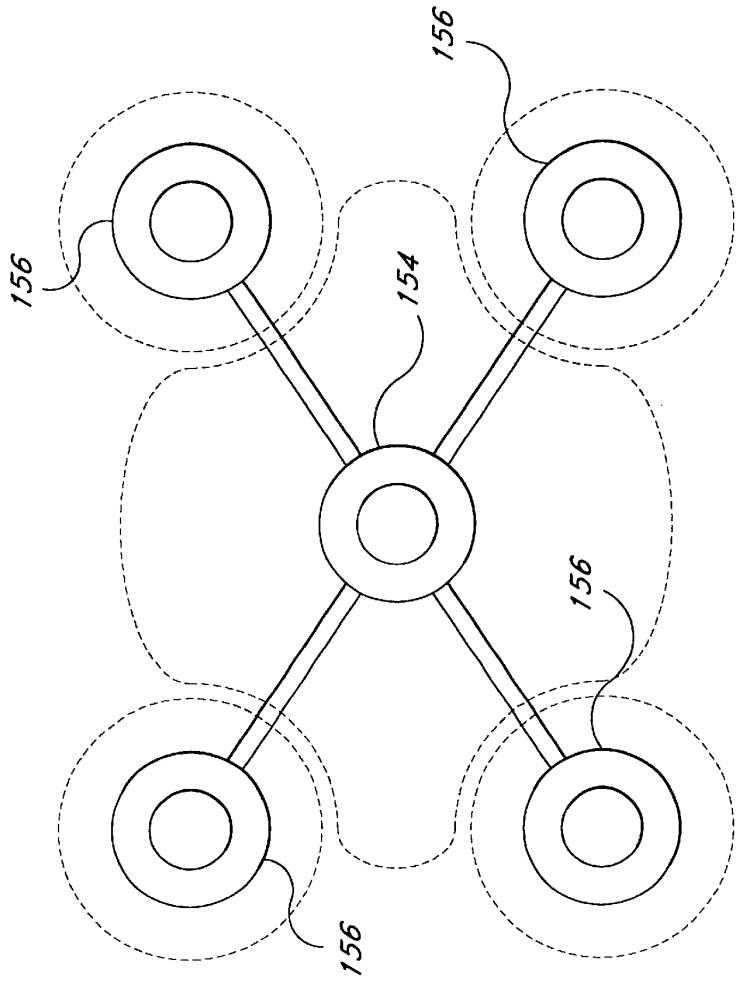
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Fig. 6A

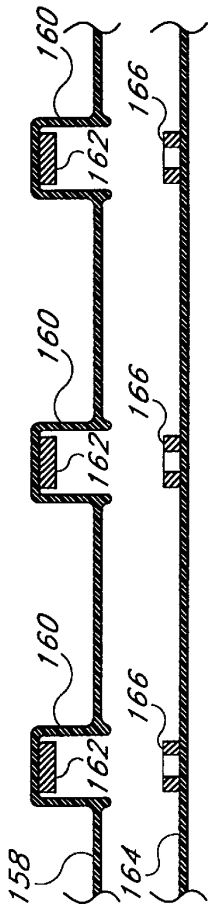
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Fig. 6B

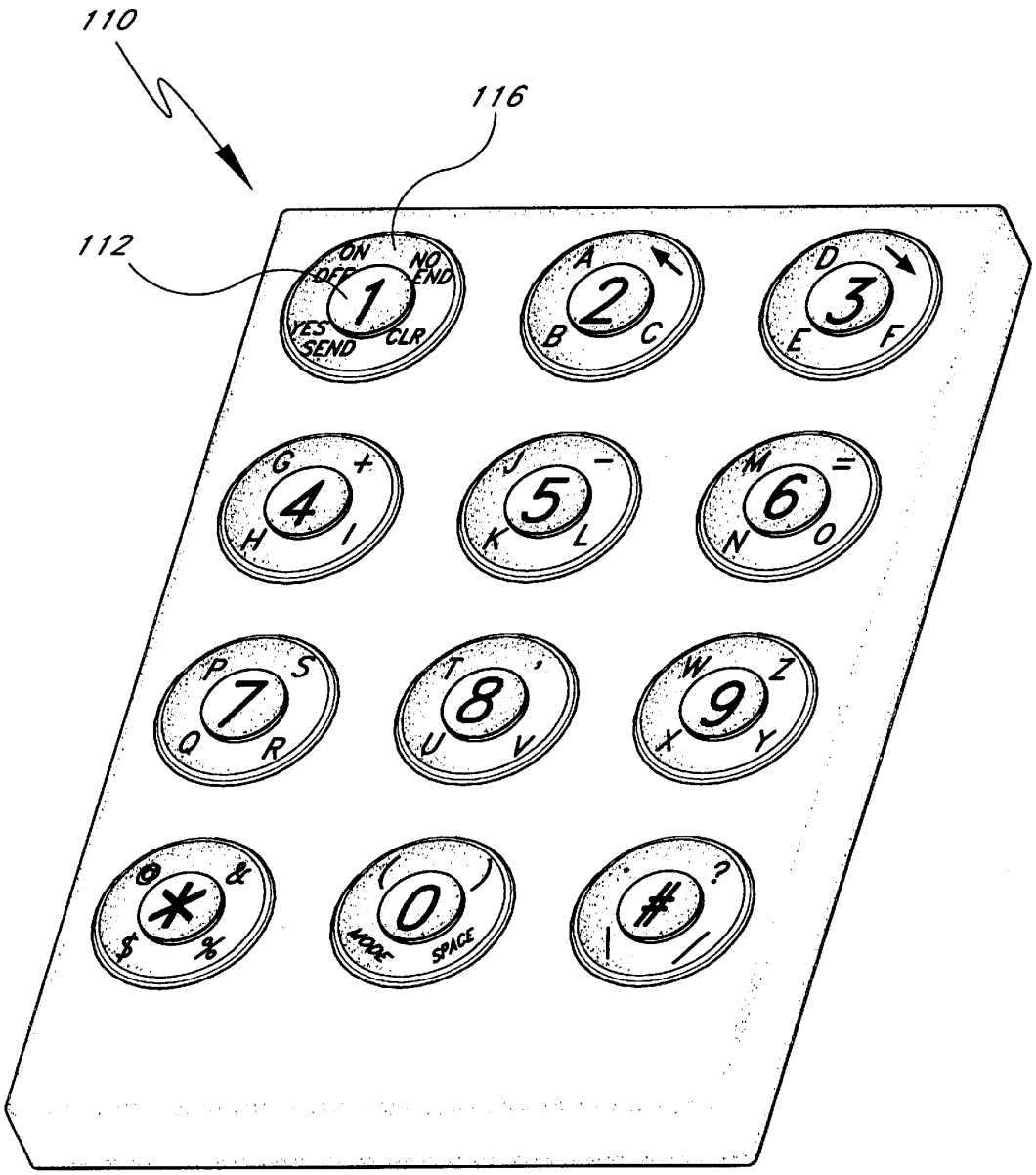
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*Fig. 7*

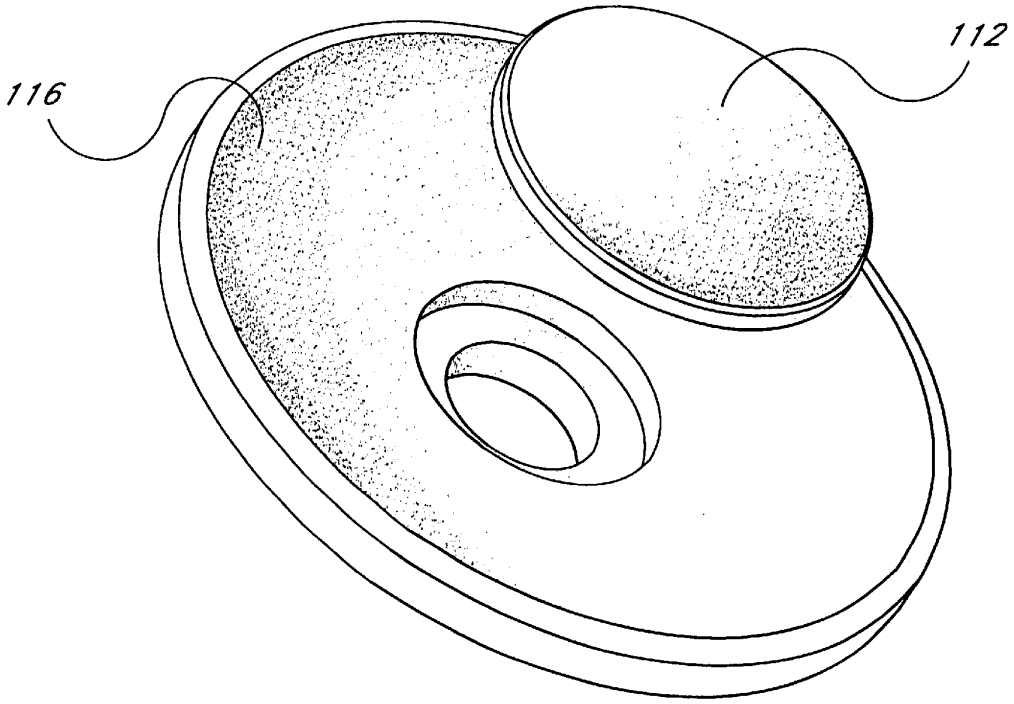


Fig. 8A

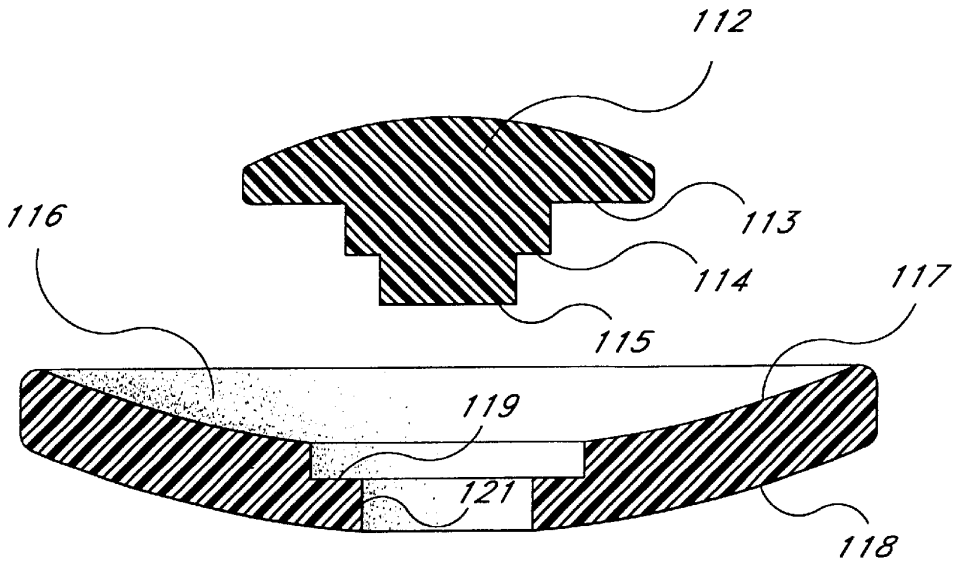


Fig. 8B

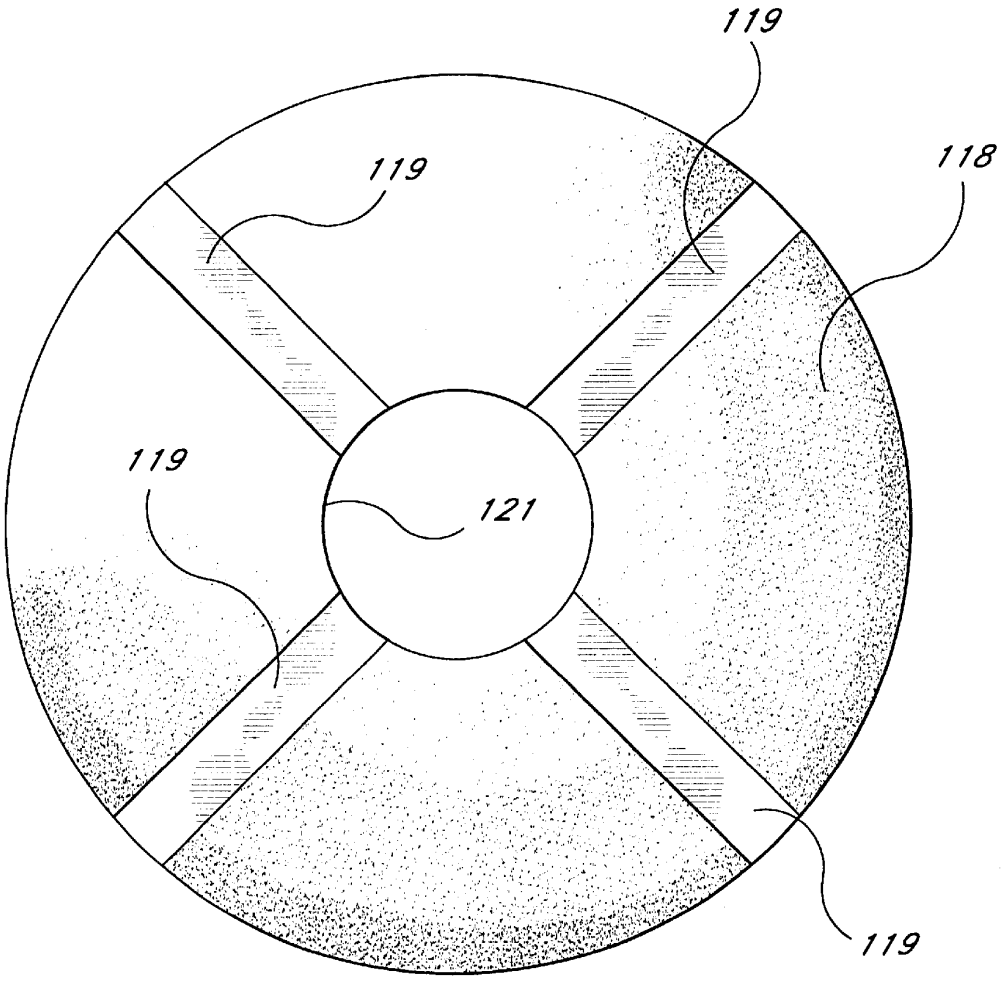


*Fig. 9*

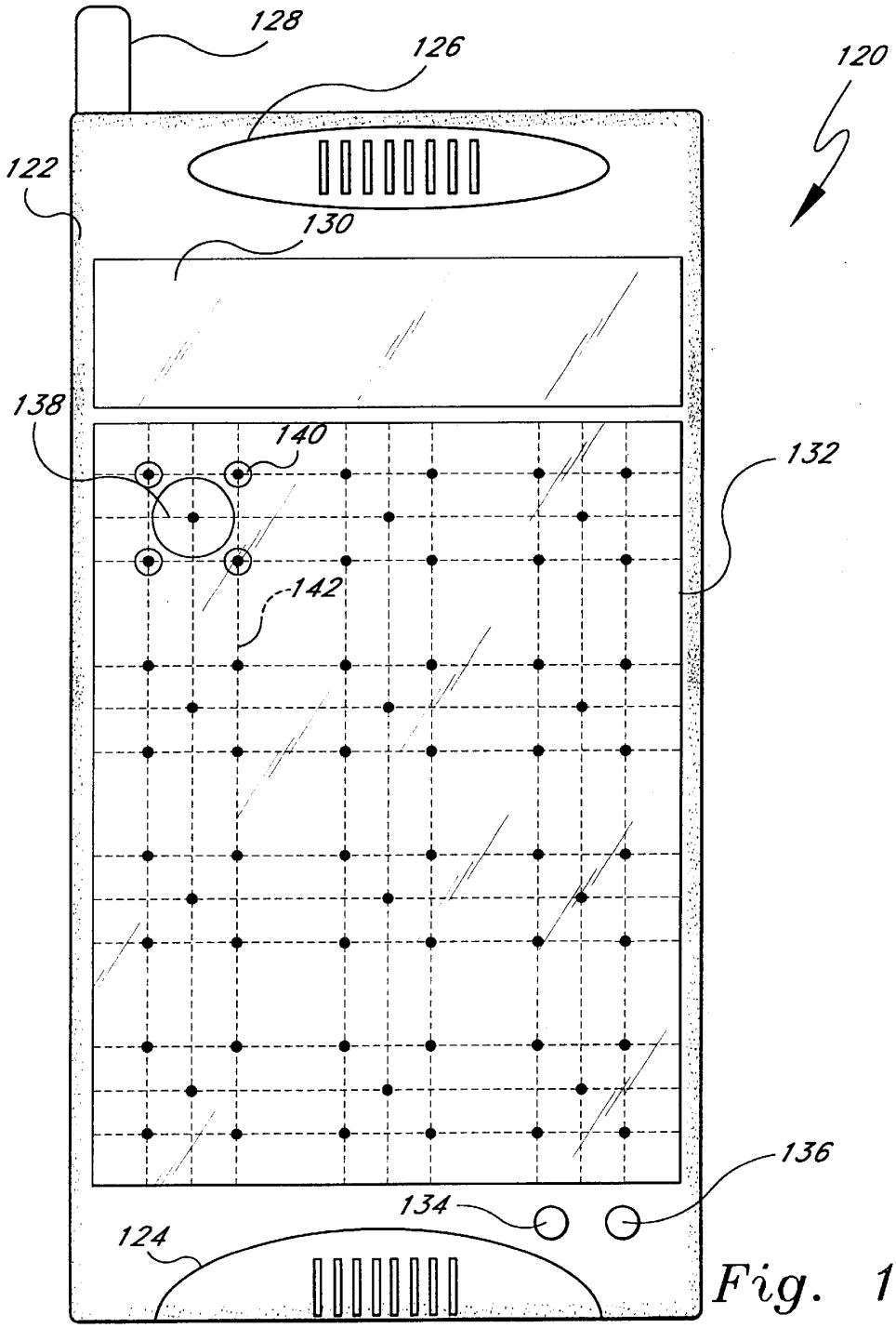


Fig. 10A

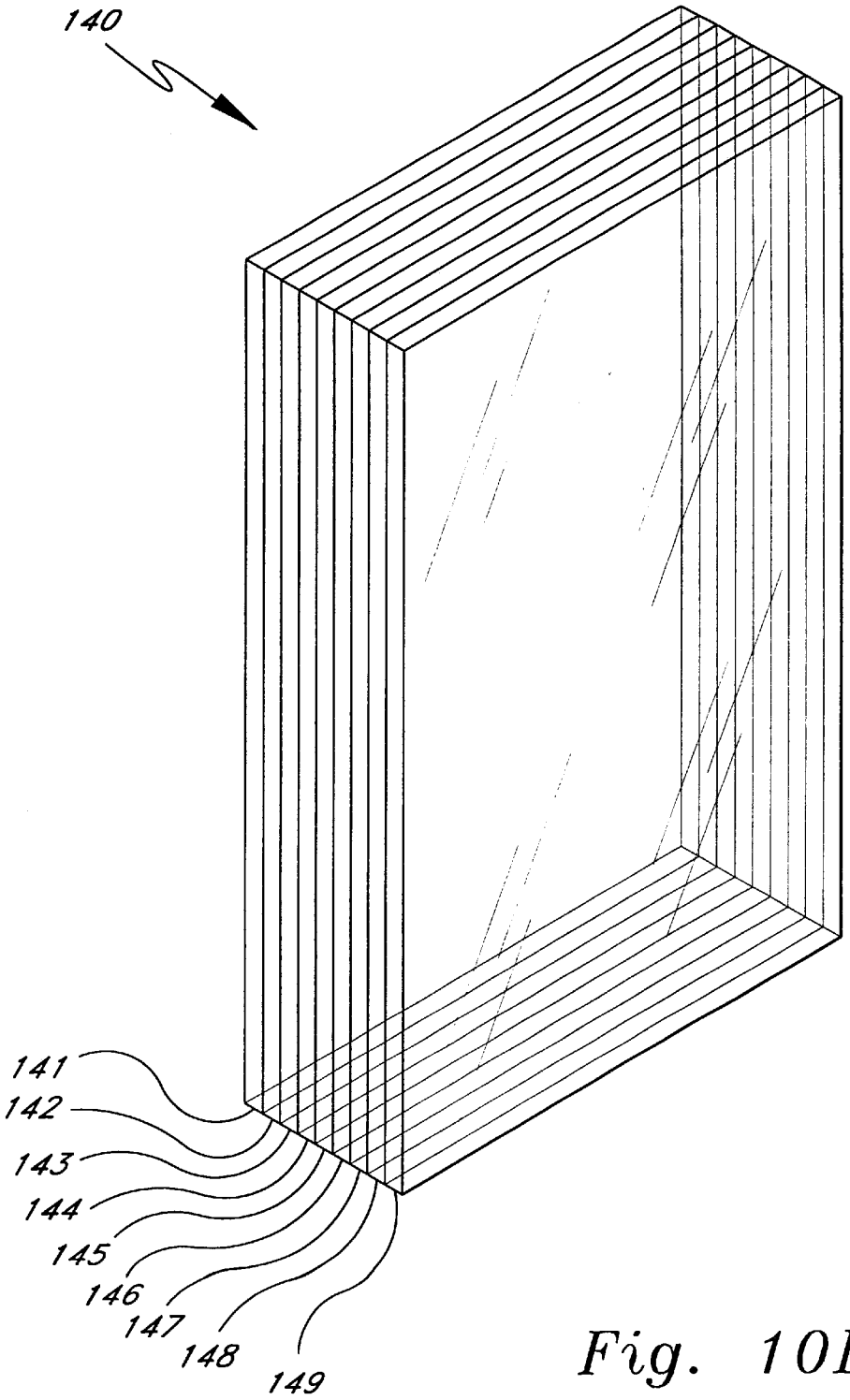


Fig. 10B

# CLUSTER KEY ARRANGEMENT

## BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a cluster key arrangement which provides a user with the ability to select one of a plurality of key elements representing numbers, letters, symbols, functions, etc., in a mutually exclusive manner.

2. Description of the Related Art

The touch-tone dial system has become the standard dialing system for conventional telephones, largely replacing the older rotary dial. The standard touch-tone dials have push-buttons arranged in a rectangular matrix pattern. Each button activates a switch to energize a tone generator of unique frequency. In addition, the push-buttons are arranged to activate a common switch for disconnecting the transmitter while a tone generator is operating.

Use of a telephone keypad with a telephone keypad matrix as a data terminal for the input of alphanumeric characters into a computer system, using or via a telephone line which further in turn forwards the message from the terminal to a service provider computer, such as a paging system, facsimile device, e-mail and/or voice mail system, or Personal Digital Assistants (PDAs) which have the ability to store schedules, memos, etc., and further have the ability to upload and download information from a base computer, which are operated on an on-board battery with an operating life of many days for a monochrome display, and an operating life of on the order of six hours for displays with color capability which are increasingly desirable for clarity and user friendliness, and cellular phones with desirable code division multiple access (CDMA) technology which provides for better voice quality and security having only about two to three hours of CDMA talk time are some of the trends in this area.

The most obvious form of elementary clustering is noticed in the standard 102 or 104 key personal computer keyboards in the grouping of the directional arrows. Other than copying this idea on some cellular telephone models, this has not resulted in any clustering of other keys either in patents or in commercially available products. Thus, what is being proposed here is not a mere extension of the preceding, which would be obvious to those skilled in the art. Rather, what is being proposed here derives from an identification of the deficiencies of the prior art and an invention that overcomes those deficiencies.

It is worthwhile to review contradictions between standards that have come about due to their divergent origins but nonetheless find themselves in a convergent path due to emergence of technology driven changes. The most obvious example is the "789" arrangement of the calculator industry and the "123" arrangement of the pushbutton telephone. The horizontal "1234567890" derived from the "QWERTY" typewriter keyboard forms the backbone of computer data entry with the "789" calculator still present on the right hand side as a rarely used vestigial organ. Most of the numerical entries are done on the QWERTY side. Other non-QWERTY approaches, although better in concept have not really taken off. The preceding is mentioned also to reinforce that certain consumer "corporate memory" driven preferences will prevail as in QWERTY and in other cases the "123" of the telephone has clearly become more dominant instead of the "789" of the calculator. However, the same "123" additional alphabet assignments, upon "force fitting" them for additional uses such as for paging and e-mails have not been user friendly.



Most cell phones serve the purpose of audio(voice) interaction and are often used in unsafe but widely prevalent "while driving in an automobile mode". Typically numbers are punched in or a received call is answered by pressing a button most often with the thumb. Thus, user friendliness based on ergonomic features is a must. Thus, making the individual number buttons as large as possible is a must. In reality all products in the market have seen a trend toward miniaturization of the keycap size, driven by factors such as: (1) relentless downsizing in width (Ericsson KH668 is 1 ¾" for example contrasted with Nokia 2190 at 2 ¼" and Casio's CP-850 cordless telephone is 2 ¼") Product sleekness can still be achieved by better utilization of the space available; (2) "Real Estate" requirements for the liquid crystal display and the control keys have made the keypad size shrink further in the top vertical direction, typically being 1 ¾" for the primary keys (1, 2, 3, 4, 5, 6, 7, 8, 9, 0, *, and #). In most cell phones, the control keys comprising ON/OFF and NO/END are in one button (in Ericsson KH668), the SEND or YES (to answer an incoming call) is a second button, a CLEAR button along with two forward and backward arrows make up five keys. An additional switch may be located on the side surface. Conceptually, the prior art deficiency stems from on the one hand mindless and unimaginative miniaturization of the human interface in attempting to keep up with electronic miniaturization and assuming wrongly that all the control keys need to beg associated with the display and consequently are better positioned at the top in one separate row which happens to take up the most space. In actuality, the two largest keys (ON/OFF and NO/END) and (SEND/YES) have more functional association with the primary function of the telephone without a display. The minimal set of keys for the display are three, i.e. CLEAR, and two arrow keys.

The related art is represented by the following patents of interest.

U.S. Design Pat. No. 397,694, issued on Sep. 1, 1998; to Nicholas Mischenko et al., shows an ornamental design for a faceplate having a keypad cover for a portable telephone. Mischenko et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,370,528, issued on Jan. 25, 1983 to Louis F. Aschenbach, describes a miniature sealed toggle switch. Aschenbach does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,418,247, issued on Nov. 29, 1983 to Kaj B. Hansen, describes an electrodynamic transducer which has an, additionally improved sensitivity and can be produced almost completely automatically. Hansen does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,439,647, issued on Mar. 27, 1984 to Nick Calandrello, describes a capacitive keyboard which uses a standard printed circuit board provided in various locations with spaced conductor pairs. Calandrello does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,680,577, issued on Jul. 14, 1987 to David H. Straayer et al., describes a multipurpose keyswitch for controlling cursor movement on a CRT display and for character entry. Straayer et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,687,200, issued on Aug. 18, 1987 to Ichiro Shirai, describes a multi-directional switch in which on-off operation of multiple contacts is dependent on the pressing directions of the switch. Shirai does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,891,777, issued on Jan. 2, 1990 to James M. Lapeyre, describes a keyboard for use by one hand and adapted for entry of a large number of selections including those for alphanumeric data processing and a large range of computer operation commands. Lapeyre does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 4,918,264, issued on Apr. 17, 1990 to Masato Yamamoto et al., describes a switching device capable of I returning to the neutral position of the operating member or centering itself by the resilience of a rubber switch. Yamamoto et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,057,657, issued on Oct. 15, 1991 to Vedran Skulic, describes a low profile keyboard switch, having tactile and/or audible attributes for use in combination with a digitally operable, membrane switch array. Skulic does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,227,594, issued on Jul. 13, 1993 to Louis G. Russo, describes an electrical switch assembly. Russo does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,253,940, issued on Oct. 19, 1993 to Max Abecassis, describes a method to arrive at a single standard for numeric keypad layouts that provides consumers the means to set for themselves a single numeric keypad standard, and in this manner lead to the abandonment of layouts inconsistent with the layout incorporated on telephone devices. Abecassis does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,339,358, issued on Aug. 16, 1994 to Adel Danish et al., describes a data terminal enabling a user to easily input alphabetical, as well as numerical characters, into a telephone for input to a computer which in turn accesses a service provider computer. Danish et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,378,862, issued on Jan. 3, 1995 to Hideo Tasaka et al., describes a switch which provides different switching inputs by pushing different operating portions of a single operating button. Tasaka et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,386,091, issued on Jan. 31, 1995 to Kevin F. Clancy, describes a low profile keyswitch for use with a computer keyboard, calculator and other electronic machines that process data and information. Clancy does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,396,030, issued on Mar. 7, 1995 to Hiroshi Matsumiya et al., describes a control-key mechanism. Matsumiya et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,430,262, issued on Jul. 4, 1995 to Hiroshi Matsui et al., describes a combination push switch device comprising a single push button with at least two push members which can independently operate at least two switch elements. Matsui et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,612,690, issued on Mar. 18, 1997 to David Levy, describes a compact keypad system in which each function may be actuated comfortably by an adult-sized human finger. The key pad electronics are designed to register simultaneously actuated keycaps at an interstice as an input uniquely associated with the symbol located at the interstice. This distinguishes over the present invention because in the present invention a single character is generated in a mutually exclusive manner depending upon which specific key of a cluster key is depressed. Levy does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,631,453, issued on May 20, 1997 to Takuya Maeda, describes a multi-way flipping switch in which a movable contact can be reliably brought into contact with a stationary contact to thereby attain a stable contact state, and is capable of preventing two or more pairs of switching elements from being simultaneously turned on while securing the requisite waterproofness for the contact section. Maeda does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,666,113, issued on Sep. 9, 1997 to James D. Logan, describes a system which automatically switches uses of a touch sensitive computer input touchpad between the functions of cursor control and keypad emulation. Logan does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,758,295, issued on May 26, 1998 to Bjorn Ahlberg et al., describes a single mode mobile cellular telephone with a man-machine interface which is the same for all cellular telephone systems. Ahlberg et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,818,437, issued on Oct. 6, 1998 to Dale L. Grover et al., describes a highly efficient reduced keyboard which is used in conjunction with a display. The keyboard has twelve keys, nine of them labeled with numerous letters and other symbols, and those nine plus one more are labeled with one of the ten digits. Textural entry keystrokes are ambiguous. The user strikes a delimiting "select" key at the end of each word, delimiting a keystroke sequence which could match any of many words with the same number of letters. The keystroke sequence is processed with a complete dictionary, and words which match the sequence of keystrokes are presented to the user in order of decreasing frequency of use. The user selects the desired word. The letters are assigned to the keys in a non-sequential order which reduces chances of ambiguities. The present invention generates a single character in a mutually exclusive manner depending upon which specific key of a cluster key is depressed. Grover et al. do not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,841,374, issued on Nov. 24, 1998 to Joseph N. Abraham, describes a compact, pocket computer for word processing utilizing keys which combine a plurality of toggle switches or multidirectional keys in a pocket size case. Abraham does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,844,506, issued on Dec. 1, 1998 to Ronald P. Binstead, describes a touchpad comprising an electrically insulating membrane with a first series of spaced apart conductors on a first face of the membrane and a second series of spaced apart conductors on or proximal thereto, in which there is no electrical contact between the first and second series of conductors. Binstead does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,852,414, issued on Dec. 22, 1998 to Seymour H. Yu et al., describes a triangle-shaped 4-way-switching key for a keypad consisting of 10 keys alternating upwards and downwards pointing positioned for entering alphanumeric data into a computer or communication device. Yu et al. does not suggest a cluster key arrangement according to the claimed invention.

U.S. Pat. No. 5,861,823, issued on Jan. 19, 1999 to Gary J. Strauch et al., describes a data entry device having multifunction keys, which can produce more than one character depending upon how the key is depressed. Separation of the intended function of depressing the central primary key is achieved in all three embodiments through a second function key which puts the device in a primary function or a multifunction mode. Strauch et al. requires the generation of at least two characters, a primary character and at least one secondary character, upon depression of any key. This distinguishes over the present invention because in the present invention a single character is generated in a mutually exclusive manner depending upon which specific key of a cluster key is depressed. Strauch et al. does not suggest a cluster key arrangement according to the claimed invention.

Germany Patent document 3,234,417 A1, published on Mar. 22, 1984, describes a keyboard for generating an alphanumerical symbol. Germany '417 does not suggest a cluster key arrangement according to the claimed invention.

Germany Patent document 3,532,201 A1, published on Mar. 19, 1987, describes an electronic keyboard. Germany '201 does not suggest a cluster key arrangement according to the claimed invention.

Great Britain Patent document 1,035,193, published on Jul. 6, 1966, describes an electric switch which includes fixed contacts and a moving bridging contact in the form of a surface of revolution carried by a support on which it is free to turn about its axis and with which it can be moved generally in a radial direction at right angles to the line joining the fixed contacts to engage them. Great Britain '193 does not suggest a cluster key arrangement according to the claimed invention.

Great Britain Patent document 1,313,754, published on Apr. 18, 1973, describes a joystick controlled switch apparatus comprising an operating lever rotatable about a pivot point in a support intermediate first and second portions of the lever. Great Britain '754 does not suggest a cluster key arrangement according to the claimed invention.

Japan Patent document 1-93249, published on Apr. 12, 1989, describes a character information input device. Japan '249 does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "THE ABCs OF KEYPAD LOGIC", by Mike Mills, published Feb., 15, 1999 in the Washington Post, describes a keypad operating in conjunction with software to disambiguate keystrokes entered by a user to make a highly educated guess of what the user is trying to spell. The keyboard has twelve keys, nine of them labeled with numerous letters and other symbols, and those nine plus one more are labeled with one of the ten digits. Textural entry keystrokes are ambiguous. The user strikes a delimiting "select" key at the end of each word, delimiting a keystroke sequence which could match any of many words with the same number of letters. The keystroke sequence is processed with a complete dictionary, and words which match the sequence of keystrokes are presented to the user in order of decreasing frequency of use. The use selects the desired word. The letters are assigned to the keys in a non-sequential order which reduces chances of ambiguities. The present invention generates a single character in a mutually exclusive manner depending upon which specific key of a cluster key is depressed. This article does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "INVENTOR ON THE VERGE OF A NERVOUS BREAKTHROUGH", by David Stipp, published Mar. 29, 1999 in Fortune Magazine, pages 106–116, describes a palm-sized keyboard with full-sized keys. This article does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "SEMI-CAPTIVE KEYBOARD", published in February, 1976 in Xerox Disclosure Journal Vol. 1 Number 2, page 85, describes a keyboard for information encoding with minimal finger movement by the operator. This article does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "COMPACT COMPUTER KEYBOARD", published in March, 1985 in IBM Technical Disclosure Bulletin, Vol. 27 No. 10A, pages 5640–5642, describes a small computer keyboard that retains the conventional spatial relationships among the alphabetic keys without reducing the standard surface area for finger contact on each key or the spacing between adjacent keys. This article does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "SMART KEY", published in October, 1985 in IBM Technical Disclosure Bulletin Vol. 28 No. 5, pages 1859–1860, describes a special key positioned on the keyboard portion of an interactive terminal for controlling cursor positioning at the terminal display by touch control. This article does not suggest a cluster key arrangement according to the claimed invention.

An article entitled "SPACE BAR THAT ROLLS", published in August, 1989 in IBM Technical Disclosure Bulletin Vol. 32 No. 3B, pages 700–701, describes a space bar which can rotate along its long axis in order to provide an additional function. This article does not suggest a cluster key arrangement according to the claimed invention.

None of the above inventions and patents, taken either singularly or in combination, is seen to describe the instant invention as claimed.

## SUMMARY OF THE INVENTION

The present invention is a cluster key arrangement. The cluster key arrangement may be mechanically configured or electronically configured. The cluster key arrangement may include twelve cluster keys configured in an arrangement of three columns by four rows, such as conventionally found on standard telephones. The cluster key arrangement may also be configured for use on cellular/mobile telephones, television remote controls, other handheld data entry devices, automotive controls, desktop/wall-mounted/cordless telephones, combination telephone recorders, Personal Digital Assistants (PDAs), and other electronic devices. The cluster keys provide a user with the ability to select one of a plurality of key elements representing numbers, letters, symbols, functions, etc., in a mutually exclusive manner.

The mechanical cluster keys each include a primary key and at least one secondary key. The number of secondary keys is preferably in the range of four to eight. The mechanical cluster keys are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. The primary key preferably includes a dome or convex shaped button profile further shaped circularly, ellipsoidally, pentagonally, etc., as viewed from the top. The dome or convex shaped primary key profile as it reaches the vicinity of the secondary key assumes a concave profile. While a concave profile may be substituted for a dome, other button shapes, as viewed from the top, such as hexagonal, heptagonal, or octagonal may be substituted. The secondary keys preferably each have a concave profile starting at the perimeter of the

primary key somewhat underneath the primary key in elevation and rise up in a concave arcuate profile to increase the contact surface area of the fingertip for better pressure distribution and ends with a greater width such as obtained by the wide end of a trapezoid, for providing a greater width to the finger to act on, and ends at an elevation which is slightly lower than the top elevation of the dome of the primary key, with which it is clustered. Other secondary key profiles, as viewed from the top, may include shapes such as rectangular, trapezoidal, semi-circular, or elongated to provide more finger contact.

The primary keys are each labelled with a number, an asterisk symbol (*), or a pound sign (#). The secondary keys are each labelled with a function designation, letters, or character symbols. Each key has a first portion of the key exposed on a first side of the key cluster, and a second portion and third portion of the key exposed on a second side of the key cluster. When the first portion of a key is depressed by a user, the second portion of the primary key comes into contact with the second portions of the secondary keys with which it is clustered and mechanically mutually excludes any of the corresponding secondary keys' third portions of that particular key cluster from contacting a substrate such as a printed circuit board or an intermediate layer of an elastomeric sheet that has hat like protrusions with attached conductive elements under the hats to complete a circuit upon being depressed. If the primary key is depressed, none of the associated secondary keys may contact the substrate. If a secondary key is depressed preferably neither the associated primary key nor the remaining secondary keys may contact the substrate. It is possible that if a secondary key is depressed, at least two of the immediately adjacent secondary keys will be precluded from acting on the substrate.

One technique for detecting a depressed condition of a key utilizes a capacitive key wherein a key circuit element forms two spaced apart metallic areas and has a plated pad formed from a metal such as tin, nickel, or copper such that when the key end is brought in close proximity to the current element, a capacitive charge is noted by a keypad circuit board and a key-depressed state is acknowledged by a corresponding keyboard microprocessor and logic unit. An alternative construction incorporates a hardcontact keyboard, wherein the key has a stem which directly engages with the concave cavity, in close proximity with a pair of contacts comprising the circuit element which are then brought into electrically communicative relationship therebetween. Such a configuration for use in association would include physical shell caps on a flexible board spaced from a circuit board which includes metallic contacts. The shell caps each include a metallic element within the cap. When a user presses one button of a selected cluster key, a signal is generated when the key bottom of the key presses a shell cap and causes the associated metallic element to contact a metallic contact.

A mechanical cluster key arrangement configured for use on a remote telephone includes a housing, a speaker, and a microphone. The housing also includes a liquid crystal display. Openings in the housing are provided for the individual cluster keys. In addition, the remote telephone may also include a buzzer, indicator lights, and other features, depending upon a particular design or model. The remote telephone includes a main printed circuit board which includes all of the major radio frequency (RF) and logic circuits required to provide at least basic cellular telephone service and support a variety of features. Such circuits typically include a plurality of chips, integrated circuits, and other components interconnected formed within, or on the surface, of the printed circuit board. The remote telephone also includes an antenna that extends through an aperture provided in the housing and is electrically connected to the printed circuit board.

The housing encloses a substrate on which are mounted the closing switches and the dial pulse circuit which is controlled by these switches. Upon reception of RF signals, the mobile telephone receives the RF signals through the antenna. The antenna converts the received RF signals into electrical RF signals for use by the radio circuitry. The radio circuitry demodulates the electrical RF signals and recovers the data transmitted using the RF signals. Additionally, the radio circuitry outputs the data to a processor. The processor includes at least a main processor and associated memory as well as other control circuits including integrated circuits or other known technologies. The processor formats the data output from the radio circuitry into a recognizable voice or message information for use by the user interface. The user interface communicates the received information or voice to a user through the use of the speaker and the display. All digital or all analog or combinations of analog and digital network based cellular telephone services are possible.

Unlike present analog systems and other digital systems that divide the available spectrum into narrow channels and assign one or more conversations to each channel, CDMA is a wideband spread spectrum technology that spreads multiple conversations across a wide segment of the broadcast spectrum. Each telephone or data call is assigned a unique code that distinguishes it from the multitude of calls simultaneously transmitted over the same broadcast spectrum. So long as the receiving device has the right code, it can pick its conversation out from all the others.

Another mechanical cluster key arrangement according to the invention includes cluster keys which each include a primary key circularly surrounded by a concave shaped secondary key. The various possible shapes attributed to the primary and secondary keys in the previously described mechanical cluster key arrangements are also possible in this mechanical cluster key arrangement. The cluster keys in this cluster key arrangement are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. As before, typically, the primary keys are each labelled with a number, an asterisk symbol (*), or a pound sign (#). The secondary keys are each labelled with at least one function designation, letter, or character symbol. Each key has a first portion of the key exposed on a first side of the cluster key assembly, and a second and third portion of the key exposed on a second side of the cluster key assembly. When the first portion of a key is depressed by a user, the third portion of the key comes into contact with a substrate while its second portion mechanically mutually excludes any functions associated with the corresponding secondary key of that particular cluster key from contacting the, substrate.

The primary key travels through a stepped hole in the key cluster. When the primary key is actuated, a shoulder on the primary key mates with steps in the secondary keys. This engagement of the shoulder of the primary key with the steps in secondary keys traps the secondary keys against the substrate and prevents them from rotating and rolling over the surface of the substrate. Since the secondary keys are actuated by rotating and rolling over the substrate, the secondary keys can not be actuated when the primary key is actuated.

When a secondary key is actuated by rotating and rolling over the surface of the substrate, it positions the primary key

at an) angle with the substrate. If the primary key is then depressed, this angle will cause the edge of the primary key to contact the substrate and prevent the bottom face of the primary key from making contact. Since actuation of the primary key is produced by the bottom face contacting the substrate, this prevents actuation of the primary key when a secondary key is actuated. Each secondary key includes a bottom surface which includes electrical traces corresponding to the number of functions designated on the upper surface of the secondary key. Selection of one function mutually precludes the selection of the other secondary key functions or the primary key function.

An electronic cluster key arrangement comprises a primary key and at least one secondary key and is electronically configured in the form of a transparent a touch screen liquid crystal display (LCD) mounted within a remote telephone which includes a housing, a speaker, and a microphone. Obviously, this electronically configured touch screen LCD cluster key arrangement may also be configured for use on cellular/mobile telephones, television remote controls, other handheld data entry devices, automotive controls, desktop/wall-mounted/cordless telephones, combination telephone recorders, PDAs, and other electronic devices, according to the desires of the user. The cluster keys in this electronic configuration are preferably displayed in the form of circular, ellipsoidal, pentagonal, etc., images as viewed from the top. The secondary keys each preferably displayed in the form of rectangular, trapezoidal; semi-circular, images which may be elongated to provide more finger contact.

The housing also includes a liquid crystal display (LCD) for displaying information for the user, a power switch, and a mode switch. The touch screen LCD may be any conventionally configured touch screen LCD. For example, the touch screen LCD may be configured in the form of an upper glass sheet and a lower glass sheet with a thin layer of liquid crystal material including a pressure sensing element sandwiched between the glass sheets. However, the touch screen LCD may also be configured in combination with a transparent thin film solar cell such as a p-i-n junction type amorphous silicon solar cell.

Many approaches to the determination of the location of X and Y coordinates of a touch point based on sensing pressure are well known. A pressure-sensitive input device comprising an X-coordinate detection resistive element connected to mutually parallel vertical conductors and a Y-coordinate detection resistive element connected to mutually parallel horizontal conductors, for detecting the position of a point depressed by a stylus or the like, works by detecting changes in the resistance values of these resistive elements. Switches are used for on-off control of the current flowing into or out of both ends of the X-coordinate detection resistive element and the Y-coordinate detection resistive element, and a voltage detection circuit detects the voltage between the X-coordinate detection resistive element and the Y-coordinate detection resistive element. Multiple inputs can be detected based on the results from the voltage detection circuit when the currents are switched by the switches.

The preceding is but one approach to pressure sensing based location determination known in the art. A more sensitive "smart sensor" type micro-strain gage based localized point sensor located at the midpoint of the keycaps of the primary keys and at the midpoint of the secondary keycaps, located along the circumference of a circle which constitutes the "virtual circle" along which lie the locus of the centers of the secondary keys of the various embodiments. This sensitive pressure sensor can output an analog pressure level and its digitized digital equivalent and likewise the rate of change of pressure and its digitized equivalent. The sensor is a smart sensor in that it can be embedded in the carrier material.

The first level of mutual exclusivity is rather trivial. The system logic will not accept inputs from two different cluster keys; such dual activation attempt will occur when a user inadvertently presses two adjacent secondary keys belonging to two different clusters (the system will output an error message and sound a beep asking the user to move the finger a little closer to the center of the cluster). It can also occur when one purposely tests the system by pressing keys from clusters that are not adjacent (this will merely elicit a beep and optionally display an error message).

Once the finger is operating within a cluster, the finger perhaps overlaps a little over let us say 3 keys . . . . The intended secondary key (let us say the alphabet B), the corner of the primary key (which is the number **2**) and a portion of the adjacent secondary key (say the letter A) . . . under these circumstances, the pressure sensor that is distributed over the entire "keycap" areas of both the secondary keys and the primary key will generate a logical YES for these keys. However, the more sensitive pressure sensor located in the middle (lower threshold) will in most instances have an output only in the intended secondary key of B. This output in reality has two components, an analog level (or its digitized equivalent) representing the amount of or relative amount of pressure (this is likely to be the highest in the intended secondary key since presumably the finger tip is acting on it. For further reliability, a rate input will also be generated in identical fashion. When uniqueness is established the logical outputs from the other two keys are precluded from proceeding further. A simple implementation would accomplish this inside the box with conventional electronics. It is also possible to implement this in a solid state or monolithic way by opening the conductive pathway from the non intended keys thus making it mutually exclusive.

A second pressure sensor, i.e., the generalized or entire keycap based pressure sensor also needs to be there for another case, i.e. when one attempts to provide a very clean input by using a pen tip or stylus as is done on palmtop PDAs these days. This capability falls under the realm of user friendliness, since there are many users who use this method currently, albeit with a complaint. Of course they are doing it because they have no choice.

The touch screen LCD could be of the monochromatic type or an active matrix full color display. As is known widely to those skilled in the art, an active matrix generally consists of two sheets between which is inserted an electro-optical material such as a liquid crystal. On one of the sheets is a matrix of transparent conductive blocks, thin film transistors, a group of conducting addressing lines, and a group of conductive addressing columns. Each transistor has a gate connected to a line, a source connected to a block, and a drain connected to a column. On the second sheet is a counter electrode. In one electronic cluster keys arrangement, on top of the liquid crystal material is attached a flexible transparent film which has patterned thin film semiconductor layers preferably comprising a layer of i(intrinsic) -type semiconductor disposed between a layer of p-type semiconductor and a layer of n-type semiconductor. The p-i-n layer is further sandwiched on either side by a thin layer of transparent conductive layer such as tin oxide, indium tin oxide, or the like, to constitute a p-i-n junction amorphous silicon solar cell.

A silicon solar cell connected to the emitter of a common base amplifier biased so that the cell voltage is near to zero,

a short-circuit load can be used as a sensor. Collector load is three forward diodes which develop an approximately logarithmic voltage versus current in the current ranges involved. The next stage provides the alternating current (AC) coupling for the pulses, so that the sensitivity of the sensing system is essentially independent of the light level on the cell. This stage is an operational amplifier with a bypass on the feedback for high AC gain and low direct current (DC) gain. This network also has a low-pass net to reject noise spikes picked up from the environment. The coverage of the conductive layers by an actuating finger causes shadowing which results in a decreased current output proportional to the area shadowed.

The p-i-n junction amorphous silicon solar cell is scribed, preferably using a laser scriber, into smaller portions comprising one primary portion and at least one peripheral secondary portion (preferably four secondary portions around the primary portion) t configure an electronic cluster key. The p-i-n junction amorphous silicon solar cell include at least one vertical and horizontal grid of transparent conductors laid in between two transparent insulating layers of the thin film variety such as silicon dioxide. The p-i-n junction amorphous silicon solar cell's two conductive transparent coatings of tin oxide, indium tin oxide, or the like, can be combined in series using techniques well known to persons skilled in the art to provide a trickle charge at approximately 12–14 volts. One approach to series connection entails using a laser to scribe and separate the initial tin oxide coating into islands, using a photoresist mask on the edge to prevent the subsequent layers of p-type, i-type, and n-type semiconductors from touching the conductive layer. Thereafter, the mask is removed and the second tin oxide layer is applied which connects the top, surface of the second cell to the bottom surface of the first cell, resulting in a series connection. Other intervening steps are well known to those versed in the art. The p-i-n junction amorphous silicon solar cell may include capacitors and/or pressure sensors at the center of each key which are all deposited on a flexible transparent substrate such as Kapton and then glued on to the LCD. Kapton or other high temperature plastic is used to withstand high temperatures associated with chemical vapor deposition of amorphous silicon. It is possible to integrate the processing of the solar cell and the touch screen LCD based on active matrix thin film transistors (TFTs).

The touch screen LCD is preferably an active matrix TFT display which preferably displays the primary keys as white key with black characters for most contrast and which preferably displays secondary key alphabet characters in a particular color such as red. Preferably secondary key function symbols are displayed in green, secondary key characters such as the AT sign (@) are displayed in blue, and secondary key control symbols such as YES/SEND are displayed in yellow with green letters and NO/END are displayed in yellow with red letters. Obviously, a variety of other color assignments are possible.

The electronic cluster key arrangement is configured utilizing a keyboard emulator within the remote telephone in accordance with the mode selected by the user using the mode switch. One arrangement showing an electronic cluster key arrangement comprises a set of twelve cluster keys arranged in four rows by three columns. Each electronically configured cluster key includes a primary key location surrounded by at least one secondary key location. By touching a particular key location on the touch screen LCD, the user activates an electrical signal which passes through an electrical matrix formed by a plurality of contact lines interconnecting each of the particular key locations. The electrical signal is delivered to a processing unit stored within the remote telephone, which is then converted into a symbol and displayed on the LCD. The remote telephone also includes circuitry which precludes the simultaneous activation of more than one key location of a particular cluster key.

The electronic or opto-electronic mutually exclusive cluster key arrangement works on the same basis of preprocessing as was done in the mechanical cluster key arrangements wherein only one signal could be generated at a time. In the electronic cluster key arrangement the preprocessing is based on sensing one or more variables such as contact pressure or shadowing of a solar cell's microcell element. Both analog levels and digital/logical inputs are used in preprocessing. Other types of sensing such as capacitive is also possible. Appropriate grid work of conductors and electronics which is well known to those skilled in the art will be used, entailing the use of digital and analog mutiplexers, operational amplifiers polling elements and the like. In a pure LCD cluster key arrangement, wherein a pressure sensor alone is the sensing element, in the trivial case where one uses a stylus, such as is done in the use of PDAs currently available in the market the sensing and interpretation is easy. These preceding devices do not work with fingers reliably since the keycaps are too small.

In the present invention, since there is a certain amount of shared "real estate" due to clustering, the user is intentionally allowed to press part of an adjacent key (principally the primary key while pressing a secondary key). The present invention utilizes a distributed or wide area logical pressure sensor alone which provides a logical YES output for a selected positional area, or a low threshold central pressure sensor in combination with other detected readings such as an applied pressure, applied pressure rate, or shadowing. However, the pressure sensing area is mostly in a restricted smaller area around the center. The centers of the adjacent keys are located far enough apart that they result in one or more different levels of pressure generated by a pressing finger. The key associated with the higher level is selected as representing the fingertip which better represents the intended key. In the embodiment with the solar cell, the pressing of a key generates both an analog signal representing the amount of shadowing of a key cap by a operating finger and a digital/logical output which are used in preprocessing singly or in combination with the outputs from the pressure sensor. One approach involves picking for comparison of the shadowing levels only those keys whose pressure sensors have generated a logical YES and simultaneously picking for comparison of the pressure levels only those keys whose shadowing has generated a logical YES. In this scheme of preprocessing, at any stage upon identifying a reliable output such as by the use of a logical AND of the pressure and shadow/solar cell sensors further processing is stopped. The early and reliable identification of an input precludes the activation or consideration of another input in this mutually exclusive electronic cluster key arrangement.

The invention is believed to reside in the cluster key per se, the various arrangements thereof, the combination of known electronic circuitry, and the overall combination of cooperating telephones, PDAs or the like including the Internet at large. Furthermore, the invention may be easily implemented in a manner that is compatible with the existing prior art in terms of user friendliness, such as allowing a user to operate a device in a numeric mode, an alphabetic mode, or the like.

Accordingly, it is a principal object of the invention to provide a cluster key arrangement that enables a user to

select one of a plurality of characters representing numbers, letters, symbols, functions, etc., in a mutually exclusive manner.

It is another object of the invention to provide a cluster key arrangement in a mechanical configuration.

It is yet another object of the invention to provide a cluster key arrangement in an electronic configuration.

It is a further object of the invention to provide a mobile telephone having a touch screen LCD with an electronic cluster key

Still another object of the invention is to provide a mobile or palmtop computer based Personal. Digital Assistant having a color touch screen LCD with electronic cluster keys with various configurations as chosen by the user with built-in functions of a cellular telephone resulting in a combination cellphone/PDA that has a bigger display area without exceeding the overall dimensions and which provides for a longer talk/useage time per battery charge.

It is an object of the invention to provide improved elements and arrangements thereof in a mechanical or electronic cluster key arrangement for the purposes described which is inexpensive, dependable and fully effective in accomplishing its intended purposes.

These and other objects of the present invention will become readily apparent upon further review of the following specification and drawings.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front perspective view of a cluster key arrangement according to the present invention.

FIG. **2** is a top view of a mechanical cluster key arrangement according to the present invention configured in the form of a telephone.

FIG. **3** is a top view of a mechanical cluster key arrangement according to the present invention.

FIG. **4** is a side perspective view of a mechanical cluster key according to the present invention.

FIG. **5** is an exploded view of the mechanical cluster key shown in FIG. **4**.

FIG. **6**A is a substrate electrical contact for the mechanical cluster key shown in FIG. **4** in accordance with the present invention.

FIG. **6**B is a cross-sectional view of the substrate electrical contact shown in FIG. **6**A.

FIG. **7** is a front perspective view of a mechanical cluster key arrangement according to the present invention.

FIG. **8**A is an exploded perspective view of a cluster key from the cluster key arrangement shown in FIG. **7**.

FIG. **8**B is a cross-sectional view of the cluster key shown in FIG. **8**A.

FIG. **9** is a bottom view of the cluster key shown in FIG. **8**A.

FIG. **10**A is a front view of a mobile telephone with a touch screen LCD utilizing an electronic cluster key configuration according to the invention.

FIG. **10**B is a front perspective view of a p-i-n junction amorphous silicon solar cell according to the invention.

Similar reference characters denote corresponding features consistently throughout the attached drawings.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a cluster key arrangement. The cluster key arrangement may be mechanically configured or electronically configured. A mechanical cluster key arrangement according to the invention is shown in FIG. **1**. This mechanical cluster key arrangement **10** includes twelve cluster keys configured in an arrangement of three columns by four rows, such as conventionally found on standard telephones. This cluster key arrangement **10** may also be configured for use on cellular/mobile telephones, television remote controls, other handheld data entry devices, automotive controls, desktop/wall-mounted/cordless telephones, combination telephone recorders, PDAS, and other electronic devices. The cluster keys provide the user with the ability to select one of a plurality of key elements representing numbers, letters, symbols, functions, etc., in a mutually exclusive manner.

The cluster keys shown in FIG. **1** each include a primary key **12** surrounded by four secondary keys **14**. However, a cluster key arrangement according to the invention may obviously include a primary key and any number of secondary keys, i.e., one, two, three, etc. The number of secondary keys is preferably in the range of four to eight. The cluster keys are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. The primary key **12** for a particular cluster key preferably includes a dome or convex shaped button profile further shaped circularly, ellipsoidally, pentagonally, etc., as viewed from the top. The dome or convex shaped primary key profile as it reaches the vicinity of the associated secondary keys **14** assumes a concave profile. While a concave profile may be substituted for a dome, other button shapes, as viewed from the top, such as hexagonal, heptagonal, or octagonal may be substituted. The secondary keys **14** preferably each have a concave profile starting at the perimeter of the primary key somewhat underneath the primary key **12** in elevation and rises up in a concave arcuate profile to increase the contact surface area of the fingertip for better pressure distribution and ends with a greater width such as obtained by the wide end of a trapezoid, for providing a greater width to the finger to act on, and ends at an elevation which is slightly lower than the top elevation of the dome of the primary key **12**, with which it is clustered. Other secondary key profiles, as viewed from the top, may include shapes such as rectangular, trapezoidal, semi-circular, which may be elongated to provide more finger contact.

The primary keys **12** are each labelled with a number, an asterisk symbol (*), or a pound sign (#). The secondary keys **14** are preferably nominally small in relation to the associated primary key **12** to accommodate space constraints. The secondary keys **14** preferably each include an arcuate concave surface which increases the surface area of contact for better pressure distribution at the finger tip of the user. Preferably, the outer edge of the secondary keys **14** flares out to provide a greater width on which a finger may act. The secondary keys **14** are each labelled with a function designation, letters, or character symbols.

Each primary key **12** has a first portion of the key exposed on a first side of the associated key cluster, and a second portion and third portion of the key exposed on a second side of the key cluster. When the first portion of a primary key **12** is depressed by a user, the second portion of the primary key **12** comes into contact with the second portions of the associated secondary keys with which it is clustered and mechanically mutually excludes any of the corresponding secondary keys third portions of that particular key cluster from contacting a substrate such as a printed circuit board or an intermediate layer of an elastomeric sheet that has hat like protrusions with attached conductive elements under the

hats to complete a circuit upon being depressed. If the primary key **12** of a cluster key is depressed, none of the associated secondary keys may contact the substrate. If a secondary key of a cluster key is depressed preferably neither the associated primary key nor the remaining associated secondary keys may contact the substrate. It is possible that if a secondary key is of a cluster key is depressed, at least two of the immediately adjacent secondary keys will be precluded from acting on the substrate.

A perspective view and an exploded view of one of these key clusters **100** is shown in FIGS. **4** and **5**, wherein a primary key **101** is surrounded by four secondary keys **104** that each pivot about a pivot axis **106**. As shown, the primary key **101** includes a first portion of the key exposed on a first side of the associated key cluster, and a second portion **103** and third portion **102** of the key exposed on a second side of the key cluster. If the primary key **101** of the cluster key is depressed, none of the associated secondary keys **104** may contact the substrate. If a secondary key **104** of the cluster key is depressed neither the associated primary key **101** nor preferably the remaining associated secondary keys **104** may contact the substrate, since secondary key mutual exclusivity actuator **108** precludes it. However, it is possible to mechanically configure a cluster key arrangement wherein two secondary keys of a particular cluster key may be simultaneously depressed. In that case a processor operating in conjunction with the cluster key arrangement would not generate a signal in response to such activity, and may generate a error signal to the user.

One technique for detecting a depressed condition of a key utilizes a capacitive key wherein a key circuit element forms two spaced apart metallic areas and one key and has a plated pad formed from a metal such as tin, nickel, or copper such that when the key end is brought in close proximity to the current element, a capacitive charge is noted by a keypad circuit board and a key-depressed state is acknowledged by a corresponding keyboard microprocessor and logic unit. An alternative construction incorporates a hardcontact keyboard, wherein the key has a stem which directly engages with the concave cavity, in close proximity with a pair of contacts comprising the circuit element which are then brought into electrically communicative relationship therebetween. As shown in FIGS. **6**A and **6**B, such a configuration for use in association with the cluster key shown in FIGS. **4** and **5** include physical shell caps **160** on a flexible board **158** spaced from a circuit board **164** which includes metallic contacts **166**. The shell caps **160** each include a metallic element **162** within the cap **160**. When a user presses one button of a selected cluster key, a signal is generated when the key bottom of the key presses a shell cap **160** and causes the associated metallic element **162** to contact a metallic contact **166**.

A mechanical cluster key arrangement configured for use on a remote telephone **20** is shown in FIG. **2** which includes a housing **22**, a speaker **24**, and a microphone **26**. The housing **22** also includes a liquid crystal display (LCD) **28**. Openings in the housing are provided for the individual cluster keys. In addition, although not shown, the remote telephone **20** may also include a buzzer, indicator lights, and other features, depending upon a particular design or model. The remote telephone **20** includes a main printed circuit board (not shown) which includes all of the major radio frequency (RF) and logic circuits required to provide at least basic cellular telephone service and support a variety of features. Such circuits typically include a plurality of chips, integrated circuits, and other components interconnected formed within, or on the surface, of the printed circuit board. The remote telephone **20** also includes an antenna **30** that extends through an aperture provided in the housing **22** and is electrically connected to the printed circuit board. The housing **22** encloses a substrate on which are mounted the closing switches and the dial pulse circuit which is controlled by these switches. Upon reception of RF signals, the mobile telephone **20** receives the RF signals through the antenna **30**. The antenna **30** converts the received RF signals into electrical RF signals for use by the radio circuitry. The radio circuitry demodulates the electrical RF signals and recovers the data transmitted using the RF signals. Additionally, the radio circuitry outputs the data to a processor. The processor includes at least a main processor and associated memory as well as other control circuits including integrated circuits or other known technologies. The processor formats the data output from the radio circuitry into a recognizable voice or message information for use by the user interface. The user interface communicates the received information or voice to a user through the use of the speaker **24** and the display **28**. All digital or all analog or combinations of analog and digital network based cellular telephone services are possible.

Unlike present analog systems and other digital systems that divide the available spectrum into narrow channels and assign one or more conversations to each channel, CDMA is a wideband spread spectrum technology that spreads multiple conversations across a wide segment of the broadcast spectrum. Each telephone or data call is assigned a unique code that distinguishes it from the multitude of calls simultaneously transmitted over the same broadcast spectrum. So long as the receiving device has the right code, it can pick its conversation out from all the others.

The mechanical cluster keys shown in FIG. **2** each include a primary key **32** and five secondary keys. As stated before, a cluster key arrangement according to the invention may obviously include a primary key and any number of secondary keys, i.e., one, two, three, etc. The selected number of secondary keys is preferably in the range of four to eight. The cluster keys are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. The primary key **32** for a particular cluster key preferably includes a dome or convex shaped button profile further shaped circularly, ellipsoidally, pentagonally, etc., as viewed from the top. The dome or convex shaped primary key profile as it reaches the vicinity of the associated secondary keys assumes a concave profile. While a concave profile may be substituted for a dome, other button shapes, as viewed from the top, such as hexagonal, heptagonal, or octagonal may be substituted. The associated secondary keys each preferably have a concave profile starting at the perimeter of the primary key somewhat underneath the primary key in elevation and rises up in a concave arcuate profile to increase the contact surface area of the fingertip for better pressure distribution and ends with a greater width such as obtained by the wide end of a trapezoid, for providing a greater width to the finger to act on, and ends at an elevation which is slightly lower than the top elevation of the dome of the primary key, with which it is clustered. Other secondary key profiles, as viewed from the top, may include shapes such as rectangular, trapezoidal, semi-circular, which may be elongated to provide more finger contact.

The primary keys **32** are each labelled with a number, an asterisk symbol (*), or a pound sign (#) The secondary keys are each labelled with a function designation, letters, or character symbols. In this mechanical cluster key arrangement, the primary key labelled "1" is surrounded by

unmarked secondary keys **34**,**36**,**38**,**40** and a secondary key labelled with "!". While the secondary keys **34**,**36**,**38**,**40** may obviously be labelled according to the desires of the user, preferably secondary key **34** is labelled "CLR", secondary key **36** is labelled "YES/SEND", secondary key **38** is labelled "PWR ON/OFF", and secondary key **40** is labelled "NO/END". Each key is disposed within the housing. The primary key labelled "4" includes an unmarked secondary key **42** which is preferably labelled "CTRL". The primary key labelled "5" includes an unmarked secondary key **44** which is preferably labelled "ALT". The primary key labelled "6" includes an unmarked secondary key **46** which is preferably labelled "ENTER". The primary key labelled "8" includes an unmarked secondary key **48** which is preferably labelled with an accent mark. The primary key labelled "0" includes an unmarked secondary key **50** which is preferably labelled "SPACE BAR". The primary key labelled "#" includes an unmarked secondary key **52** which is preferably labelled with an underscore. The primary key labelled "#" also includes another unnumbered unmarked secondary key which is preferably labelled "MODE". Each key has a first portion of the key exposed on a first side of the housing and a second portion of the key exposed on a second side of the housing. When the first portion of a key is depressed by a user, the second portion of the key comes into contact with a substrate and mechanically mutually excludes any of the corresponding keys of that particular key cluster from contacting the substrate. These cluster keys function in the same manner as the cluster key shown in FIGS. **4** and **5**, wherein a primary key is surrounded by secondary keys which pivot about a pivot axis. If the primary key of a cluster key is depressed, none of the associated secondary keys may contact the substrate. If a secondary key of a cluster key is depressed preferably neither the associated primary key nor the remaining associated secondary keys may contact the substrate. It is possible that if a secondary key of a cluster key is depressed, at least two of the immediately adjacent secondary keys will be precluded from acting on the substrate on account of secondary key mutual exclusivity actuator **108**.

One technique for detecting a depressed condition of a key utilizes a capacitive key wherein the key circuit element forms two spaced apart metallic areas and has a plated pad formed from a metal such as tin, nickel, or copper such that when the key end is brought in close proximity to the current element, a capacitive charge is noted by the circuit board and a key-depressed state is acknowledged by a corresponding keyboard microprocessor and logic unit. An alternative construction incorporates a hardcontact keyboard, wherein the key has a stem which directly engages with the concave cavity, in close proximity with a pair of contacts comprising the circuit element which are then brought into electrically communicative relationship therebetween, previously described.

Another mechanical cluster key arrangement **60** according to the invention is shown in FIG. **3**. The cluster keys in this cluster key arrangement **60** each include a primary key **62** surrounded by six secondary keys. As stated above, a cluster key arrangement according to the invention may obviously include a primary key and any number of secondary keys, i.e., one, two, three, etc. The number of secondary keys is preferably in the range of four to eight. The cluster keys are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. The primary key for a particular cluster key preferably includes a dome or convex shaped button profile further shaped circularly, ellipsoidally, pentagonally, etc., as viewed from the top. The dome or convex shaped primary key profile as it reaches the vicinity of the associated secondary keys assumes a concave profile. While a concave profile may be substituted for a dome, other button shapes, as viewed from the top, such as hexagonal, heptagonal, or octagonal may be substituted. The secondary keys each have a concave profile starting at the perimeter of the primary key somewhat underneath the primary key in elevation and rises up in a concave arcuate profile to increase the contact surface area of the fingertip for better pressure distribution and ends with a greater width such as obtained by the wide end of a trapezoid, for providing a greater width to the finger to act on, and ends at an elevation which is slightly lower than the top elevation of the dome of the primary key, with which it is clustered. Other secondary key profiles, as viewed from the top, may include shapes such as rectangular, trapezoidal, semicircular, which may be elongated to provide more finger contact. The primary keys **62** are each labelled with a number, an asterisk symbol (*), or a pound sign (#). The secondary keys are each labelled with a function designation, letters, or character symbols. Each key is disposed within the housing. In this cluster key arrangement, the primary key **62** labelled "1" is surrounded by unmarked secondary keys **64**,**66**. While the secondary keys **64**,**66** may obviously be labelled according to the desires of the user, preferably secondary key **64** is labelled "NO/END", and secondary key **66** is labelled "YES/SEND". The primary key labelled "2" includes an unmarked secondary key **68** which is preferably labelled "MODE". The primary key labelled "3" includes an unmarked secondary key **70** which is preferably labelled "ENTER". The primary key labelled "8" includes an unmarked secondary key **72** which is preferably labelled "ALT". The primary key labelled "*" includes an unmarked secondary key **74** which is preferably labelled "F**10**". The primary key labelled "*" also includes an unmarked secondary key **76** which is preferably labelled "CTRL". The primary key labelled "0" includes an unmarked secondary key **78** which is preferably labelled "F**11**". The primary key labelled "#" includes an unmarked secondary key **80** which is preferably labelled "F**12**". The primary key labelled "#" also includes an unmarked secondary key **82** which is preferably labelled "SPACE BAR". The primary key labelled "#" also includes another unnumbered unmarked secondary key which is preferably labelled "MODE". Each key has a first portion of the key exposed on a first side of the housing and a of the key exposed on a second side of the housing. When the first portion of a key is depressed by a user, the of the key comes into contact with a substrate and mechanically mutually excludes any of the corresponding keys of that particular key cluster from contacting the substrate. These cluster keys function in the same manner as the cluster key shown in FIGS. **4** and **5**, wherein a primary key is surrounded by secondary keys which each pivot about a pivot axis. If a primary key **62** is depressed, none of the secondary keys associated with that key cluster may contact the substrate. If a secondary key is depressed neither the primary key nor the remaining secondary keys may contact the substrate.

One technique for detecting a depressed condition of a key utilizes a capacitive key wherein a key circuit element forms two spaced apart metallic areas and one key and has a plated pad formed from a metal such as tin, nickel, or copper such that when the key end is brought in close proximity to the current element, a capacitive charge is noted by a keypad circuit board and a key-depressed state is acknowledged by a corresponding keyboard microprocessor

and logic unit. An alternative construction incorporates a hardcontact keyboard, wherein the key has a stem which directly engages with the concave cavity, in close proximity with a pair of contacts comprising the circuit element which are then brought into electrically communicative relationship therebetween.

Another mechanical cluster key arrangement **110** according to the invention is shown in FIG. **7**. The cluster keys in this cluster key arrangement **110** each include a primary key **112** circularly surrounded by a concave shaped secondary key **116**, as more particularly shown in FIGS. **8**A, **8**B, and **9**. The various possible shapes attributed to the primary and secondary keys in previously described mechanical cluster key arrangements are also possible in this mechanical cluster key arrangement. The cluster keys in this mechanical cluster key arrangement are preferably constructed from material giving a large range of hardness that may be needed to provide positive tactile feedback to the user. As before, typically, the primary keys **112** are each labelled with a number, an asterisk symbol (*), or a pound sign (#). The secondary keys **116** are each labelled with at least one function designation, letter, or character symbol. Each key has a first portion of the key exposed on a first side of the cluster key assembly **110** and a of the key exposed on a second side of the cluster key assembly **110**. When the first portion of a key is depressed by a user, the of the key comes into contact with a substrate and mechanically mutually excludes any functions associated with the corresponding secondary key of that particular key cluster from contacting the substrate. If a primary key **112** is depressed, the secondary key **116** associated with that key cluster may contact the substrate. If a secondary key **116** is depressed the primary key **112** may not contact the substrate. As shown in FIG. **9**, each secondary key **116** includes a convex bottom surface **118** which includes electrical traces **119** corresponding to the number of functions designated on the concave upper surface **117** of the secondary key **116**. Selection of one function mutually precludes the selection of the other secondary key functions or the primary key **112** function.

One technique for detecting a depressed condition of a key utilizes a capacitive key wherein a key circuit element forms two spaced apart metallic areas and has a plated pad formed from a metal such as tin, nickel, or copper such that when the key end is brought in close proximity to the current element, a capacitive charge is noted by a keypad circuit board and a key-depressed state is acknowledged by a corresponding keyboard microprocessor and logic unit. An alternative construction incorporates a hardcontact keyboard, wherein the key has a stem which directly engages with the concave cavity, in close proximity with a pair of contacts comprising the circuit element which are then brought into electrically communicative relationship therebetween.

Each key has a first portion of the key exposed on a first side of the cluster key assembly, and a second and third portion of the key exposed on a second side of the cluster key assembly. When the first portion of a key is depressed by a user, the third portion of the key comes into contact with a substrate while its second portion mechanically mutually excludes any functions associated with the corresponding secondary key of that particular key cluster from contacting the substrate.

The primary key **112** travels through a stepped hole in the key cluster. When the primary key **112** is actuated, a shoulder **114** on the primary key **112** mates with steps **119** in the associated secondary key **116**. This engagement of the shoulder **114** of the primary key **112** with steps in the secondary key **116** traps the secondary key **116** against the substrate and prevents it from rotating and rolling over the surface of the substrate. Since the secondary key **116** is actuated by rotating and rolling over the substrate, the secondary key **116** can not be actuated when the primary key **112** is actuated.

When a secondary key **116** is actuated by rotating and rolling over the surface of the substrate, it positions the associated primary key **112** at an angle with the substrate. If the associated primary key **112** is then depressed, this angle will cause the edge of the primary key **112** to contact the substrate and prevent the bottom face **115** of the primary key **112** from making contact. Since actuation of the primary key **112** is produced by the bottom face **115** contacting the substrate, this prevents actuation of the primary key **112** when the associated secondary key **116** is actuated.

An electronic cluster key arrangement according to the invention is shown in FIG. **10**A. This cluster key arrangement is electronically configured in the form of a touch screen liquid crystal display (LCD) **132** mounted within a remote telephone **120** which includes a housing **122**, a microphone **124**, and a speaker **126**. Obviously, this electronically configured touch screen LCD cluster key arrangement may also be configured for use on cellular/mobile telephones, television remote controls, other handheld data entry devices, automotive controls, desktop/wall-mounted/cordless telephones, combination telephone recorders, PDAs, and other electronic devices, according to the desires of the user.

The cluster keys in this electronic configuration are preferably displayed in the form of circular, ellipsoidal, pentagonal, etc., images as viewed from the top. The secondary keys each preferably displayed in the form of rectangular, trapezoidal, semi-circular, images which may be elongated to provide more finger contact. The preceding images may be similar to those shown in FIGS. **1**, **2**, **3**, and **7**. The housing **122** also includes a liquid crystal display (LCD) **130** for displaying information for the user, a power switch **134**, and a mode switch **136**. The touch screen LCD may be any conventionally configured touch screen LCD. For example, the touch screen LCD may be configured in the form of an upper glass sheet and a lower glass sheet with a thin layer of liquid crystal material including a pressure sensing element sandwiched between the glass sheets. However, the touch screen LCD may also be configured in combination with a transparent thin film solar cell such as a p-i-n junction type amorphous silicon solar cell **140**, as shown in FIG. **10**B.

Many approaches to the determination of the location of X and Y coordinates of a touch point based on sensing pressure are well known. A pressure-sensitive input device comprising an X-coordinate detection resistive element connected to mutually parallel vertical conductors and a Y-coordinate detection resistive element connected to mutually parallel horizontal conductors, for detecting the position of a point depressed by a stylus or the like, works by detecting changes in the resistance values of these resistive elements. Switches are used for on-off control of the current flowing into or out of both ends of the X-coordinate detection resistive element and the Y-coordinate detection resistive element, and a voltage detection circuit detects the voltage between the X-coordinate detection resistive element and the Y-coordinate detection resistive element. Multiple inputs can be detected based on the results from the voltage detection circuit when the currents are switched by the switches.

The preceding is but one approach to pressure sensing based location determination known in the art. A more

sensitive "smart sensor" type micro-strain gage based localized point sensor located at the midpoint of the keycaps of the primary keys and at the midpoint of the secondary keycaps, located along the circumference of a circle which constitutes the "virtual circle" along which lie the locus of the centers of the secondary keys of the various electronic arrangements. This sensitive pressure sensor can output an analog pressure level and its digitized digital equivalent and likewise the rate of change of pressure and its digitized equivalent. The sensor is a smart sensor in that it can be embedded in the carrier material.

The touch screen LCD **132** could be of the monochromatic type or an active matrix full color display. As is known widely to those skilled in the art, an active matrix generally consists of two sheets between which is inserted an electro-optical material such as a liquid crystal. On one of the sheets is a matrix of transparent conductive blocks, thin film-transistors, a group of conducting addressing lines, and a group of conductive addressing columns. Each transistor has a gate connected to a line, a source connected to a block, and a drain connected to a column. On the second sheet is a counter electrode. On top of the liquid crystal material is attached a flexible transparent film which has patterned thin film semiconductor layers preferably comprising a layer of i(intrinsic)-type semiconductor disposed between a layer of p-type semiconductor and a layer of n-type semiconductor. The p-i-n layer is further sandwiched on either side by a thin layer of transparent conductive layer such as tin oxide, indium tin oxide, or the like to constitute a p-i-n junction amorphous silicon solar cell.

A silicon solar cell connected to the emitter of a common base amplifier biased so that the cell voltage is near to zero, a short-circuit load can be used as a sensor. Collector load is three forward diodes which develop an approximately logarithmic voltage versus current in the current ranges involved. The next stage provides the AC coupling for the pulses, so that the sensitivity of the sensing system is essentially independent of the light level on the cell. This stage is an operational amplifier with a bypass on the feedback for high AC gain and low direct current DC gain. This network also has a low-pass net to reject noise spikes picked up from the environment. The coverage of the conductive layers by an actuating finger causes shadowing which results in a decreased current output proportional to the area shadowed.

A preferable p-i-n junction amorphous silicon solar cell **140** is shown in FIG. **10**B. This p-i-n junction amorphous silicon solar cell **140** includes nine layers **141**–**149**. Layer **141** is a transparent conductive tin oxide layer. Layer **142** is a transparent layer of p-type semiconductor. Layer **143** is a transparent layer of i-type semiconductor. Layer **144** is a transparent layer of n-type semiconductor. Layer **145** is a transparent conductive tin oxide layer. Layer **146** is a transparent insulating silicon-dioxide layer. Layer **147** is a transparent layer containing a horizontal or vertical electrical grid. Layer **148** is a transparent insulating silicon-dioxide layer. Layer **149** is a transparent layer containing a horizontal or vertical electrical grid. Once this p-i-n junction amorphous silicon solar cell **140** is attached to an LCD, the solar cell **140** is covered with a transparent plastic layer to protect the cell from the environment. In actuality the solar cell and associated layers are deposited on the plastic layer which is then inverted and attached to the glass.

The p-i-n junction amorphous silicon solar cell is scribed into smaller portions comprising one primary portion and at least one peripheral secondary portion (preferably four secondary portions around the primary portion) to configure an electronic cluster key. The p-i-n junction amorphous silicon solar cell include at least one vertical and horizontal grid of transparent conductors laid in between two transparent insulating layers of the thin film variety such as silicon dioxide. The p-i-n junction amorphous silicon solar cell's two conductive transparent coatings of tin oxide, indium tin oxide, or the like, can be combined in series using techniques well known to persons skilled in the art to provide a trickle charge at approximately 12–14 volts. One approach to series connection entails using a laser to scribe and separate the initial tin oxide coating into islands, using a photoresist mask on the edge to prevent the subsequent layers of p,i,n from touching the conductive layer. Thereafter, the mask is removed and the second tin oxide layer is applied which connects the top surface of the second cell to the bottom surface of the first cell, resulting in a series connection. Other intervening steps are well known to those skilled in the art. The p-i-n junction amorphous silicon solar cell may include capacitors and/or pressure sensors at the center of each key which are all deposited on a flexible transparent substrate such as Kapton and then glued on to the LCD. Kapton or other high temperature plastic is used to withstand high temperatures associated with chemical vapor deposition of amorphous silicon. It is possible to integrate the processing of the solar cell and the LCD based on active matrix thin film transistors (TFTs).

The LCD is preferably an active matrix TFT display which preferably displays the primary key as a white key with black characters for most contrast and which preferably displays the secondary key alphabet characters in a particular color such as red. Preferably secondary key function symbols are displayed in green, secondary key characters such as the AT sign (@) are displayed in blue, and secondary key control symbols such as YES/SEND are displayed in yellow with green letters and NO/END are displayed in yellow with red letters. Obviously, a variety of other color assignments are possible.

The cluster key arrangement is configured utilizing a keyboard emulator within the remote telephone in accordance with the mode selected by the user using the mode switch. FIG. **10**A illustrates one arrangement showing a cluster key arrangement comprising a set of twelve cluster keys arranged in four rows by three columns. The primary key for a particular cluster key is preferably displayed in the form of a circularly, ellipsoidally, pentagonally, etc., shaped image as viewed from the top. The secondary keys are each preferably displayed in the form of a rectangularly, trapezoidally, or semi-circularly, shaped image which may be elongated to provide more finger contact. Each electronically configured cluster key includes a primary key location **138** surrounded by at least one secondary key location **140**. By touching a particular key location on the touch screen LCD **132**, the user activates an electrical signal which passes through an electrical matrix formed by a plurality of contact lines **142** interconnecting each of the particular key locations. The electrical signal is delivered to a processing unit stored within the remote telephone **120**, which is then converted into a symbol and displayed on the LCD **130**. The remote telephone also includes circuitry which precludes the simultaneous activation of more than one key location of al particular cluster key.

The electronic or opto-electronic mutually exclusive cluster key arrangement works on the same basis of preprocessing as was done in the mechanical cluster key arrangements wherein only one signal could be generated at a time. In the electronic cluster key arrangement the preprocessing is based on sensing one or more variables such as contact

pressure or shadowing of a solar cell's microcell element. Both analog levels and digital/logical inputs are used in preprocessing. Other types of sensing such as capacitive is also possible. Appropriate grid work of conductors and electronics which is well known to those skilled in the art will be used, entailing the use of digital and analog mutiplexers, operational amplifiers polling elements and the like. In a pure LCD cluster key arrangement, wherein a pressure sensor alone is the sensing element, in the trivial case where one uses a stylus, such as is done in the use of PDAs currently available in the market place called "Palmtops" (made by 3Com, Hewlett Packard, Casio, Philips, etc.) the sensing and interpretation is easy. These devices utilize a distributed or wide area logical pressure sensor which provides a logical YES output for a selected positional area. These preceding devices do not work with fingers reliably since the keycaps are too small.

In the present invention, since there is a certain amount of shared "real estate" due to clustering, the user is intentionally allowed to press part of an adjacent key (principally the primary key while pressing a secondary key. Many approaches to the determination of the location of X and Y coordinates of a touch point based on sensing pressure are well known. A pressure sensitive input device comprising an X-coordinate detection resistive element connected to mutually parallel vertical conductors and a Y-coordinate detection resistive element connected to mutually parallel horizontal conductors, for detecting the position of a point depressed by a stylus or the like, works by detecting changes in the resistance values of these resistive elements.

The present invention utilizes either a distributed or wide area logical pressure sensor alone which provides a logical YES output for a selected positional area, or a low threshold central pressure sensor in combination with other detected readings such as an applied pressure, rate of applied pressure, or shadowing. Switches are used for on-off control of the current flowing into or out of both ends of the X-coordinate detection resistive element and the Y-coordinate detection resistive element, and a voltage detection circuit detects the voltage between the X-coordinate detection resistive element and the Y-coordinate detection resistive element. Multiple inputs can be detected based on the results from the voltage detection circuit when the currents are switched by the switches.

The preceding is but one approach to pressure sensing based location determination known in the art. A more sensitive "smart sensor" type micro-strain gage based localized point sensor located at the midpoint of the keycaps of the primary keys and at the midpoint of the secondary keycaps (the midpoints are mildly, textured to facilitate tactile feedback without optical degradation), located along the circumference of a circle which constitutes the "virtual circle" along which lie the locus of the centers of the secondary keys of the various electronic arrangements. This sensitive pressure sensor can output an analog pressure level and its digitized digital equivalent and likewise the rate of change of pressure and its digitized equivalent. The sensor is a smart sensor in that it can be embedded in the carrier material.

The first level of mutual exclusivity is rather trivial. The system logic will not accept inputs from two different cluster keys; such dual activation attempt will occur when a user inadvertently presses two adjacent secondary keys belonging to two. different clusters (the system will output an error message and sound a beep asking the user to move the finger a little closer to the center of the cluster). It can also occur when one purposely tests the system by pressing keys from clusters that are not adjacent (this will merely elicit a beep and optional error message). Once the finger is operating within a cluster, the finger perhaps overlaps a little over let us say 3 keys . . . . The intended secondary key (let us say the alphabet B), the corner of the primary key (which is the number 2) and a portion of the adjacent secondary key (say the letter A) . . . under these circumstances, the pressure sensor that is distributed over the entire "keycap" areas of both the secondary keys and the primary key will generate a logical YES for these keys. However, the more sensitive pressure sensor located in the middle (lower threshold) will in most instances have an output only in the intended secondary key of B. This output in reality has two components, an analog level (or its digitized equivalent) representing the amount of or relative amount of pressure (this is likely to be the highest in the intended secondary key since presumably the finger tip is acting on it. For further reliability, a rate input will also be generated in identical fashion. When uniqueness is established the logical outputs from the other two keys are precluded from proceeding further. A simple implementation would accomplish this inside the box with conventional electronics. It is also possible to implement this in solid state or monolithic way by opening the conductive pathway from the non intended keys thus making it mutually exclusive. It is noted that a second pressure sensor, i.e., the generalized pressure sensor also needs to be there for another case, i.e. when one attempts to provide a very clean input by using a pen tip or stylus as is done on Palmtops these days. Of course they are doing it because the current art is deficient in that it provides no choice of finger actuation because the keycaps are based on the emulation of QWERTY type keys which are tiny.

However, the pressure sensing area is mostly in a restricted smaller area around the center. The centers of the adjacent keys are located far enough apart that they result in one or more different levels of pressure generated by a pressing finger. The key associated with the higher level is selected as representing the fingertip which better represents the intended key. In the embodiment with the solar cell, the pressing of a key generates both an analog signal representing the amount of shadowing of a key cap by a operating finger and a digital/logical output which are used in preprocessing singly or in combination with the outputs from the pressure sensor. One approach involves picking for comparison of the shadowing levels only those keys whose pressure sensors have generated a logical YES and simultaneously picking for comparison of the pressure levels only those keys whose shadowing has generated a logical YES. In this scheme of preprocessing, at any stage upon identifying a reliable output such as by the use of a logical AND of the pressure and shadow/solar cell sensors further processing is stopped. The early and reliable identification of an input precludes the activation or consideration of another input in this mutually exclusive electronic cluster key arrangement.

It is to be understood that the present invention is not limited to the embodiments described above, but encompasses any and all embodiments within the scope of the following claims.

I claim:

**1**. A cluster key arrangement comprising:

at least one cluster key, said cluster key comprising:

a single primary key;

at least one secondary key, said secondary key being located immediately adjacent to said primary key of said cluster key; and

mutual exclusivity selecting means for selecting said primary key or said secondary key in a mutually exclusive manner;

wherein when both said primary key and said secondary key have met a threshold for actuation close in time to each other, said mutual exclusivity selecting means includes the use of a difference between said primary and said secondary key other than a difference in order of activation of said primary and said secondary key to select between said primary and said secondary key;

each of said primary and secondary keys is individually actuable;

each of said primary key and said secondary key upon actuation move in a direction substantially parallel to the motion of the other of said primary and said secondary key upon actuation;

each of said primary key and said secondary key has an associated electrical contact, activation of each said electrical contact sends a signal which indicates an input from said cluster key arrangement, and said mutual exclusivity selecting means selects between said primary key and said secondary key during preprocessing prior to activation of any one of said electrical contacts.

**2**. A cluster key arrangement according to claim **1**, wherein:

each of said primary and secondary keys is arranged on a planar surface; and

each of said primary and secondary keys upon actuation moves in a direction substantially perpendicular to said planar surface.

**3**. A cluster key arrangement according to claim **1**, wherein each of said primary key and said secondary key has a button profile having an arcuate shape, said arcuate shape being selected from the group consisting of dome shaped, convex, trough, and concave.

**4**. A cluster key arrangement according to claim **1**, wherein said primary key has a top view which is shaped circularly, ellipsoidally, pentagonally, hexagonally, heptagonally, or octagonally.

**5**. A cluster key arrangement according to claim **1**, wherein:

the number of said cluster keys is at least two;

each said primary key has a primary key label, each primary key label including at least one primary key symbol selected from the group consisting of numerals, an asterisk symbol, and a pound sign;

each said secondary key has a secondary key label, each secondary key label including at least one secondary key symbol selected from the group consisting of alphabetic characters and function designations.

**6**. A cluster key arrangement according to claim **1**, wherein each said cluster key is separated by a gap from any other of said cluster keys.

**7**. A cluster key arrangement according to claim **1**, wherein each said primary key and each said secondary key includes a top surface and an opposing underside surface;

each said top surface includes a first portion;

each said underside surface includes a second portion and a third portion;

said third portion of each said key is positioned with respect to the top surface of said key such that if a user applies pressure to the top surface of said key, said key will be activated through said third portion; and

said second portion of each said key is connected through a mutual exclusivity actuator to said second portion of at least one adjacent key of said keys, such that when the user presses one of said keys, said second portion of said pressed one of said keys interacts with said second portion of said adjacent key to preclude said adjacent key from being activated.

**8**. A cluster key arrangement according to claim **1**, wherein said mutual exclusivity selecting means uses differences in pressure to select between said primary key and said secondary key.

**9**. The cluster key arrangement according to claim **1**, wherein said mutual exclusivity selecting means uses differences in shadowing to select between said primary key and said secondary key.

**10**. A cluster key arrangement according to claim **1**, wherein the number of said secondary keys in each of said at least one cluster key is at least four.

**11**. A cluster key arrangement according to claim **1**, wherein said secondary key is smaller in surface area than said primary key.

**12**. A cluster key arrangement according to claim **1**, wherein the number of said secondary keys in each said cluster key is at least two, and said mutual exclusivity selecting means selects between each said secondary key of each said cluster key in a mutually exclusive manner.

**13**. A cluster key arrangement according to claim **1**, wherein:

said primary key includes a single conductive pathway associated with said primary key, said conductive pathway associated with said primary key being normally open;

said secondary key includes a single conductive pathway associated with said secondary key, said conductive pathway associated with said secondary key being normally open; wherein

said conductive pathway associated with said primary key is closed when said primary key is selected, and said conductive pathway associated with said secondary key is closed when said secondary key is selected.

**14**. A cluster key arrangement according to claim **1**, in combination with an electronic device, said electronic device being selected from the group consisting of a telephone, a remote control, a computer, and a personal digital assistant;

wherein the number of cluster keys is twelve;

the functions of said electronic device are controlled by said primary and secondary keys of said cluster keys; and

said combination includes no keys other than said primary and secondary keys of said twelve cluster keys.

**15**. A cluster key arrangement according to claim **1**, in combination with an electronic device, said electronic device being selected from the group consisting of a telephone, a remote control, a computer, and a personal digital assistant; wherein:

said electronic device includes a liquid crystal display;

said cluster key arrangement includes at least two secondary keys; and

at least two of said secondary keys are arrow keys.

**16**. A cluster key arrangement according to claim **1**,

wherein said cluster key arrangement includes at least two secondary keys; and

at least one of said secondary keys is a mode key.

**17**. A cluster key arrangement according to claim **1**, wherein:

the number of cluster keys is at least twelve;

twelve of said at least twelve cluster keys are configured in an arrangement of three columns by four rows;

at least one of said cluster keys includes at least four secondary keys;

each said primary key has at least one primary key label, each primary key label including at least one primary key symbol selected from the group consisting of numerals, an asterisk symbol, and a pound sign;

each said secondary key has at least one secondary key label, each secondary key label including at least one secondary key symbol selected from the group consisting of alphabetic characters and function designations.

**18**. A cluster key arrangement according to claim **17**,

wherein each of said cluster keys includes at least four secondary keys;

at least one of said secondary keys is a mode key; and

said cluster key arrangement emulates a standard keyboard.

**19**. A cluster key arrangement according to claim **17**, wherein said numerals are selected from the group consisting of ten numbers from 0 to 9, and wherein said alphabetic characters are selected from the group consisting of 26 letters from A to Z.

**20**. A cluster key arrangement according to claim **19**, wherein said four rows include a top row, and said primary keys of said three columns of said top row are labelled **1**, **2**, and **3** respectively from left to right.

**21**. A cluster key arrangement according to claim **20**, wherein:

said cluster key of said primary key labelled **2** of said top row includes secondary keys labelled A, B, and C; and

said secondary key labelled A is located at the upper left of said primary key labelled **2** of said top row.

**22**. A cluster key arrangement according to claim **1**, wherein:

said mutual exclusivity selecting means includes a preprocessor, and said preprocessor includes at least one configuration selected from the group consisting of an electronic configuration and an opto-electronic configuration.

**23**. A cluster key arrangement according to claim **22**, wherein said primary key is pentagonally shaped, the number of secondary keys in each cluster key is five, and said five secondary keys are circumferentially distributed about the five sides of said primary key.

**24**. A cluster key arrangement according to claim **22**, further comprising an integrated pressure sensing element.

**25**. A cluster key arrangement according to claim **22**, further comprising a p-i-n junction amorphous silicon solar cell with two conductive transparent coatings.

**26**. A cluster key arrangement according to claim **22**, further comprising a conductive grid.

**27**. A cluster key arrangement according to claim **22**, further comprising a mechanical cluster key configuration.

**28**. A cluster key arrangement according to claim **22**, wherein the preprocessor comprises electronics that use differences in pressure to select one of said primary keys or one of said secondary keys over an adjacent one of said primary and secondary keys.

**29**. A cluster key arrangement according to claim **22**, wherein said mutual exclusivity selecting means includes an embedded smart sensor.

**30**. A cluster key arrangement according to claim **22**, wherein said cluster key arrangement is electronically configured in the form of a touch screen liquid crystal display.

**31**. A cluster key arrangement according to claim **30**, wherein said touch screen liquid crystal display is an active matrix thin film transistor display.

**32**. A cluster key arrangement according to claim **31**, further comprising a layer of i-type semiconductor disposed between a layer of p-type semiconductor and a layer of n-type semiconductor.

**33**. A cluster key arrangement according to claim **32**, further comprising two conductive transparent coatings of tin oxide or indium tin oxide to provide two layers, wherein said layers are capable of being combined in series to provide a trickle charge.

**34**. A cluster key arrangement comprising:

at least one cluster key, said cluster key comprising:

a single primary key;

at least one secondary key, said secondary key being located immediately adjacent to said primary key of said cluster key; and

a mutual exclusivity actuator for selecting said, primary key or said secondary key in a mutually exclusive manner;

wherein each said cluster key includes a support structure supporting said cluster key;

said mutual exclusivity actuator interacts with said support structure of said cluster key, such that a user may mutually, exclusively select between said primary key and said secondary key;

each of said primary and secondary keys is individually actuable;

each of said primary key and said secondary key upon actuation move in a direction substantially parallel to the motion of the other of said primary key and said secondary key upon actuation;

each of said primary key and said secondary key has an electrical contact, activation of each said electrical contact sends a signal which indicates an input from said cluster key arrangement, and said mutual exclusivity actuator selects between said primary key and said secondary key during preprocessing prior to activation of any one of said electrical contacts.

**35**. A cluster keyboard comprising:

at least one cluster key, said cluster key comprising:

a primary key, said primary key having a first support structure that supports the primary key;

at least one secondary key, said secondary key being located immediately adjacent to said primary key of said cluster key, said secondary key having a second support structure that support the secondary key;

a mutual exclusivity actuator, said mutual exclusivity actuator interacting with said first support structure of said primary key and with said second support structure of said secondary keys, such that a user may mutually exclusively select between said primary key and said secondary key;

wherein each of said primary and secondary keys is individually actuable.

**36**. A method of inputting data using a keyboard in which more than one key is located within the width of a fingertip, comprising the steps of:

providing a cluster keyboard comprising a first cluster key and a second cluster key, each said cluster key comprising at least two keys:

one of said keys of each cluster key being a primary key;

at least one of said keys of each cluster key being a secondary key, said secondary keys being located immediately adjacent and circumferentially to said primary key of said cluster key;

receiving input signals from two of said keys, said input signals being received close in time to each other; and

processing said input signals in accordance with a predetermined set of logical rules such that the cluster keyboard recognizes said input signal from only one of said keys;

wherein said set of logical rules includes a plurality of sensory thresholds;

at least one of said sensory thresholds is a threshold for actuation;

wherein when both said primary key and said secondary key have met said threshold for actuation close in time to each other, said set of logical rules includes the use of a difference between said primary and said secondary key other than a difference in order of activation of said primary and said secondary key to select between said primary and said secondary key.

**37**. A method of inputting data according to claim **36**, wherein said set of logical rules uses differences in pressure to select one of said keys.

**38**. A method of inputting data according to claim **36**, wherein said set of logical rules uses differences in shadowing to select one of said keys.

**39**. A method of inputting data using a keyboard in which more than one key is located within the width of a fingertip, comprising the steps of:

providing a cluster keyboard comprising a first cluster key and a second cluster key, each said cluster key comprising at east two keys:

one of said keys of each said cluster key being a single primary key, said primary key having a support structure that supports the primary key;

at least one of said keys of each cluster key being a secondary key, said secondary key being located immediately adjacent and circumferentially to said primary key of said cluster key, said secondary key having a support structure that supports the secondary key;

actuating two of said keys, said two of said keys being actuated close in time to each other, thereby actuating a mutual exclusivity actuator;

said mutual exclusivity actuator interacting with said support structure of said two actuated keys, said mutual exclusivity actuator acting to exclude input from one of said two actuated keys.

* * * * *

# Exhibit B

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(54) **INPUT APPARATUS**

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(73) Assignee: **KYOCERA CORPORATION**, Kyoto (JP)

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*G06F 3/041* (2006.01)

(52) **U.S. Cl.** ..... **345/173**

(57) **ABSTRACT**

An input apparatus has a display unit for displaying an input object, an input unit for receiving a pressure input to the input object, a load detection unit for detecting a pressure load on the input unit, and a control unit for controlling to receive the pressure input if the pressure load detected by the load detection unit satisfies a load standard. The control unit controls such that a load standard for receiving the pressure input to the input object is different from a load standard for receiving a pressure input to another input object adjacent to the input object.

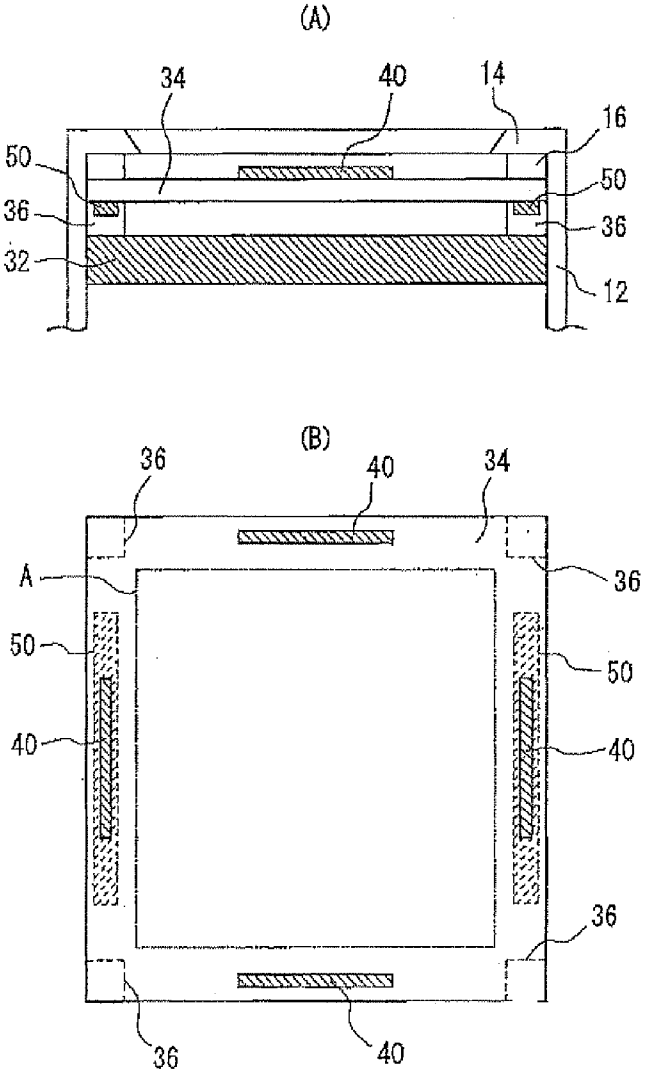


FIG. 1

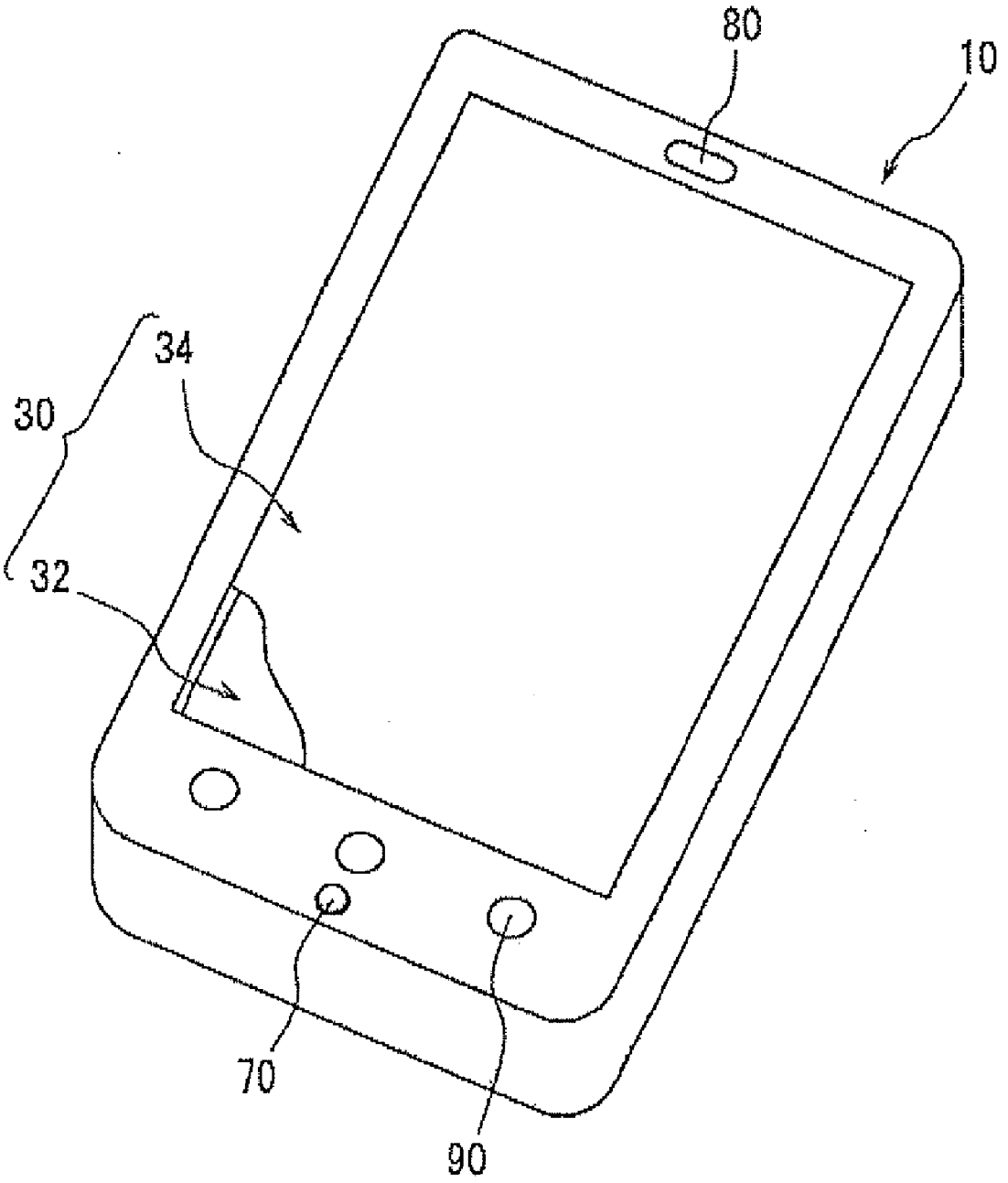


FIG. 2

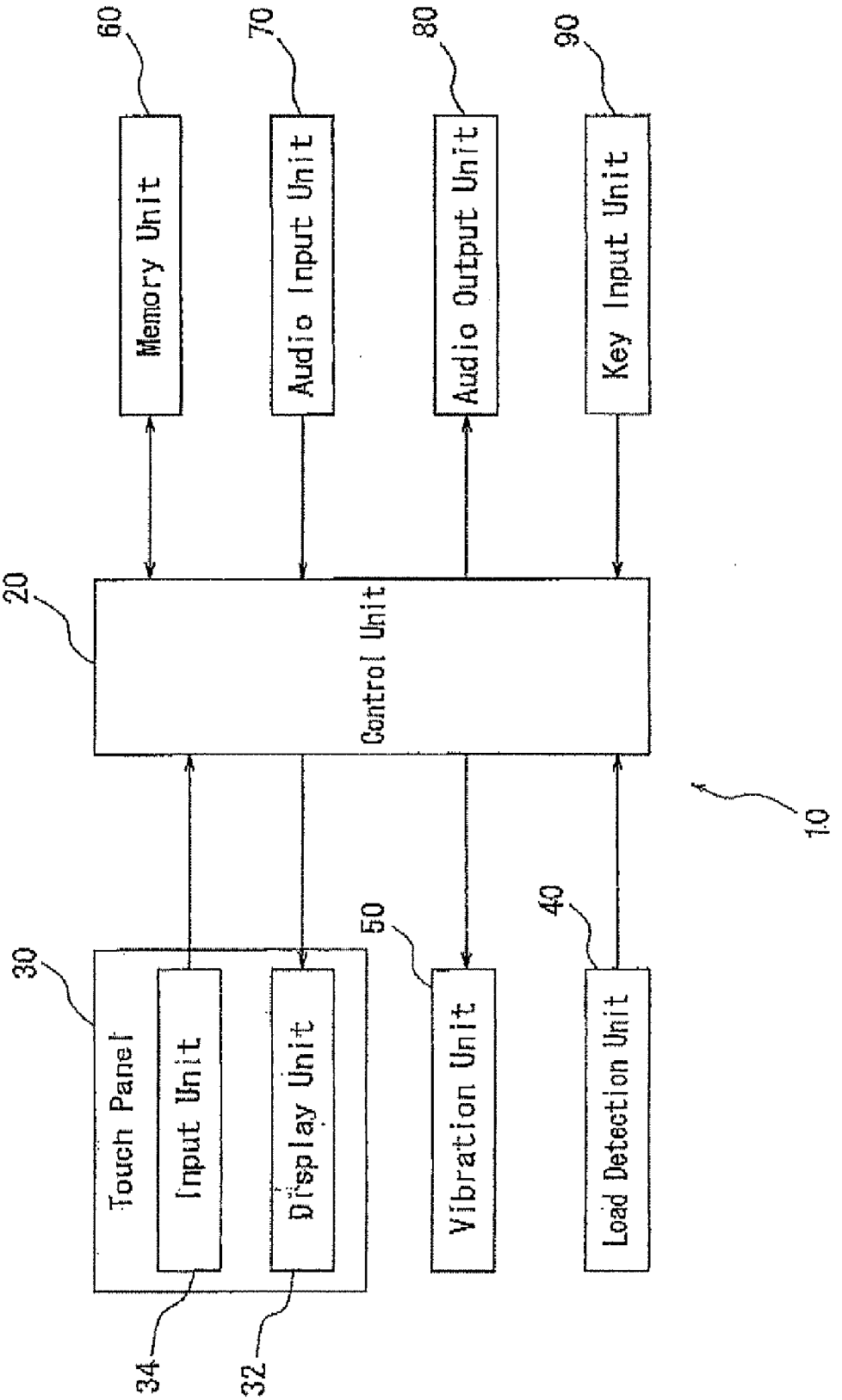

60
Memory Unit
70
Audio Input Unit
80
Audio Output Unit
90
Key Input Unit
20
Control Unit
10
30
Touch Panel
Input Unit
Display Unit
50
Vibration Unit
40
Load Detection Unit
34
32

FIG. 3

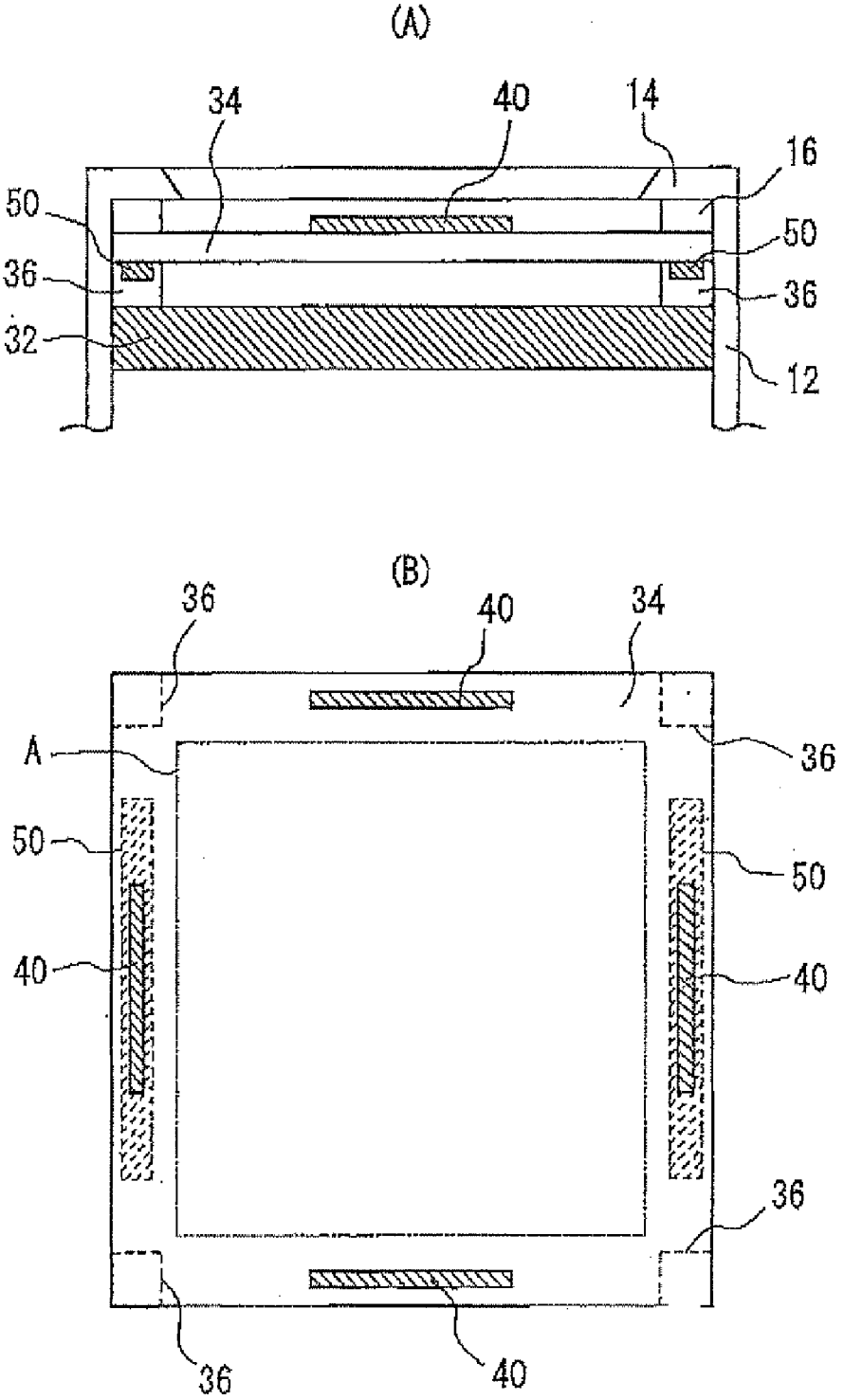


FIG. 4

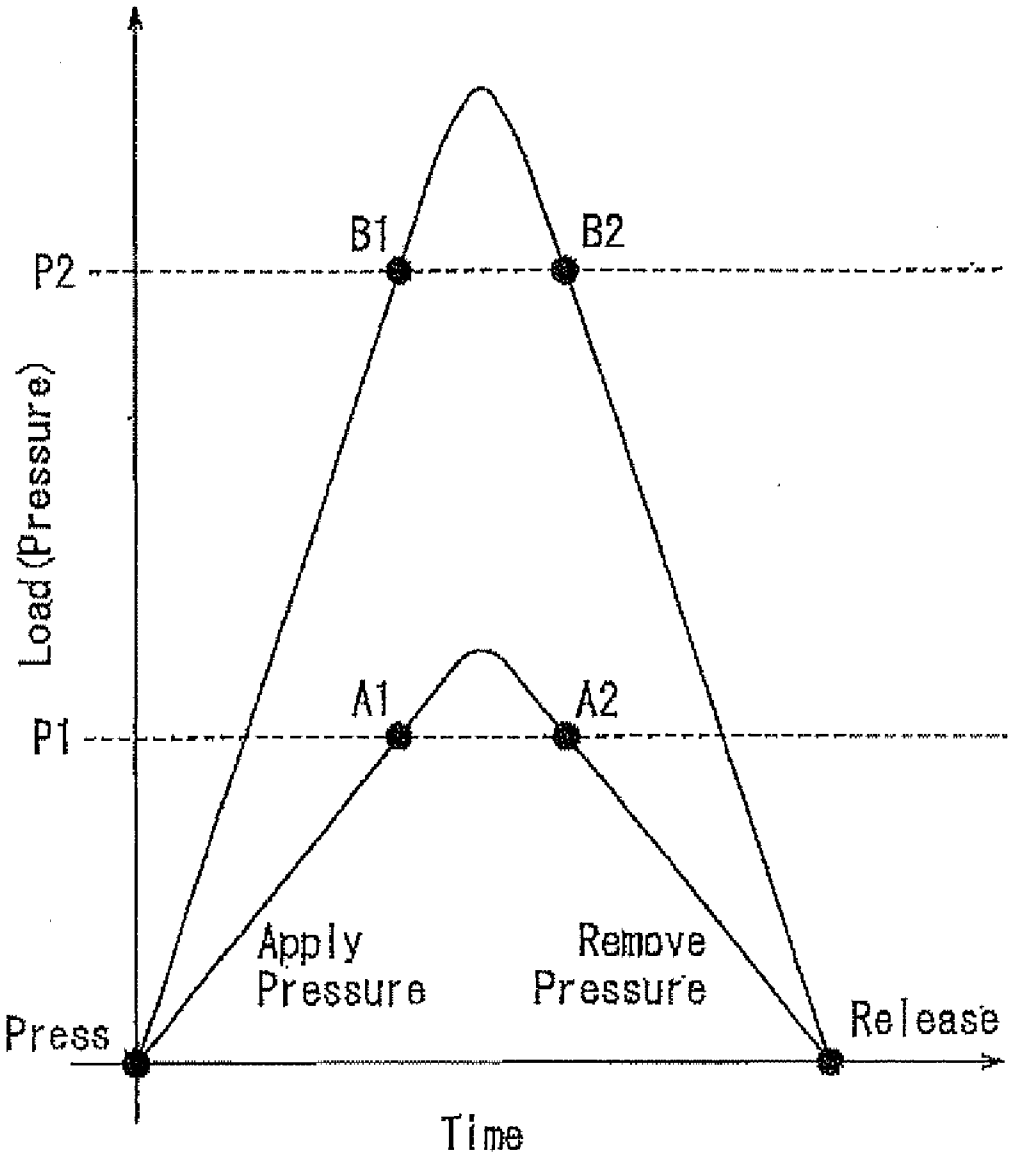

B1
B2
P2
Load (Pressure)
A1
A2
P1
Apply
Pressure
Remove
Pressure
Press
Release
Time

FIG. 5

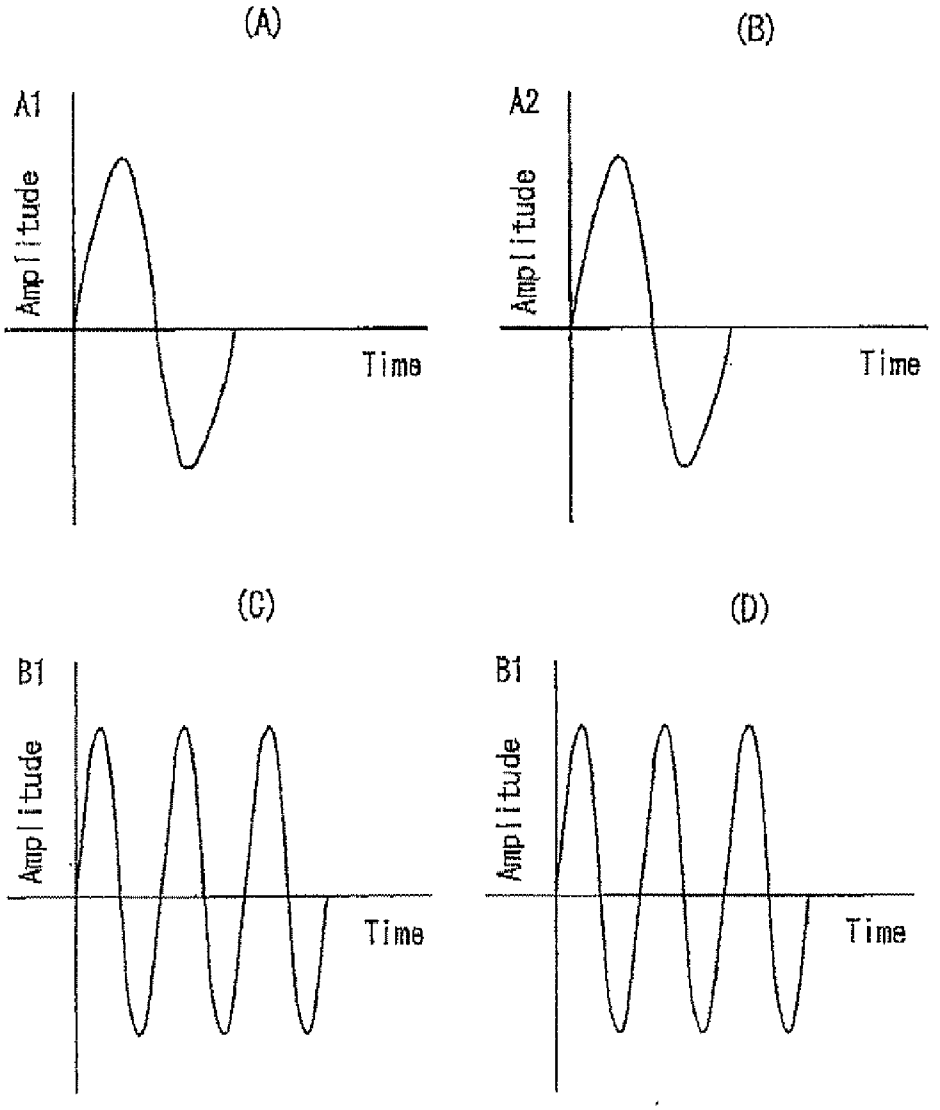

(A)
A1
Amplitude
Time
(B)
A2
Amplitude
Time
(C)
B1
Amplitude
Time
(D)
B1
Amplitude
Time

FIG. 6

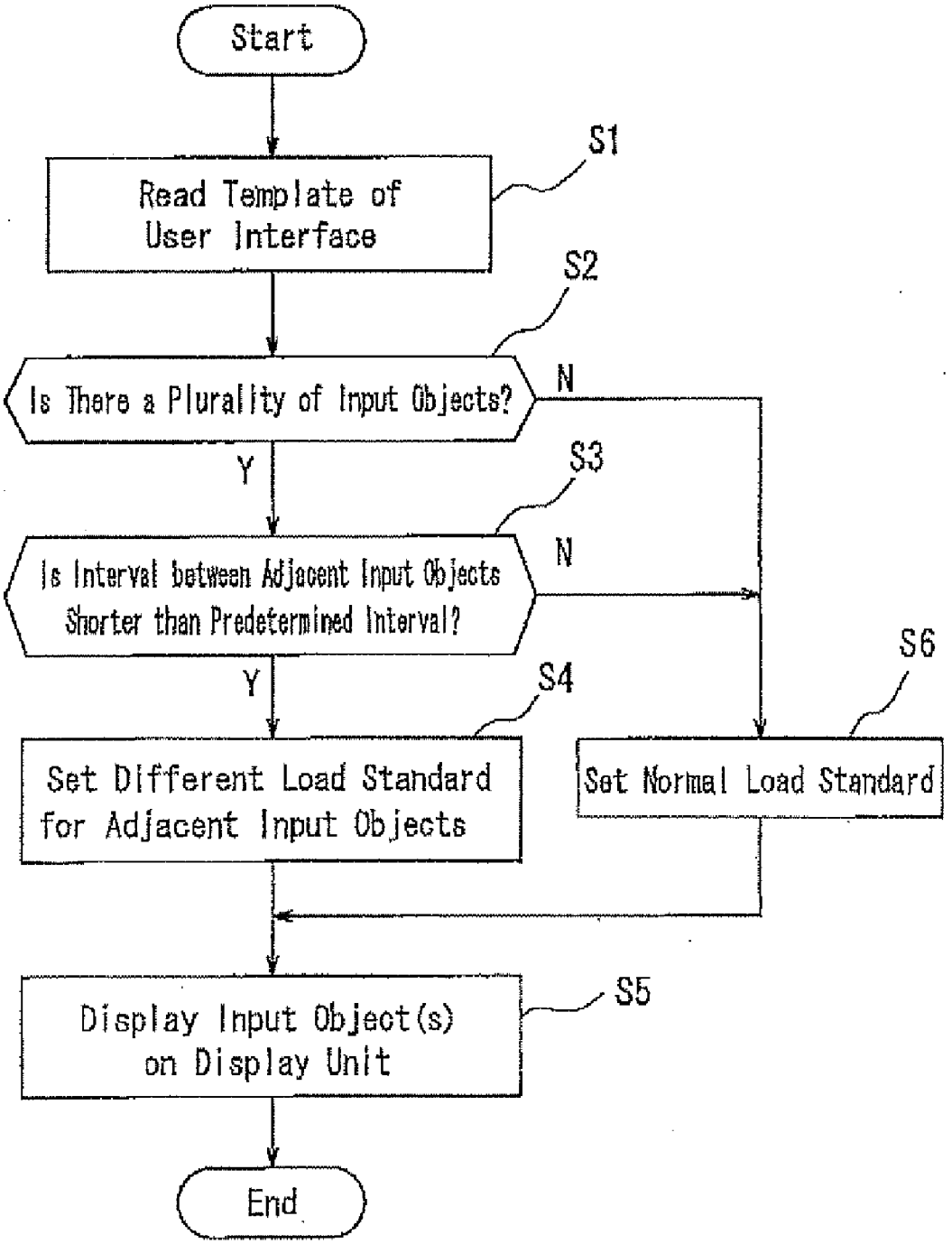
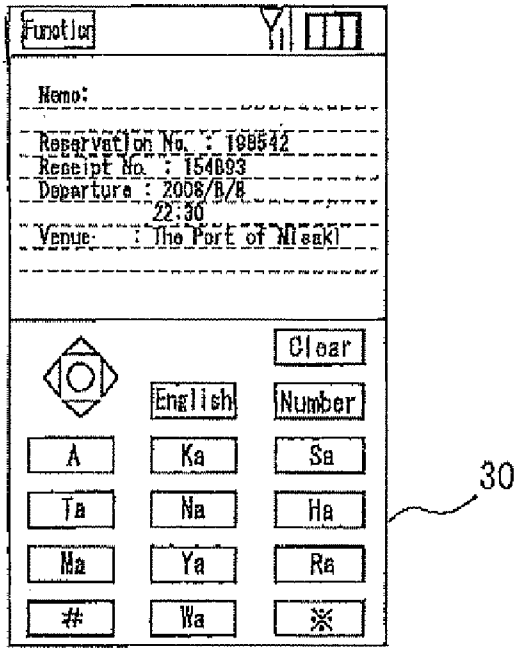

Start
S1
Read Template of User Interface
S2
Is There a Plurality of Input Objects?
N
Y
S3
Is Interval between Adjacent Input Objects Shorter than Predetermined Interval?
N
Y
S4
Set Different Load Standard for Adjacent Input Objects
S6
Set Normal Load Standard
S5
Display Input Object(s) on Display Unit
End

FIG. 7

(A)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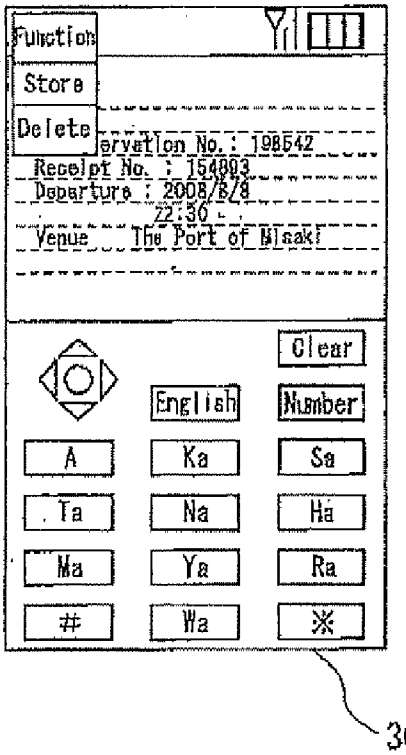
Memo:
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue : The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30

(B)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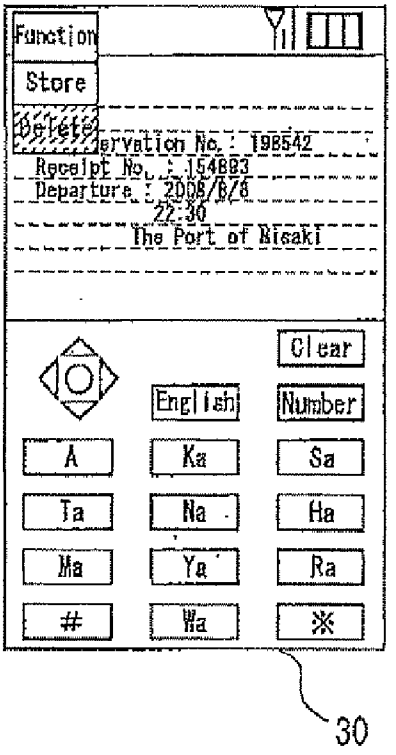
Store
Delete
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30

(C)


Function
Store
Delete
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
The Port of Misaki
Clear
English
Number
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Ka
Sa
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Ha
Ma
Ya
Ra
#
Wa
※
30

FIG. 8

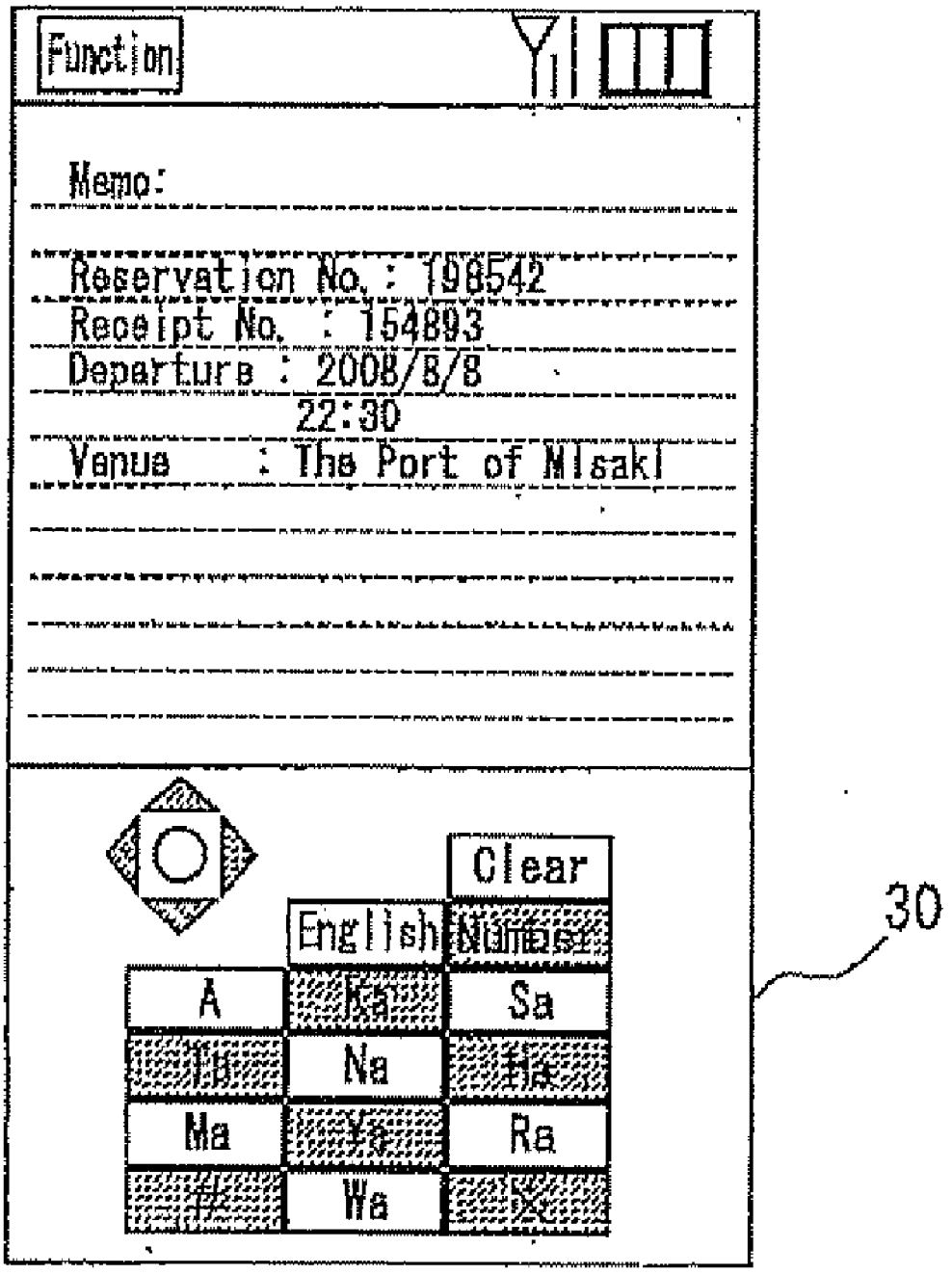

Function
Memo:
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue : The Port of Misaki
Clear
English
A
Ka
Sa
Na
Ha
Ma
Ya
Ra
Wa
30

FIG. 9

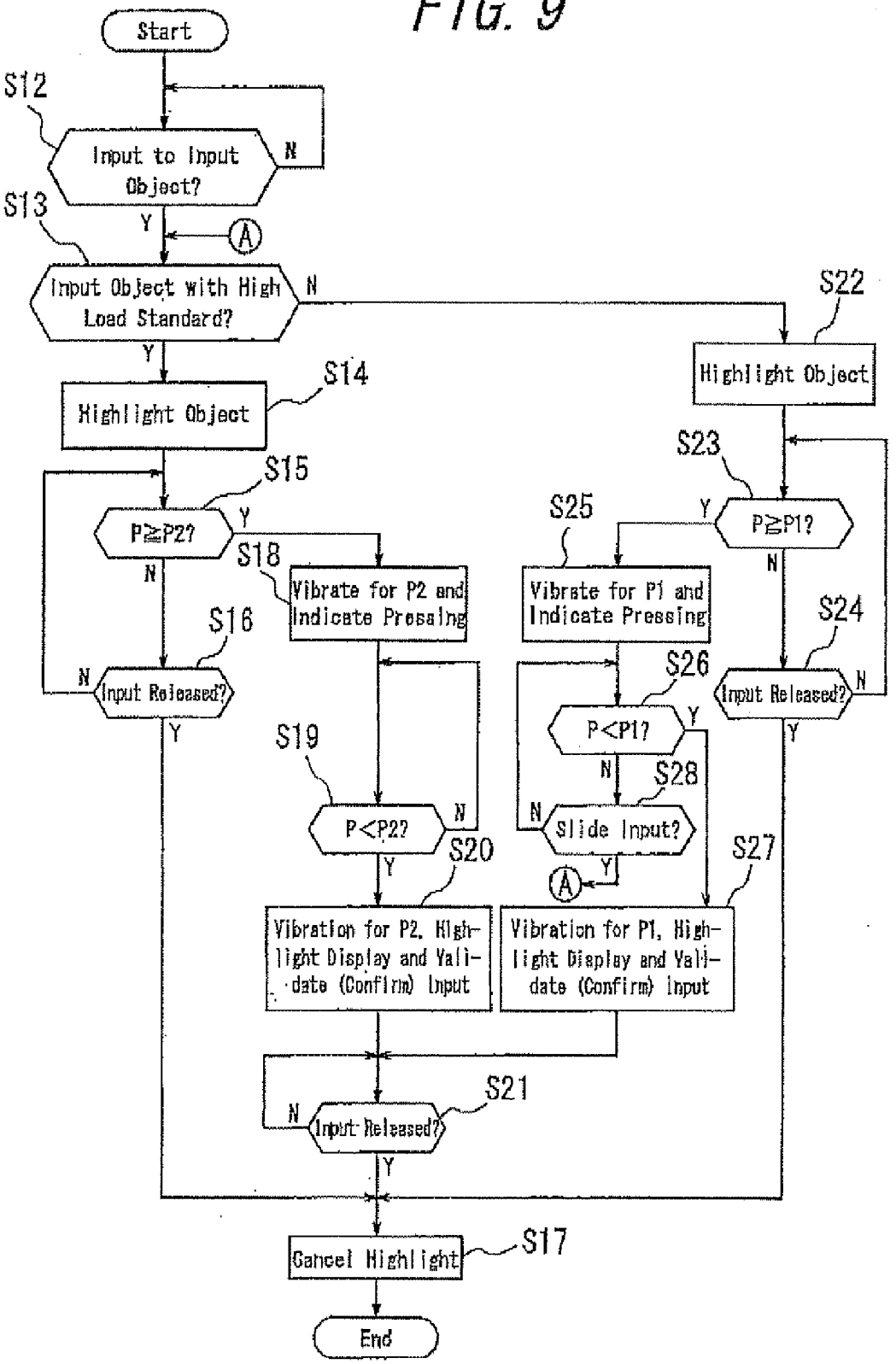

Start
S12
Input to Input Object?
N
Y
S13
A
Input Object with High Load Standard?
N
Y
S14
Highlight Object
S15
P≧P2?
Y
N
S16
Input Released?
N
Y
S18
Vibrate for P2 and Indicate Pressing
S19
P<P2?
N
Y
S20
Vibration for P2, Highlight Display and Validate (Confirm) Input
S22
Highlight Object
S23
P≧P1?
Y
N
S24
Input Released?
N
Y
S25
Vibrate for P1 and Indicate Pressing
S26
P<P1?
Y
N
S28
Slide Input?
N
Y
A
S27
Vibration for P1, Highlight Display and Validate (Confirm) Input
S21
Input Released?
N
Y
S17
Cancel Highlight
End

FIG. 10

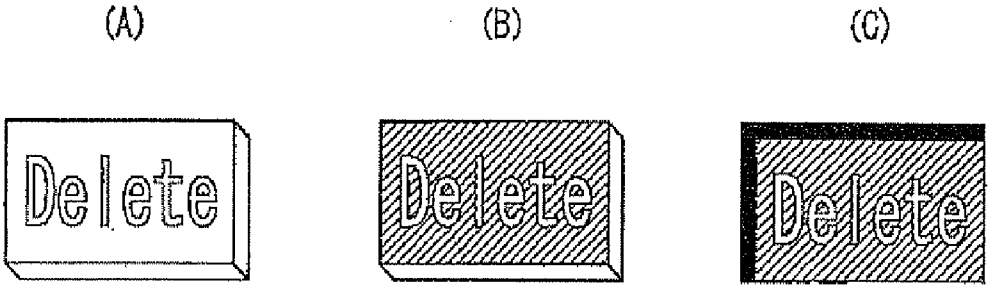
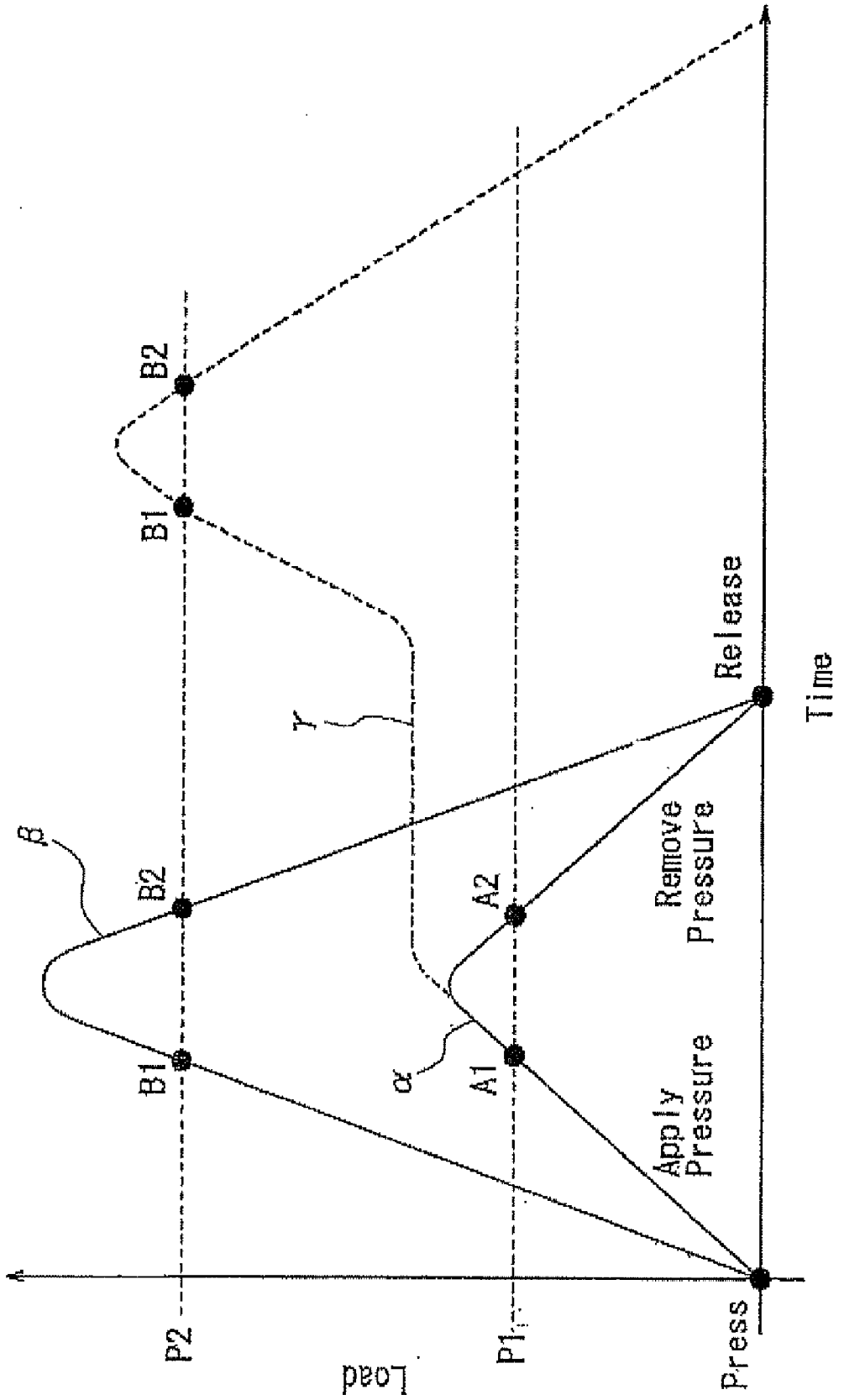


FIG. 11


B2
B1
γ
β
B2
A2
Release
Time
Remove Pressure
α
B1
A1
Apply Pressure
P2
P1
Press
Load

# INPUT APPARATUS

## CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority to and the benefit of Japanese Patent Application No. 2008-331056 filed on Dec. 25, 2008, the entire contents of which are incorporated herein by reference.

## TECHNICAL FIELD

**[0002]** The present invention relates to input apparatuses, and more particularly, to input apparatuses having touch panels.

## BACKGROUND ART

**[0003]** For mobile terminals such as mobile phones, various input apparatuses used by users to operate the terminals have been developed according to functions and usages of each of the terminals. In many cases, an input apparatus has mechanical keys or buttons arranged in advance on a surface of a body such that a user performs an input operation by directly pressing a finger or the like to the keys.

**[0004]** The mechanical keys (for example, a numerical keypad) of the input apparatus of the terminal are normally arranged in advance to suit a main usage of the terminal. Accordingly, it is generally not possible to change a physical arrangement of keys, once defined, later.

**[0005]** Recently, a variety of functions are incorporated in small mobile terminals. For example, the mobile phones have a digital camera function and a music player function. There are mobile terminals such as a mobile phone having numerous supplementary functions incorporated therein in addition to a function for a main usage of the terminal, and PDA (Personal Digital Assistant: mobile information terminal) having, as a single terminal, a plurality of main usages such as schedule management, an address book and the like. If such terminals have keys fixedly arranged, it may inconvenience the user significantly in using particular functions.

**[0006]** In order to resolve such inconvenience, there is disclosed an input apparatus having a touch panel designed such that a transparent input unit is arranged overlapping a front face of a liquid crystal display constituting a display unit (for example, see Patent Document 1). The input apparatus having such a touch panel generally displays graphical images of operation keys and buttons (hereinafter, referred to as "input objects") on a display screen of the touch panel. When the user presses an input object displayed on the display screen, an input unit at a corresponding position on the touch panel receives an input.

**[0007]** A folding mobile phone described in the above Patent Document 1 can display input objects arbitrarily arranged on the display screen of the touch panel to receive input operations by the user, and thus key arrangements can be designed as desired. Accordingly, this mobile phone may provide an excellent operability, as capable of changing the arrangement of the input objects as desired to suit a function when each function of the terminal is switched. For example, when the user uses a digital camera function implemented in the mobile phone, this mobile phone may display input objects constituting an operation unit for a digital camera on the touch panel and receive operation inputs. On the other hand, when the user inputs characters in messages using the mobile phone, the mobile phone may display an input object constituting a keyboard like a personal computer (PC) on the touch panel and receive inputs. As stated above, this mobile phone having the touch panel can optimize a single input apparatus to suit each of a plurality of functions and receive operation inputs.

**[0008]** In addition, since the input apparatus having the touch panel receives an input in the form of a user's direct contact (touch) of a finger or the like to the input object displayed on the display unit, the user can operate it highly intuitively. That is, the user operates the input apparatus by directly touching the input object displayed on the screen with a finger or the like following a guide displayed on the screen of the touch panel. Accordingly, the user can operate the terminal extremely easily through intuitive operations following the guide displayed on the screen, which offers an effect to reduce incorrect operations as a result.

**[0009]** In recent years, the mobile terminal having the touch panel as stated above enables the user not only to make a normal telephone call and to perform operation inputs for creating a message but also to perform operation inputs to view (browse) contents delivered through the internet and websites. In addition, the input apparatuses having the touch panel are commonly used for not only the mobile terminals but also, for example, ATMs (Automatic Teller Machines) of a bank and the like and ticket vending machines at train stations. Moreover, in stores such as fast-food shops, terminal equipment with the input apparatus having the touch panel as above is used by a clerk to process orders from customers. When the touch panel is employed as the input apparatus, the mechanical buttons and keys such as the keyboard are not essential components any more. Accordingly, since only a small area is required to arrange mechanical buttons and the like on the terminal apparatus, it enables downsizing of overall terminal apparatus. Therefore, it offers a broader choice of installation sites of the terminal apparatus in stores and train stations.

**[0010]** In addition, the touch panel employed as the input apparatus eliminates the necessity of separately having a display unit for displaying various information and an input unit for receiving operation inputs by the user as individual function units like a general design of conventional apparatus, and enables to configure the information display unit and the input unit on the same screen. Accordingly, it is possible, for example, to display input object constituting keys of a keyboard on the touch panel to receive an input by the user while displaying a result of the input near the keyboard on the touch panel. Thereby, the user can perform an operation input and confirm the result of the input on the same screen.

**[0011]** As described above, the touch panel provides merits to enable to configure the input unit and the display unit on the same screen and also to enable intuitive operation inputs. For that reason, the number of terminal apparatuses having such input apparatus has been increased more and more.

**[0012]** However, the input apparatus with the touch panel has a specific problem because of its configuration to have the input unit and the display unit on the same screen and to receive the intuitive operation input. That is, although the touch panel can constitute the display unit arranging the input objects as desired, it is difficult for the user to determine a boundary between an input object and another area by a tactile sensation because a surface of the input unit is generally flat. In addition, since the user directly touches the input unit with a finger or a stylus in order to input to the touch panel, the input object is covered at the moment of the pres-

sure input, preventing the user from visually confirming the input object to receive the operation input.

**[0013]** Accordingly, since the user cannot determine, with a feeling on the finger, whether the finger is touching an input object, there is always a possibility to press an unintended position. That is, there is a risk of pressing a position elsewhere than an intended input object by pressing a position slightly off from it or a risk of pressing another input object adjacent to the intended input object. When pressing an input object intended with a finger, a risk of unintended input becomes higher, as the input object is covered with the finger.

**[0014]** In addition, if the unintended input of the user is received by the input apparatus, an operation that the user does not intend may be started in response to the input. In such a case, the user must perform an additional operation to stop (cancel) the unintended operation. Moreover, if an important processing or operation being performed is stopped because of the unintended operation, it may cause an unrecoverable situation. Accordingly, it is desired to reduce a risk that such an unintended operation is started based on the unintended input by the user, as much as possible.

**[0015]** As a scheme capable of handling such a condition, there is suggested an input apparatus having a means to detect an input pressure to the touch panel and is configured to change a height of a surface of the touch panel in accordance with a position and the pressure of the input to the touch panel by the user (for example, see Patent Document 2).

## PRIOR ART DOCUMENTS

### Patent Documents

**[0016]** Patent Document 1: Japanese Patent Laid-Open No. 2006-311224

**[0017]** Patent Document 2: Japanese Patent No. 4039344

## SUMMARY OF INVENTION

### Technical Problem

**[0018]** According to the input apparatus described in the above Patent Document 2, when there is a user's input to an input object displayed on the display unit of the touch panel, it is possible to indicate that the user is touching the input object, by changing the height of the touch panel. That is, when the user touches an input object, this input apparatus indicates that the position touched by the user corresponds to an input object, by lifting the surface of the touch panel higher than a level when the user touches an area elsewhere than an input object. In addition, when recognizing a light touch by the user to a position corresponding to an input object of the touch panel, this input apparatus enlarges an image of the input object to allow for better viewability (for example, see FIG. 7 and FIG. 10 of Patent Document 2). With a variety of measures taken as stated above, the input apparatus described in Patent Document 2 helps the user to input avoiding erroneous operations.

**[0019]** According to this input apparatus, the user can determine, with the feeling on the finger, whether there is an input object at a position of the touch panel that the finger is touching. In addition, as capable of enlarging the image of the input object being touched by the user, this input apparatus can relatively reduce an area covered with the finger touching the input object. Accordingly, this input apparatus can reduce the risk of receiving unintended inputs by the user.

**[0020]** However, there are disadvantages when such a technique is applied to a small mobile terminal such as the mobile phone, for example. That is, a mechanism to change the height of the surface of the touch panel as stated above requires a considerable width wider than the variation width of the surface of the touch panel. This is because that a mechanical drive apparatus to change the height of the touch panel needs to be in a certain size at least and that it is necessary to secure a space to allow for a change in the height of overall touch panel. In recent development of the mobile phone, it is desired to minimize its size as much as possible and thus it is anticipated to present a technical difficulty in mounting such a mechanism for changing the height of the surface of the touch panel in a body of the mobile phone.

**[0021]** In addition, in case of a small mobile terminal such as a mobile phone, unlike large terminals such as the ATMs of a bank and the ticket vending machines at a train station, the touch panel serving also as a display unit is substantially limited in size, and thus the display unit for displaying input objects is small in size inevitably. On the other hand, although being small in size, the mobile terminal needs to display a number of input objects of various types, in order to receive various inputs to the touch panel by the user. Accordingly, it is considered that there is difficulty for the mobile terminal to display an enlarged image of an input object when a user touches the input object.

**[0022]** Moreover, when a number of input objects are displayed on the touch panel limited in size, it is considered that it is difficult to virtually indicate whether the location the user is touching corresponds to an input object, by changing the height of the touch panel as stated above. Especially, if a number of input objects limited in size are arranged at adjacent positions, there is little or no space between them. Therefore, it is considered that it is very difficult to enable the user to recognize an edge portion (a portion corresponding to an edge of a key) of each of the input objects by changing the height of the touch panel. Accordingly, it is considered that, when a number of small input objects are displayed at adjacent positions on the touch panel of the small mobile terminal such as the mobile phone, it is difficult to reduce user's incorrect inputs by applying the above scheme described in the Patent Document 2.

**[0023]** In addition, the small mobile terminal such as the mobile phone has a particular condition not only to display a number of input objects on the touch panel limited in size but also to receive user's inputs while the user is walking or performing another operation. It is desired to provide an input apparatus which, even if the user is not gazing at the input unit, receives inputs to a number of input objects as intended by the user and also helps to avoid incorrect operations by the user.

**[0024]** Accordingly, an object of the present invention in consideration of such conditions is to provide an input apparatus capable of reducing incorrect operations by a user in receiving pressure inputs to a plurality of adjacent input objects on a touch panel mounted on, for example, a mobile phone.

### Solution to Problem

**[0025]** In order to achieve the above object, an input apparatus according to a first aspect of the present invention includes:

**[0026]** a display unit for displaying an input object;

**[0027]** an input unit for receiving a pressure input to the input object displayed on the display unit;

**[0028]** a load detection unit for detecting a pressure load on the input unit; and

**[0029]** a control unit for controlling to receive the pressure input if the pressure load detected by the load detection unit satisfies a load standard, wherein

**[0030]** the control unit controls such that a load standard for receiving a pressure input to the input object is different from a load standard for receiving a pressure input to another input object adjacent to the input object.

**[0031]** A second aspect of the present invention is that the input apparatus according to the first aspect further including a vibration unit for vibrating the input unit, wherein

**[0032]** the control unit controls to drive the vibration unit if the pressure load detected by the load detection unit satisfies the load standard.

**[0033]** A third aspect of the present invention is that, in the input apparatus according to the second aspect,

**[0034]** the control unit controls to drive again the vibration unit if the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

**[0035]** A fourth aspect of the present invention is that, in the input apparatus according to any one of the first to the third aspects,

**[0036]** the control unit controls to confirm the pressure input to the input object being received by the input unit when the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

## BRIEF DESCRIPTION OF DRAWINGS

**[0037]** FIG. **1** is an external perspective view of a mobile phone having an input apparatus according to an embodiment of the present invention;

**[0038]** FIG. **2** is a functional block diagram illustrating an internal configuration of the mobile phone according to the embodiment of the present invention;

**[0039]** FIG. **3** shows diagrams illustrating an exemplary implementation structure of a touch panel, a load detection unit and a vibration unit of the mobile phone shown in FIG. **2**;

**[0040]** FIG. **4** is a graph schematically illustrating an exemplary chronological change in a load (pressure) detected by the load detection unit when a user presses an input unit of the touch panel;

**[0041]** FIG. **5** shows exemplary waveforms of vibrations generated by the vibration unit of the mobile phone according to the present embodiment;

**[0042]** FIG. **6** is a flowchart illustrating input object load standard setting processing according to the present embodiment;

**[0043]** FIG. **7** shows exemplary displays on the display unit based on the input object load standard setting processing according to the present embodiment;

**[0044]** FIG. **8** shows another exemplary display on the display unit based on the input object load standard setting processing according to the present embodiment;

**[0045]** FIG. **9** is a flowchart illustrating pressure input reception processing of an input object according to the present embodiment;

**[0046]** FIG. **10** is a diagram illustrating a highlight display and a press-down display according to the present embodiment; and

**[0047]** FIG. **11** is a graph schematically illustrating an exemplary chronological change in a load (pressure) detected by the load detection unit in the pressure input reception processing of an input object.

## DESCRIPTION OF EMBODIMENTS

**[0048]** Embodiments of the present invention will be described with reference to the accompanying drawings. In the following embodiments, a mobile phone is used as an exemplary mobile terminal with an input apparatus according to the present invention. However, the mobile terminal to which the input apparatus according to the present invention is applicable is not only the mobile phone but also any mobile terminal having a touch panel such as a PDA, for example. In addition, the present invention is applicable not only to the mobile terminal having the touch panel but also to any input terminal having the touch panel such as ATMs of a bank and ticket vending machines at a train station as stated above.

**[0049]** FIG. **1** is an external perspective view illustrating a schematic configuration of a mobile phone **10** having an input apparatus according to an embodiment of the present invention. The mobile phone **10** has a display unit **32**, a part of which is displayed in the figure, on a front face of a terminal body, for displaying a variety of information and graphical images of keys and buttons on a liquid crystal display (LCD), an organic EL display or the like. The mobile phone **10** also has an input unit **34** constituted of a matrix switch or the like for receiving an input by a user with a finger or a stylus at a front face of the display unit **32**. According to the present embodiment, a touch panel **30** includes the display unit **32** and the input unit **34**. The mobile phone **10** further includes an audio input unit **70** constituted of a microphone or the like, an audio output unit **80** constituted of a speaker or the like, and a key input unit **90** constituted of at least one mechanical key.

**[0050]** Although the mobile phone **10** may additionally have a digital camera function unit, a One-seg broadcast tuner, a Near Field Communication unit such as an infrared communication function unit, various interfaces and the like according to necessary functions, figures and detailed descriptions thereof are omitted.

**[0051]** FIG. **2** is a functional block diagram illustrating a schematic internal configuration of the mobile phone **10**. As shown in FIG. **2**, the mobile phone **10** has a control unit **20**, a touch panel **30**, a load detection unit **40**, a vibration unit **50**, a memory unit **60**, the audio input unit **70**, the audio output unit **80** and the key input unit **90**. The control unit **20** controls and manages the entire mobile terminal **10** as well as each functional block of the mobile terminal **10**. As stated above, the touch panel **30** has a structure that the input unit **34** for receiving input from a user is arranged overlapping the front face of the display unit **32**. Thereby, the touch panel **30** receives an operation input by the user as well as displaying a variety of information such as a result of the input according to each application program (hereinafter, abbreviated to an "application").

**[0052]** The input unit **34** of the touch panel **30**, upon detection of an input by a contact (pressure) of a user's finger or a stylus, outputs a signal corresponding to a position where such input is detected. The touch panel **30** is made as a known type such as, for example, resistance film type, capacitance type or the like. The display unit **32** performs display according to each application, as well as displaying a graphical image of user interface, composed of various keys and buttons for receiving operation inputs to the input unit **34** by the

user in a predetermined display area. According to the present embodiment, the images of the various keys and buttons displayed on the display unit **32** for receiving operation inputs to the input unit **34** of the touch panel **30** by the user are referred to as "input objects".

**[0053]** The load detection unit **40** may be a strain gauge sensor, for example, and detects a pressure load on the touch panel **30** (or the input unit **34**). The vibration unit **50** may be, for example, a piezoelectric element or an ultrasonic transducer and vibrates the touch panel **30**. A constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** will be described below.

**[0054]** The memory unit **60** stores various applications and a variety of input information, as well as functioning as a work memory. In addition, the memory unit **60** also stores a plurality of templates including various input objects to be used according to each application.

**[0055]** The audio input unit **70** converts user's voice and the like into input signals and transmits them to the control unit **20**. The audio output unit **80** converts voice signals transmitted from the control unit **20** into voice. The key input unit **90** transmits a signal corresponding to an operation input by the user to the control unit **20**. Usages and functions of the various keys constituting the key input unit **90** are defined according to an application to be used.

**[0056]** The mobile phone **10** further includes various function units necessary for providing functions as a usual mobile phone such as an antenna and a wireless communication unit for transmitting and receiving a variety of information such as voice call and e-mail data to/from a base station via the interne, wireless communication and the like. However, since such function units have no particular distinction from known arts, descriptions thereof are omitted.

**[0057]** Next, the constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** is described.

**[0058]** FIG. **3** is a diagram illustrating an exemplary implementation structure of the touch panel **30**, the load detection unit **40** and the vibration unit **50** of the mobile phone **10** shown in FIG. **2**. FIG. **3**(A) is a cross-sectional view of a main section, whereas FIG. **3**(B) is a plane view of the main section.

**[0059]** The display unit **32** for displaying various input objects on the touch panel **30** is housed in a housing **12**. In the input apparatus according to the present embodiment, the input unit **34** is supported on the display unit **32** via insulators **36** made of elastic members. In the input apparatus according to the present embodiment, the display unit **32** and the input unit **34** are rectangular in a planar view. Although the touch panel **30** is square in FIG. **3**, it may be oblong in accordance with specifications of the mobile terminal mounting the touch panel **30**. In the input apparatus, the input unit **34** is supported on the display unit **32** via the insulators **36** arranged at four corners outside a display area A of the display unit **32** indicated by virtual lines in FIG. **3**(B).

**[0060]** In addition, in the input apparatus, the housing **12** is provided with an upper cover **14** for covering a surface area of the input unit **34** outside the display area of the display unit **32**. Insulators **16** made of elastic members are arranged between the upper cover **14** and the input unit **34**.

**[0061]** The input unit **34** has a surface, that is, a face for receiving input operations, formed of a transparent film, and a rear face formed of a glass. The input unit **34** may be designed such that the transparent film of the surface slightly bends (strains) in proportion to pressure when an operation face is pressed.

**[0062]** In addition, in the input apparatus according to the present embodiment, the strain gauge sensor for detecting the pressure load (pressure) applied on the input unit **34** is provided, adhered or the like, to the transparent film on the surface of the input unit **34** near each side covered by the upper cover **14**. Moreover, in the input apparatus, the piezoelectric element or the ultrasound transducer for vibrating the input unit **34** is provided, adhered or the like, to the face of the glass on the rear side of the input unit **34** near each of two opposed sides. That is, in the input apparatus shown in FIG. **3**, the load detection unit **40** and the vibration unit **50** shown in FIG. **2** include four strain gauge sensors and two vibrators, respectively. It is to be noted that the housing **12**, the upper cover **14** and the insulator **16** shown in FIG. **3**(A) are omitted in FIG. **3**(B).

**[0063]** In the input apparatus according to the present embodiment, the control unit **20** monitors an input detected by the input unit **34** and a pressure load detected by the load detection unit **40**. If the pressure input detected by the input unit **34** is an input to an input object displayed on the display unit **32** and the pressure load detected by the load detection unit **40** satisfies a predetermined standard for receiving an input, the control unit **20** receives such an input as a normal input. Hereinafter, this "standard for receiving an input" is referred to as a "load standard", simply. In addition, when the input satisfies the load standard, the control unit **20** controls the vibration unit **50** to generate vibration such that the vibration is given to an object pressing the input unit **34** such as the user's finger or the stylus. The load detection unit **40** detects the load from, for example, an average output value of the four strain gauge sensors. Additionally, the vibration unit **50** drives, for example, two ultrasound transducers in phase. Since the vibration unit **50** generates vibration when the load standard is satisfied, the user can recognize that the pressure input by the user is received appropriately.

**[0064]** Next, the load standard of an input object according to the present embodiment is described. FIG. **4** is a graph schematically illustrating an exemplary chronological change in a pressure load (pressure) detected by the load detection unit **40** when the user performs an operation input by pressing the input unit **34** of the touch panel **30**. Generally, when performing operation to press (pressure input) the input unit **34** of the touch panel **30**, the user continues to increase pressure on the input unit **34** (that is, the user presses the input unit **34** down) from when touching the input unit **34** until determining that the input is received. In addition, upon determining that the input is received, the user reduces the pressure on the input unit **34** (that is, the user releases a finger or the like from the input unit **34**). Accordingly, as represented by a curved line shown in FIG. **4**, the load detected by the load detection unit **40** is first increased upward and then reduced downward with time passing from the left side to the right side.

**[0065]** The following is a description of an initial setting preparing for input object load standard setting processing. In order to perform the input object load standard setting processing according to the present embodiment, a load standard P**1** is set for determining that there is an input to the input unit **34** as a normal operation input to an input object displayed on the display unit **32**. The load standard P**1** is set by the control unit **20** based on a normal pressure at the normal operation

input to the display unit **32** by the user. Based on this setting, if a pressure load exceeding the P**1** (A**1**), as the normal pressure at the normal operation input by the user, is detected by the load detection unit **40**, the control unit **20** determines that the input object displayed on the display unit **32** is pressed. In addition, if the load detection unit **40** detects that the load pressure on the input object being pressed drops under the P**1** (A**2**) (after A**1**), the control unit **20** determines that the operation input to the input object being pressed is completed (confirmed).

**[0066]** The load standard P**1** set as stated above prevents the input apparatus from determining a slight touch to the input unit **34** by the user as an input. Thereby, it is possible to avoid an unintended input by the user.

**[0067]** In addition, the load standard P**1** set as stated above enables the user to perform a repetitive tapping by pressing the same spot (the same input object) on the input unit **34** multiple times continually, without releasing the finger from the input unit **34** each time. That is, even if the user's finger keeps touching the input unit **34**, the user can make the input unit **34** recognize such an input as the repetitive tapping, by adjusting strength of pressure by the finger to increase and decrease across the load standard P**1**. Since this input method needs only small strokes of the user's finger, the user mastering this method may quickly and easily input with a smaller movement of the finger.

**[0068]** Next, according to the present embodiment, the control unit **20** sets a load standard P**2** based on a pressure larger (heavier) than the normal pressure at the normal operation input to the input unit **34** by the user. According to the present embodiment, a pressure exceeding the load standard P**2** set in this manner is received as an input to another input object adjacent to the input object with the load standard P**1** described above. Accordingly, if a pressure load exceeding the load standard P**2** (B**2**) greater than the P**1** on another input object adjacent to the input object with the load standard P**1** is detected by the load detection unit **40**, the control unit **20** determines that this adjacent input object is pressed. In addition, if the load detection unit **40** detects that the load pressure on the adjacent input object being pressed drops under the P**2** (**132**) (after B**1**), the control unit **20** determines that the operation input to the input object being pressed is completed (confirmed). That is, the control unit **20** controls such that the load standard for receiving a pressure input to another input object adjacent to the input object displayed on the display unit **32** is higher than the load standard P**1** for receiving a pressure input to the input object.

**[0069]** Accordingly, even if the user presses another input object adjacent to the input object with the load standard P**1** at a normal pressure (under P**2**) of the normal operation input, the control unit **20** does not receive this pressure input as an input to this adjacent input object. However, only if the user presses the adjacent input object at a pressure exceeding the P**2** greater than the normal pressure (P**1**) at the normal operation input, the control unit **20** receives this pressure input as an input to this input object.

**[0070]** In the above description, the load standards (P**1**, P**2**) are defined as "pressure load thresholds" and used to determined that "the load standard is satisfied" if it is exceeded, for example. Although a determination in this manner is applied to the following descriptions, there may also be other conditions to determine that "the load standard is satisfied". For example, it is possible to determine that the load standard is satisfied if the pressure load of the pressure input to an input object by the user "reaches" the above load standard. In addition, it is also possible to determine that the load standard is satisfied if the pressure load indicating the above load standard is "detected" by the load detection unit **40**.

**[0071]** Next, operations by the vibration unit **50** according to the present embodiment is described. The vibration unit **50** is controlled by the control unit **20** to vibrate the input unit **34**. Since vibration of the input unit **34** is transmitted to the user's finger or the stylus performing an operation input, the user can recognize, by feeling the vibration, that an input to the input unit **34** is appropriately received. In generating vibration, the control unit **20** controls to drive the vibration unit **50** when the pressure load detected by the load detection unit **40** satisfies the load standard.

**[0072]** According to the present embodiment, different vibrations are generated when each of the load standard P**1** and the load standard P**2** is satisfied. That is, for the input object with the load standard P**1**, the control unit **20** generates vibration corresponding to the load standard P**1**. Thereby, the user can recognize that an input with the load standard P**1** to the input object is received appropriately. In addition, for the input object with the load standard P**2**, the control unit **20** generates vibration corresponding to the load standard P**2**, which is different from the vibration for the P**1**. Thereby, the user can recognize that an input with the load standard P**2** to the input object is received appropriately.

**[0073]** For example, upon detection of a pressure load exceeding the P**1** (A**1**) shown in FIG. **4** to the input object with the load standard P**1** by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **5**(A). Then, upon detection of a pressure load equal to or lower than the P**1** (A**2**) shown in FIG. **4** to this input object by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **5**(B). Moreover, upon detection of a pressure load exceeding the P**2** (B**1**) shown in FIG. **4** to the input object with the load standard P**2** by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **5**(C). Then, upon detection of a pressure load equal to or lower than the P**2** (B**2**) shown in FIG. **4** to this input object by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **5**(D).

**[0074]** As shown by exemplary vibrations in FIG. **5**, a short vibration (with a low frequency) is generated for an input object with a low load standard (P**1**), whereas a long vibration (with a high frequency) is generated for an input object with a high load standard (P**2**). Thereby, the user can confirm an input with a weak (low) pressure load and an input with a strong (high) pressure load by feeling weak (short) vibration and strong (long) vibration, respectively.

**[0075]** Next, the input object load standard setting processing according to the present embodiment is described with reference to a flowchart shown in FIG. **6**. The input object load standard setting processing according to the present embodiment starts upon reception, by the control unit **20**, of a request (command) to activate an application to display a user interface composed of input objects on the display unit **32** of the touch panel **30**. First, upon reception of the command to activate the application to display the user interface, the control unit **20** reads a template corresponding to the request among templates of various user interfaces stored in the memory unit **60** (step S**1**).

**[0076]** After reading the template of the user interface, the control unit **20** determines whether there is a plurality of input objects included in the template (step S**2**). If there is a plurality of input objects included in the template, the control unit **20** next determines whether the specification needs to arrange adjacent input objects at intervals shorter than a predetermined interval (step S**3**). The predetermined interval will be described below. If there is a plurality of input objects included in the template and the adjacent input objects arranged at intervals shorter than the predetermined interval, the control unit **20** sets a load standard of each of the input objects (step S**4**) such that load standards (P**1** and P**2**) for receiving pressure inputs to these input objects are different from each other.

**[0077]** Upon completion of setting the load standard of each of the input objects at step S**4**, the control unit **20** displays these input objects on the display unit **32** to receive an input by the user (step S**5**). If the number of input objects is not more than 1 at step S**2**, that is, there is only one input object, the normal load standard (P**1**) is set for this input object (step S**6**), and then the processing shifts to step S**5**. Also, if a plurality of input objects is arranged at intervals wider than the predetermined interval at step S**3**, the normal load standard (P**1**) is set for all of these input objects (step S**6**), and then the processing shifts to step S**5**.

**[0078]** Thereby, if a plurality of input objects is arranged at adjacent positions, different load standards for receiving pressure inputs are set to the input objects, respectively. The predetermined interval stated above is an interval at which, if the input objects are arranged at intervals narrower than that, it is highly possible for the user to press an input object other than an intended input object by mistake. Here, the predetermined interval may be a distance from an end of one input object to an end of another input object or a distance from a center of one input object to a center of another input object. The following is a detailed description of a result of the above processing with reference to a typical embodiment.

**[0079]** The following is a description of a case in which a user memo writing application is activated as shown in FIG. **7**(A), for example. This application displays character input objects in an approximately lower half portion of the display unit **32** of the touch panel **30** in order to receive user's inputs to the input unit **34**. This user memo writing application displays the character input objects arranged at the predetermined intervals or wider. In this example, accordingly, there is a less probability for the user to press an input object other than an intended input object by mistake, the control unit **20** sets the normal load standard (P**1**) for each of these input objects. It is to be noted that, since it is a conventional art known as a "multi-tap input method" to input each character using a numerical keypad associated with kana characters by transiting kana characters corresponding to each key according to the number of input times of the key in order of "Hiragana", a description thereof is omitted.

**[0080]** When the user stores a memo in the memory unit (memory) **60** after completing inputs of the characters as shown in FIG. **7**(A), the control unit **20**, in response to a pressure input to the input object "Function" displayed in the upper left portion of the display unit **32** of the touch panel **20**, displays a so-called pull-down menu as shown in FIG. **7**(B). The pull-down menu of a "Function" includes input objects "Store" and "Delete". If these two input objects are arranged at an interval narrower than the predetermined interval (for example, adjacent to each other), different load standards for receiving pressure inputs are set for the input objects "Store" and "Delete" by the load standard setting processing stated above. If one of the adjacent input objects is related to an unrecoverable (important) operation such as the input object "Delete" in this case, the load standard P**2**, 3N (Newton), for example, is set for this input object. Additionally, the load standard P**1**, 1N, for example, is set for the input object such as the input object "Store" adjacent to the input object with the load standard P**2**.

**[0081]** As stated above, it is possible, by setting different load standards for the input objects, to prevent a disadvantage caused if the user presses the input object "Delete" by mistake in spite of an intention to press the input object "Store". That is, even if there is an input with a normal pressure (under P**2**) at a normal operation input to the input object "Delete", the input apparatus according to the present embodiment does not receive this as an input. In order to input to the input object "Delete", it is necessary for the user to purposely perform an operation input with a pressure load exceeding the load standard (P**2**) greater than the normal pressure (P**1**) at the normal operation input.

**[0082]** In addition, even if the touch panel **30** has a function to simultaneously receive inputs to a plurality of input objects, the same processing as stated above may be performed. That is, for example, it may happen that the user, intending to press the input object "Store", presses both of the input objects "Store" and "Delete" simultaneously by mistake (or because a contact area of the finger pressing the input unit **34** protrudes from the input object "Store"). In this case also, the input to the input object "Delete" at a normal (under P**2**) pressure of a normal operation input is not received. A method to handle a case, opposite to the case stated above, that the user presses the input object "Store" by mistake in spite of an intention to press the input object "Delete" will be described below.

**[0083]** According to the present embodiment as stated above, a load greater (exceeding the P**2**) than the pressure load based on the normal operation input is set for an input object adjacent to the input object for receiving an input by a normal pressure based on the normal operation input (exceeding the P**1**). An input by a pressure load greater (heavier) than that of the normal operation input differs from various inputs (for example, holding down and double pressing such as double click) regarded as normal input methods. Accordingly, since the various inputs, regarded as the normal input methods, to the input object with the load standard P**2** is not received, an incorrect input unintended by the user is not received as a valid input. That is, an input by an unintended operation by the user is avoided.

**[0084]** If input objects are arranged at adjacent positions in the processing according to the present embodiment, it is preferred to indicate, for the user, that the input object with the load standard P**2** needs to be pressed at a pressure heavier than that of the normal operation input. As the input object of "Delete" key shown in FIG. **7**(C), for example, the input object to which a user needs to input with a strong pressure, is displayed in a different color from other input objects on the display unit **32**. Thereby, it is possible to emphasize that the input object in the different color is the input object with the load standard P**2**. In addition, it is also possible to display such an input object, together with a note such as "Touch 'Delete' key strongly", for example, at a predetermined position on the display unit **32**.

**[0085]** Now, another embodiment is described. On a display panel of the user memo writing application shown in FIG. **8**, although an arrangement of the character input objects displayed on the display unit **32** of the touch panel **30** is similar to that shown in FIG. **7**, it is provided with a larger area to display a result (memo) of user's inputs. Accordingly, an area to arrange the character input objects for receiving pressure inputs by the user is relatively small. In this case, as shown in FIG. **8**, each of the input objects is reduced in size and the intervals between the input objects are narrowed. If the intervals between the input objects are narrower than a predetermined interval, the control unit **20**, based on the input object load standard setting processing according to the present embodiment, sets different load standards to the adjacent input objects at intervals shorter than the predetermined interval.

**[0086]** In the load standard setting processing according to the present embodiment, the input objects with different load standards are arranged alternately, as shown in FIG. **8**, for example. In an example shown in FIG. **8**, in order to indicate that the adjacent input objects have different load standards, the input objects to which a user needs to input with a stronger pressure are displayed in different colors. That is, it is indicated in FIG. **8** that the load standard (P**2**) greater than the load standard (P**1**) at the normal input operation is set for the input objects in a dark color (hatched with broken lines). It is also indicated that the normal load standard (P**1**) is set for the input objects in a normal (white) color, in contrast.

**[0087]** As a result of setting of the load standards as stated above, the input object, for which the load standard (P**2**) greater than the normal load standard (P**1**) is set, is arranged adjacent to the input object, for which the normal load standard (P**1**) is set, on the input unit **34** of the touch panel **30**. That is, the input objects for which the normal load standard (P**1**) is set and the input objects for which the load standard (P**2**) greater than the normal load standard (P**1**) is set are arranged alternately. Hence, it is possible for the user to input to the input objects distinctively even if multiple input objects are closely arranged at adjacent positions.

**[0088]** Next, pressure input reception processing of an input object carried out after arranging input objects by the input object load standard setting processing described with reference to FIG. **6** is described with reference to a flowchart shown in FIG. **9**. This processing starts at a point of receiving an input to the input unit **34** by the user after activating the user memo writing application or the like and displaying the adjacent input objects on the display unit **32** by the processing described with reference to FIG. **6**.

**[0089]** Upon start of the pressure input reception processing of an input object according to the present embodiment, the control unit **20** determines whether an input by the user's finger, the stylus or the like (hereinafter, abbreviated as a "user's input") to the input unit **34** corresponding to an input object on the touch panel **30** is detected (step S**12**).

**[0090]** If the user's input to the input unit **34** corresponding to the input object is detected at step S**12**, the control unit **20** determines whether a position on the display unit **32** where the input is detected corresponds to the input object for which the load standard (P**2**) greater (higher) than the normal load standard (P**1**) is set (step S**13**). If the input position corresponds to the input object with the load standard (P**2**) greater than the normal load standard (P**1**) (Yes of step S**13**), the control unit **20** highlights this input object (step S**14**).

**[0091]** The highlight display at step S**14** is an emphasizing display to inform the user that a finger or the like touches the input object. For example, when a user's input to the input object "Delete" key as shown in FIG. **10**(A) is detected, the control unit **20** highlights the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the input by the finger or the like touching the input unit **34** is appropriately detected by the input apparatus. The highlight display indicates simply that the user's finger or the like is touching the input unit **34** and, accordingly, at this point it is not yet determined that the input is received (that is, the key is pressed).

**[0092]** Next, the control unit **20** determines whether the pressure load P detected by the load detection unit **40** exceeds the load standard P**2** (step S**15**). For the input object with the load standard P**2**, the control unit **20** does not carry out the processing for when an input is received unless there is an input with a pressure load exceeding the load standard P**2**. Accordingly, if the pressure load P exceeding the load standard P**2** is not detected by the load detection unit **40** at step S**15**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**16**).

**[0093]** If it is determined at step S**16** that the input is not released (that is the user's finger or the like is not released from the input unit **34**), the control unit **20** returns to step S**15** to monitor the pressure load P detected by the load detection unit **40**. If it is determined at step S**16** that the user's input to the input unit **34** is released, it is regarded that there is no input to the input object touched by the user and the control unit **20** cancels the highlight display (step S**17**) and ends the processing.

**[0094]** Cancellation of the highlight display at step S**17** is a display to inform the user that the input by the user's finger or the like to the input unit **34** at a position corresponding to the input object is no longer detected. For example, the control unit **20** changes the highlight display of the input object on the display unit **32** based on a detection of a user's input back to a display state as shown in FIG. **10**(A). Thereby, the user can visually recognize that the input apparatus appropriately recognizes that the user's finger or the like, which was touching the input unit **34**, is released from the input unit **34**.

**[0095]** In contrast, if the pressure load P exceeding the load standard P**2** (B**1** shown in FIG. **4**) is detected by the load detection unit **40** at step S**15**, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user that the pressure load P exceeds the load standard P**2** (step S**18**). In this case, the control unit **20** controls the vibration unit **50** to generate vibration in the waveform (longer vibration corresponding to a strong input) as shown in FIG. **5**(C). Thereby, the user can recognize that the pressure input P exceeds the load standard P**2**.

**[0096]** In addition, at step S**18**, the control unit **20** changes the display of the display unit **32** in order to indicate that the input object to which the input is detected is pressed. That is, the control unit **20** changes the highlight display of the input object as shown in FIG. **10**(B) to the display indicating that the input object is pressed as shown in FIG. **10**(C). Thereby, the user can visually recognize that the pressure input by the user's finger or the like touching the input unit **34** is appropriately received as a pressure input to the input object by the input apparatus.

**[0097]** After step S**18**, the control unit **20** determines whether the pressure of the user's input to the input unit **34** is reduced and the pressure load P detected by the load detection

unit **40** becomes equal to or lower than the load standard P**2** (B**2** shown in FIG. **4**) (step S**19**). If it is determined at step S**19** that the pressure load P becomes equal to or lower than the load standard P**2**, the control unit **20** accepts that the operation input to the input object with the load standard P**2**, currently receiving the input, is confirmed (step S**20**). That is, in the input processing according to the present embodiment, if compared to a mechanical key, reception of an input to the key is confirmed not when the key is pressed but when the key is released.

**[0098]** At step S**20**, in addition, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure load to the input object to which the input is detected becomes equal to or lower than the P**2**. That is, for example, the control unit **20** returns the display indicating that the input object is pressed as shown in FIG. **10**(C) to the highlight display of the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as an input and also that the input apparatus appropriately recognizes that the pressure on the input object is reduced.

**[0099]** At step S**20**, moreover, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user that the operation input to the input object with the load standard P**2** is confirmed. In this case, the control unit **20** controls the vibration unit **50** to generate the vibration in the waveform (longer vibration corresponding to a strong input) as shown in FIG. **5**(D). Thereby, the user can recognize that the operation input to the input object with the load standard P**2** is confirmed.

**[0100]** After step S**20**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**21**). If it is determined at step S**21** that the input is not released (that is, the user has not released the finger or the like from the input unit **34**), the control unit **20** continues to monitor the pressure load P detected by the load detection unit **40**. If it is determined at step S**21** that the user's input to the input unit **34** is released, the control unit **20** shifts to the above step S**17** to cancel the highlight display and ends the processing.

**[0101]** Additionally, a curved line β shown in FIG. **11** represents an exemplary chronological change in the pressure load on the input unit **34** detected by the load detection unit **40** when a series of processing is performed following steps S**15**, S**18**, S**19** and S**20**.

**[0102]** On the other hand, if the input position does not correspond to the input object with the load standard P**2** at step S**13**, the control unit **20** shifts to step S**22** to highlight the input object. Here, the processing shifts from step S**13** to step S**22** if the input object to which a user's input is detected is an input object for which the load standard P**1** is set. In this case, the input object is highlighted in the same manner as the highlight display at step S**14**.

**[0103]** Next, the control unit **20** determines whether the pressure load P detected by the load detection unit **40** exceeds the load standard P**1** (step S**23**). For the input object with the load standard P**1**, the control unit **20**, in the same manner as the normal operation input, performs the processing for when the input is received, if there is an input exceeding the load standard P**1**. Accordingly, if the load pressure P exceeding the load standard P**1** is not detected by the load detection unit **40** at step S**23**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**24**).

**[0104]** If it is determined at step S**24** that the user's input is not released (that is, the user's finger or the like is not released from the input unit **34**), the control unit **20** returns to step S**23** to monitor the pressure load P detected by the load detection unit **40**. If it is determined at step S**24** that the user's input to the input unit **34** is released, the control unit **20** regards that there is no input to the input object touched by the user, cancels the highlight display (step S**17**) and then ends the processing.

**[0105]** In contrast, if the pressure load P exceeding the load standard P**1** (A**1** shown in FIG. **4**) is detected by the load detection unit **40** at step S**23**, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user that the pressure load P exceeds the load standard P**1** (step S**25**). In this case, the control unit **20** controls the vibration unit **50** to generate vibration in the waveform (shorter vibration corresponding to a weak (normal) input) shown in FIG. **5**(A). Thereby, the user can recognize that the pressure load P exceeds the load standard P**1**.

**[0106]** At step S**25**, in addition, the control unit **20** changes the display of the display unit **32** to indicate that the input object to which the input is detected is pressed. That is, the control unit **20** changes the display from the highlight display as shown in FIG. **10**(B) to the display indicating that the input object is pressed as shown in FIG. **10**(C). Thereby, the user can visually recognize that the input apparatus appropriately recognizes that the pressure input by the user's finger or the like touching the input unit **34** is received as a pressure input to the input object.

**[0107]** After step S**25**, the control unit **20** determines whether the pressure of the user's input to the input unit **34** is reduced and the pressure load P detected by the load detection unit **40** becomes equal to or lower than the load standard P**1** (A**2** shown in FIG. **4**) (step S**26**). If it is determined at step S**26** that the pressure load P becomes equal to or lower than the load standard P**1**, the control unit **20** accepts that the operation input to the input object with the load standard P**1** currently receiving the input is confirmed (step S**27**).

**[0108]** At step S**27**, additionally, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure load on the input object to which the input is detected becomes equal to or lower than the P**1**. That is, for example, the control unit **20** returns the display indicating that the input object is pressed as shown in FIG. **10**(C) to the highlight display of the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as an input and also that the input apparatus appropriately recognizes that the pressure on the input object is reduced.

**[0109]** Moreover, at step S**27**, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user that the operation input to the input object with the load standard P**1** is confirmed. In this case, the control unit **20** controls the vibration unit **50** to generate vibration in the waveform (shorter vibration corresponding to a weak (normal) input) as shown in FIG. **5**(B). Thereby, the user can recognize that the operation input to the input object with the load standard P**1** is confirmed.

**[0110]** After step S**27**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**21**). If it is determined at step S**21** that the input is not released (that is, the user's finger or the like is not released from the input unit **34**), the control unit **20** continues to monitor the pressure load P detected by the load detection unit

**40**. If it is determined at step S**21** that the user's input to the input unit **34** is released, the control unit **20** shifts to the above step S**17** to cancel the highlight display and ends the processing.

**[0111]** Additionally, a curved line a shown in FIG. **11** represents an exemplary chronological change in the pressure load to the input unit **34** detected by the load detection unit **40** when a series of processing is performed following steps S**23**, S**25**, S**26** and S**27**.

**[0112]** In contrast, if the pressure load P does not become equal to or less than the load standard P**1** at step S**26**, the control unit **20** determines whether a so-called slide input by which a position of a pressure input detected by the input unit **34** is moved is detected (step S**28**). Here, the slide input is an input performed by the user moving a finger or the like while pressing the finger or the like to the input unit **34** such that an input position is moved from an input object originally pressed to another input object.

**[0113]** If it is determined at step S**28** that the slide input as described above is not detected by the input unit **34**, the control unit **20** returns to step S**26** to continue to monitor the pressure load P detected by the load detection unit **40**. However, if the slide input with a pressure load exceeding the P**1** on the input unit **34** is detected at step S**28**, the control unit **20** shifts to step S**13** to continue the processing. Before shifting from step S**28** to step S**13**, the control unit **20** cancels the press-down display of the input object to which an input is originally detected (before the slide input).

**[0114]** At step S**13** after the slide input (step S**28**), if the input position is moved to an input object with a low load standard (P**1**) by the slide input, the processing follows steps S**22**, S**23** and S**25**. That is, since the input is not received (confirmed) at a point when the pressure load P of the input to the input object with the load standard P**1** exceeds the load standard P**1**, the user may change the input object by the slide input. If the input object is changed by the slide input and the pressure load of the pressure input to the input object with the load standard P**1** becomes equal to or less than the P**1**, the control unit **20** confirms the input to the input object with the load standard P**1** being pressed at this point.

**[0115]** In contrast, at step S**13** after the slide input (step S**28**), if the input position is moved to an input object with a high load standard (P**2**) by the slide input, the control unit **20** shifts to step S**14** to highlight this input object. Here, if the pressure load of the slide input, performed with the pressure load exceeding the load standard P**1**, does not exceed the P**2**, the control unit **20** does not receive the input to the input object with the high load standard (P**2**), to which the input position is moved, as a pressure input. That is, the user can change an original pressure input (P**1**<P<P**2**) detected on the input object with the load standard P**1** to an input to an input object with a different pressure load by the slide input to the input object with the load standard P**2** with keeping the unconfirmed state of the original pressure input.

**[0116]** Accordingly, after the above processing, the control unit **20** determines at step S**15** whether the pressure load P detected by the load detection unit **40** exceeds the load standard P**2**. If the pressure load P exceeding the load standard P**2** is detected by the load detection unit **40** at step S**15**, the control unit **20** regards that the input object is pressed. In addition, if the pressure load P becomes equal to or lower than the load standard P**2** at step S**19**, the control unit **20** accepts that the operation input to the input object currently receiving the input is confirmed.

**[0117]** As stated above, by the processing to receive the slide input at step S**28**, it is possible to handle a case that the user, intending to press an input object with the load standard P**2**, presses an input object with the load standard P**1** by mistake. That is, this processing enables to handle a case that the user, intending to press the input object "Delete" (with the load standard P**2** (high)), presses the input object "Store" (with the load standard P**1** (low)), as shown by an example in FIG. **7**. The following is detailed descriptions of processing and operations carried out in this case.

**[0118]** First, if the user, intending to press the input object with the load standard P**2**, presses the input object with the load standard P**1** by mistake (Yes of step S**23**), the user expects longer vibration corresponding to the load standard P**2**. However, short vibration corresponding to the load standard P**1** is generated actually (step S**25**). Thereby, the user can recognize that the pressure input to the input object with the load standard P**2** is not performed properly but instead the user is touching the input object with the load standard P**1**. However, at this point, the operation input to the input object (with the load standard P**1**) being pressed by the user is not confirmed yet (confirmation processing is carried out at step S**27**).

**[0119]** When recognizing, with the vibration, that the input object with the load standard P**1** is being pressed by mistake, the user can slide the finger or the like pressing the input unit **34** to the input object with the load standard P**2** originally intended, while maintaining the pressure load exceeding the load standard P**1** (step S**28**). When the slide input is performed from the input object with the load standard P**1** to the input object with the load standard P**2** originally intended by the user (step S**13**), the input object with the load standard P**2** as a destination is highlighted (step S**14**). However, the press-down display of the input object is not displayed yet.

**[0120]** Then, when the user inputs with a pressure load exceeding the P**2** (step S**15**), the control unit **20** receives the pressure input to the input object with the load standard P**2** originally intended by the user (step S**18**). This operation by the user is equivalent to an action strongly pressing down the input object after the slide input to the input object originally intended. Then, when the pressure load is reduced by the user or when the finger or the like is released from the input unit **34** (step S**19**), the control unit **20** confirms the pressure input to the input object with the load standard P**2** originally intended by the user (step S**20**).

**[0121]** A curved line γ shown in FIG. **11** represents an exemplary chronological change in the pressure load to the input unit **34** detected by the load detection unit **40** when a series of processing including before and after the slide input is performed. On the curved line γ, A**1** represents a point when the user, intending to press the input object with the load standard P**2**, presses the input object with the load standard P**1** by mistake, and a corresponding operation thereto is step S**13** to step S**22**. A flat portion between the A**1** to B**1** is a period in which the user, after realizing this incorrect input at A**1** by receiving vibration different from expected, performs the slide input (step S**28**). The B**1** represents a point when the user strongly presses down the input object originally intended after the slide input to the input object, and a corresponding operation thereto is step S**15** to step S**18**. Then, the change in the pressure load passes B**2** at which the user starts releasing the finger from the input unit **34** while reducing the pressure and a corresponding operation thereto is step S**19** to step S**20**.

**[0122]** As stated above, by the pressure input reception processing of an input object according to the present embodiment, it is possible to handle the case that the user presses the input object with the load standard P**1** ("Store" in FIG. **8**, for example) by mistake, in spite of an intention to press the input object with the load standard P**2** ("Delete" in FIG. **8**, for example).

**[0123]** It is to be understood that the present invention is not limited to the embodiments set forth above but may be modified or varied in a multiple manner. For example, although it is assumed in the above embodiments to preset the load standards P**1**, P**2** of the input objects and the predetermined interval, it is desired that the user can change or adjust them as necessary. Thereby, it is possible to appropriately adjust them later if the user feels uncomfortable with them during an operation.

**[0124]** In addition, the vibration unit **50** is vibrated when the pressure load of the user's input exceeds the P**1** or the P**2** in the above embodiments, in order to inform the user accordingly. However, the vibrations generated by the vibration unit **50** are not limited to those in the waveforms shown in FIG. **5** but may be in any waveforms as long as it is discriminated whether the pressure load by the user exceeds the P**1** or the P**2**. In addition, it is not essential to generate vibration in such a case but it is possible to generate a specific sound from the audio output unit **80**. Moreover, it is also possible to indicate that the pressure load of the user's input exceeds the P**1** or the P**2**, by altering the color or a display state of the input object receiving an input on the display unit **32**.

**[0125]** Additionally, in the above embodiment, if the input objects are arranged at intervals narrower than the predetermined interval, the load standards set to the input objects are different from one another in order to prevent an incorrect operation by the user. However, if each input object has a wide input reception area, there is a less probability for the user to perform an incorrect input, even if the adjacent input objects are arranged without any interval. Therefore, in such a case, if the input reception area of each of the input objects is larger than a predetermined size, it is not necessary to set different load standards for them. In addition, based on the fact that there is a less probability for the user to perform an incorrect input if the input reception area of each of the input objects is large, it is possible to change the predetermined interval, which is a standard for a determination whether to set different load standards, in accordance with the size of the input reception area of the input object. That is, in a case that the predetermined interval is set to 1 cm, the same load standard may be set if the input reception areas of the input objects are large (that is, if the input objects are large) and also the intervals between the input objects are wider than 0.1 cm, for example, whereas the different load standards may be set if the input reception areas are small and also the intervals are narrower than 2 cm, for example.

**[0126]** Although cases using two load standards P**1** and P**2** are described as the simplest example in the above embodiments, it is possible to use three or more load standards.

## INDUSTRIAL APPLICABILITY

**[0127]** According to the input apparatus of the present invention, the pressure load on the input unit of the touch panel is detected and a load standard for receiving a pressure input to an input object is different from a load standard for receiving a pressure input to another input object adjacent to the input object. Thereby, even if multiple input objects are displayed at adjacent positions on the input unit of a small touch panel, it is possible for the user to distinctly input to each of the input objects.

## REFERENCE SIGNS LIST

**[0128]** **10** mobile phone
**[0129]** **20** control unit
**[0130]** **30** touch panel
**[0131]** **32** display unit
**[0132]** **34** input unit
**[0133]** **40** load detection unit
**[0134]** **50** vibration unit
**[0135]** **60** memory unit
**[0136]** **70** audio input unit
**[0137]** **80** audio output unit
**[0138]** **90** key input unit

**1**. An input apparatus comprising:
a display unit for displaying an input object;
an input unit for receiving a pressure input to the input object displayed on the display unit;
a load detection unit for detecting a pressure load on the input unit; and
a control unit for controlling to receive the pressure input if the pressure load detected by the load detection unit satisfies a load standard, wherein
the control unit controls such that a load standard for receiving a pressure input to the input object is different from a load standard for receiving a pressure input to another input object adjacent to the input object.

**2**. The input apparatus according to claim **1**, further comprising a vibration unit for vibrating the input unit, wherein
the control unit controls to drive the vibration unit if the pressure load detected by the load detection unit satisfies the load standard.

**3**. The input apparatus according to claim **2**, wherein the control unit controls to drive again the vibration unit if the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

**4**. The input apparatus according to claim **1** wherein the control unit controls to confirm the pressure input to the input object being received by the input unit when the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

**5**. The input apparatus according to claim **2**, wherein the control unit controls to confirm the pressure input to the input object being received by the input unit when the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

**6**. The input apparatus according to claim **3**, wherein the control unit controls to confirm the pressure input to the input object being received by the input unit when the pressure load detected by the load detection unit does not satisfy the load standard after the pressure load detected by the load detection unit satisfies the load standard.

* * * * *

# Exhibit C

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(54) **INPUT APPARATUS**

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(86) PCT No.: **PCT/JP2009/007315**

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(52) **U.S. Cl.** ..... **345/173**

(57) **ABSTRACT**

An input apparatus has a display unit for displaying an input object, an input unit for receiving a pressure input to the input object, a load detection unit for detecting a pressure load on the input unit, and a control unit for controlling to receive the pressure input when the pressure load detected by the load detection unit satisfies a load standard. The control unit controls such that the load standard for receiving the pressure input to the input object displayed in an interrupting manner is higher than the load standard for receiving the pressure input to the input object which has been displayed.

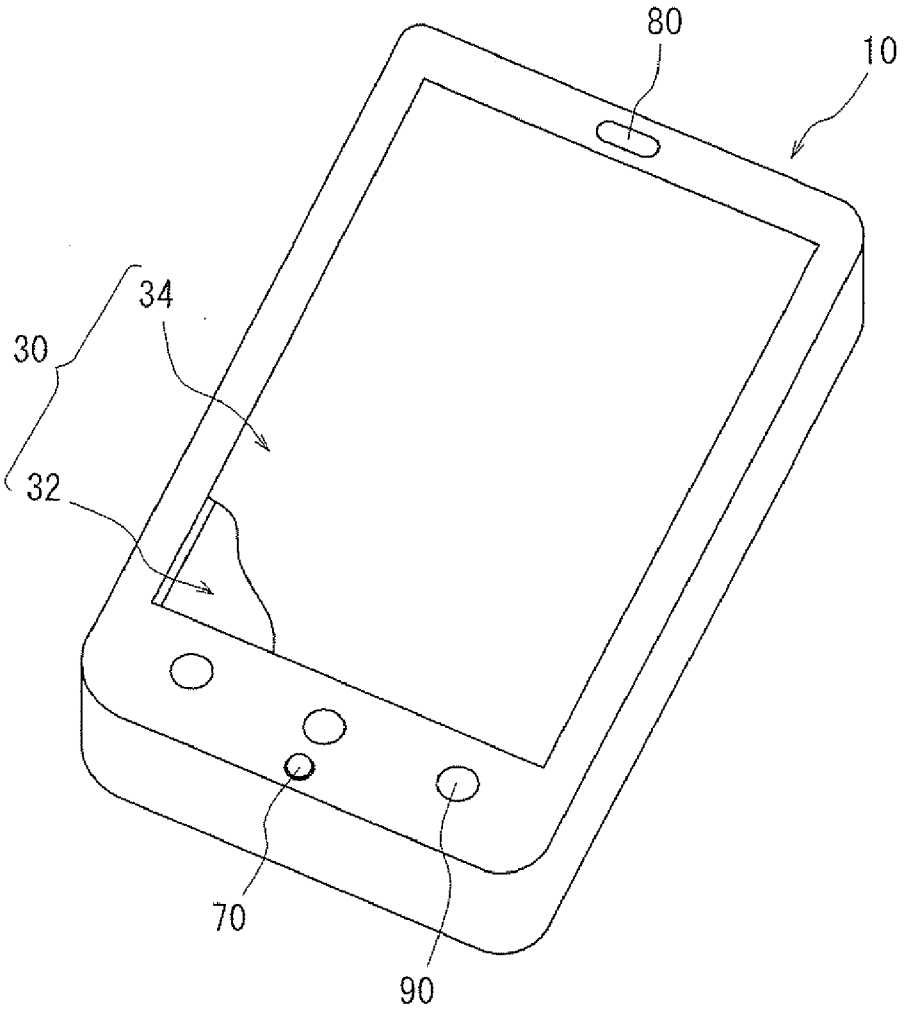


FIG. 1

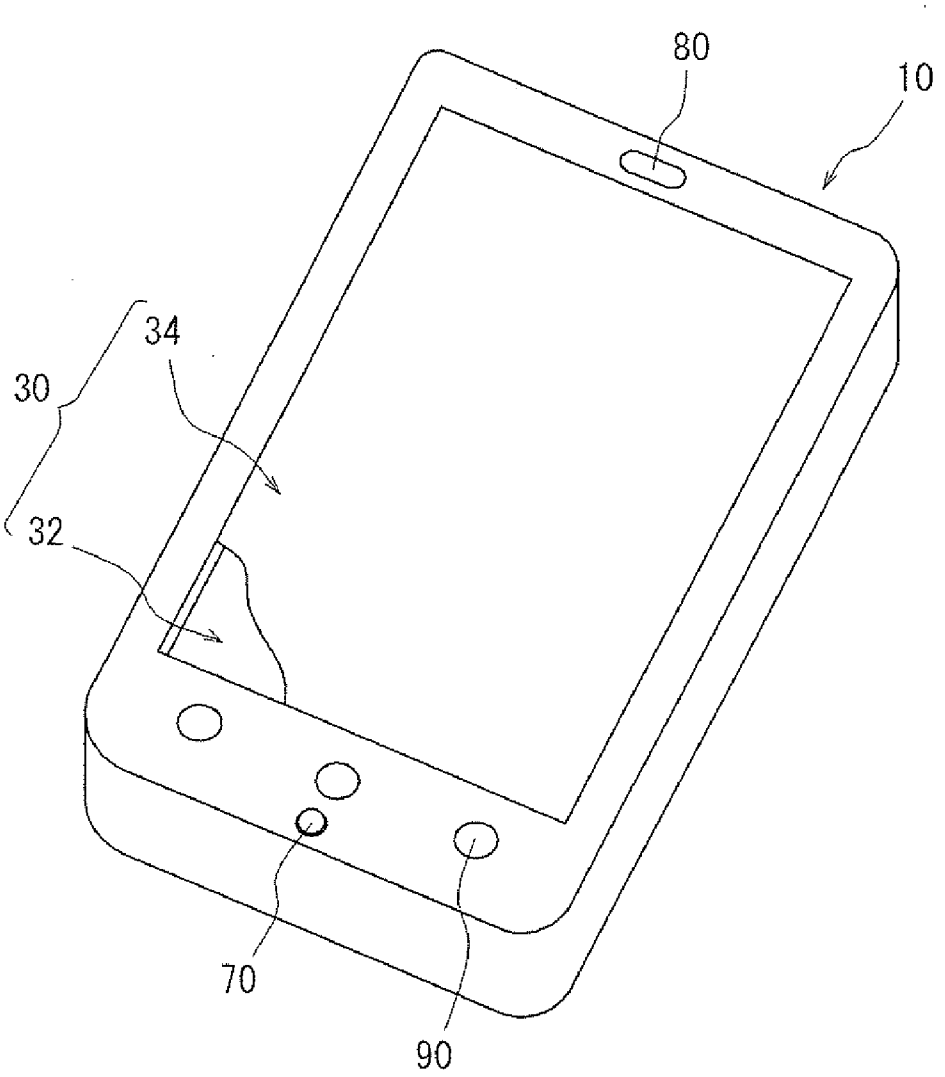


FIG. 2

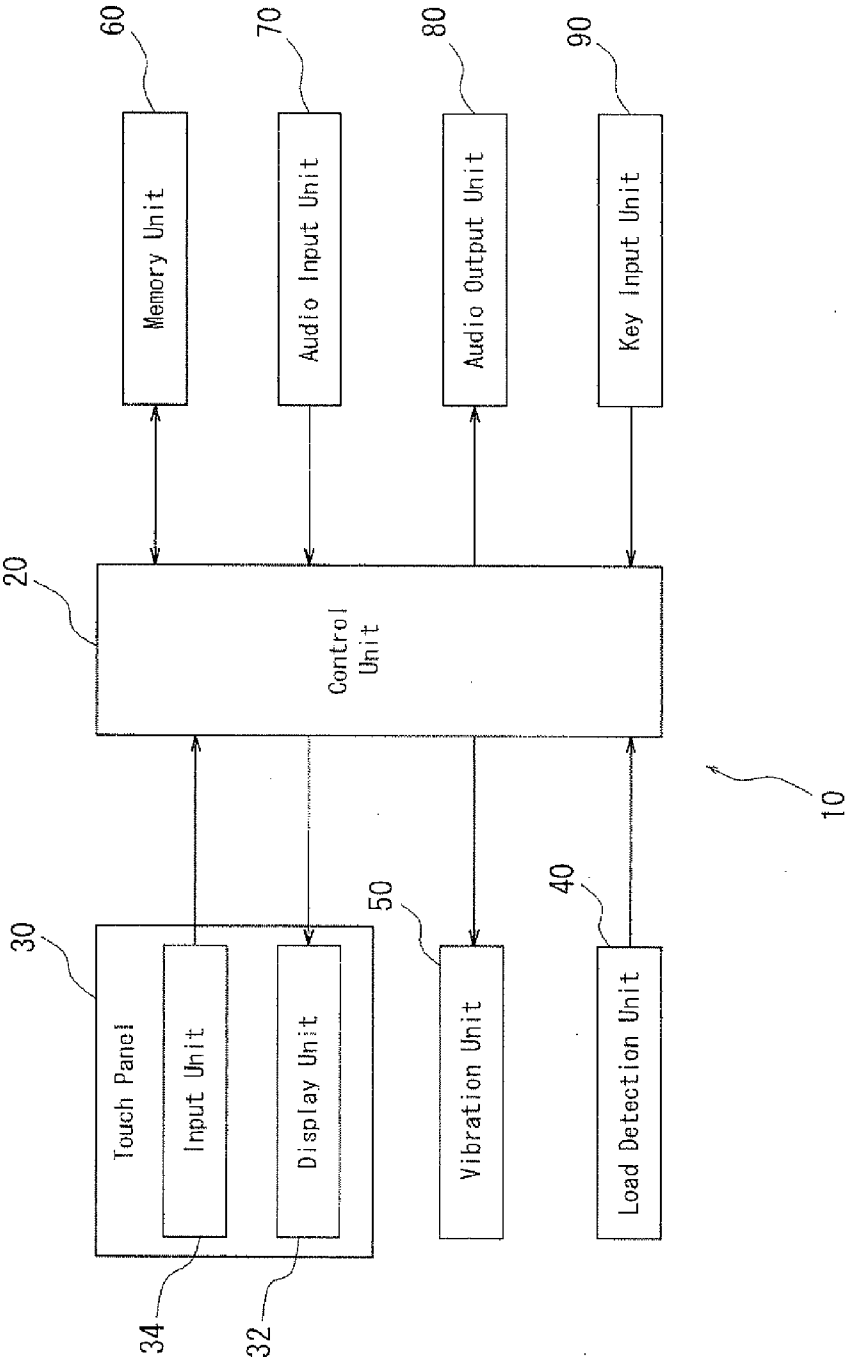

60
Memory Unit
70
Audio Input Unit
80
Audio Output Unit
90
Key Input Unit
20
Control Unit
10
30
Touch Panel
Input Unit
Display Unit
50
Vibration Unit
40
Load Detection Unit
34
32

FIG. 3

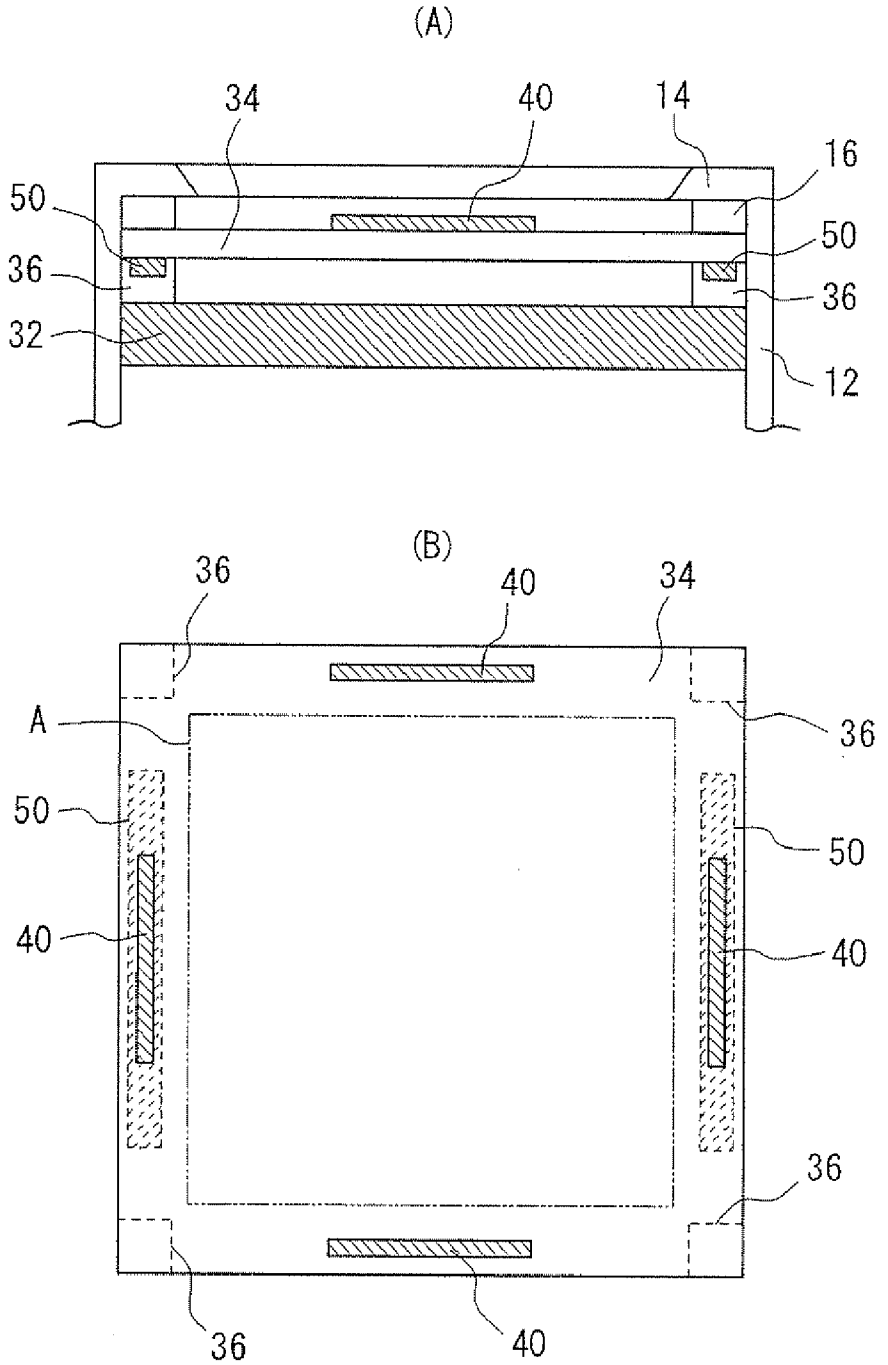


FIG. 4

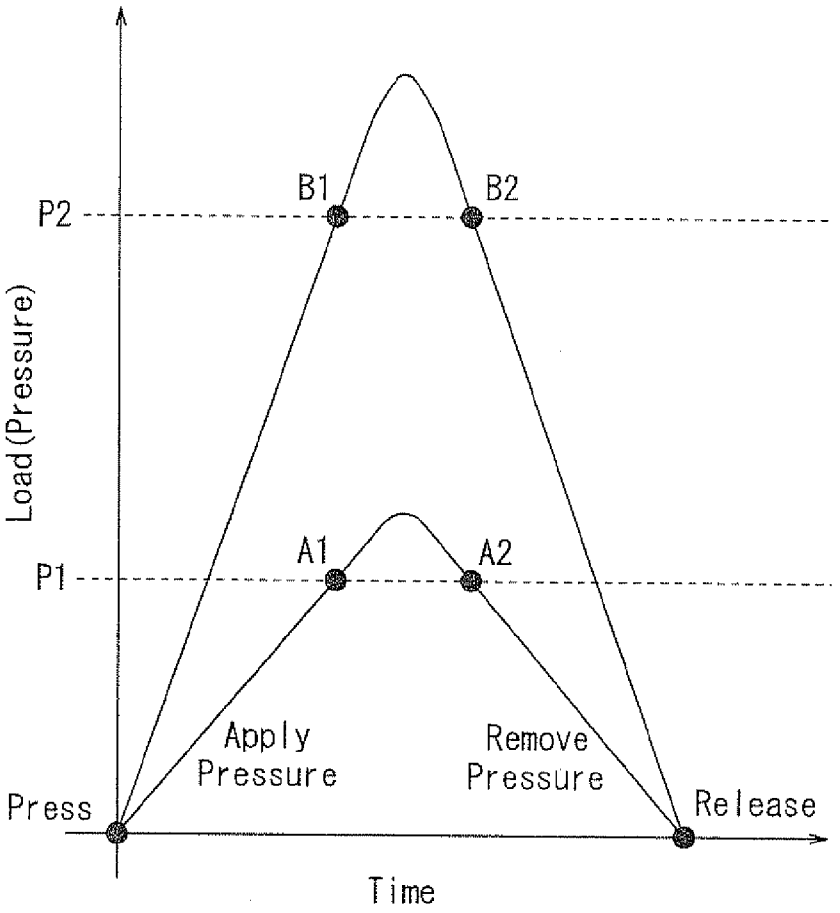

P2
B1
B2
Load (Pressure)
P1
A1
A2
Apply
Pressure
Remove
Pressure
Press
Release
Time

FIG. 5

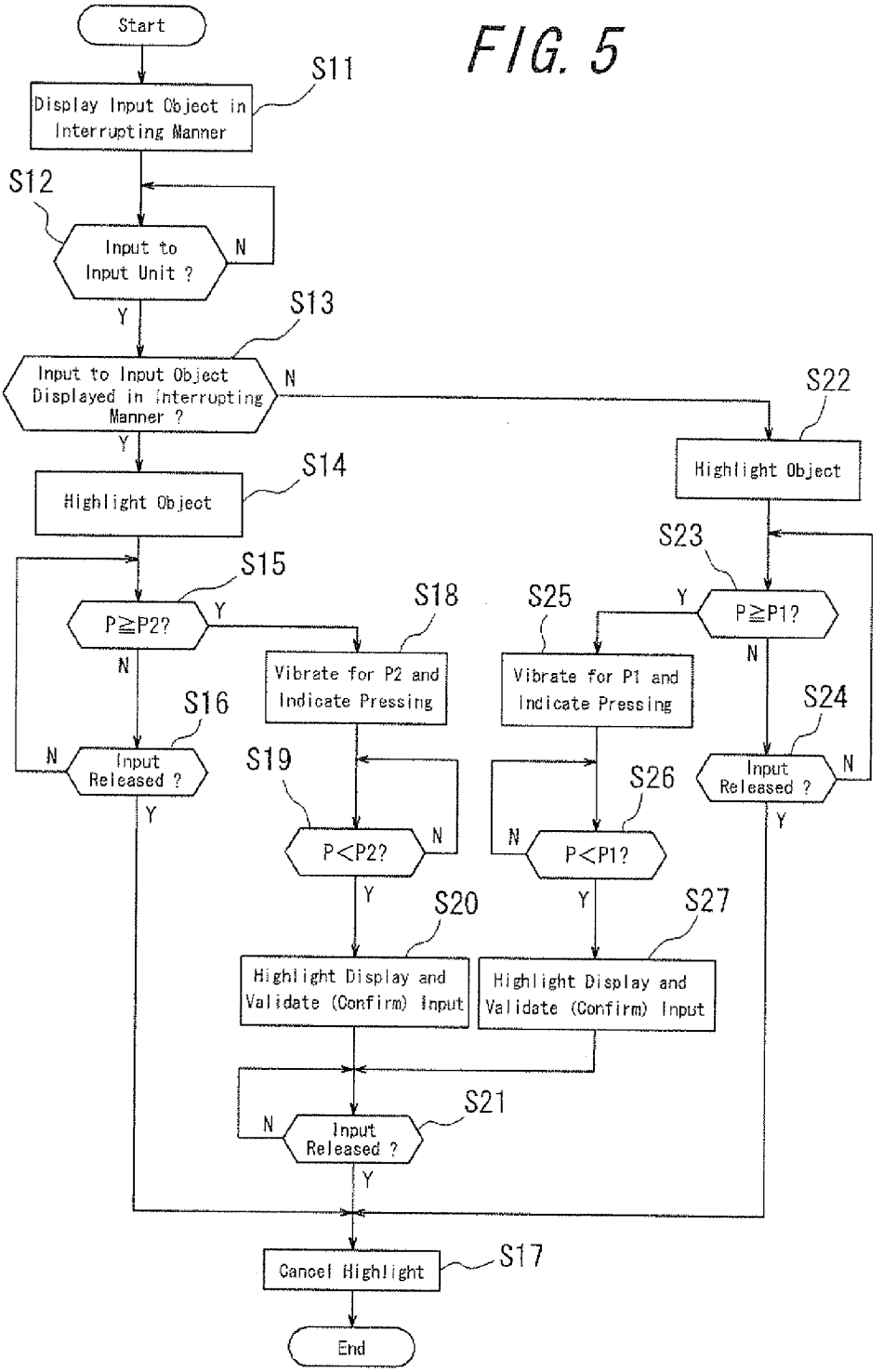
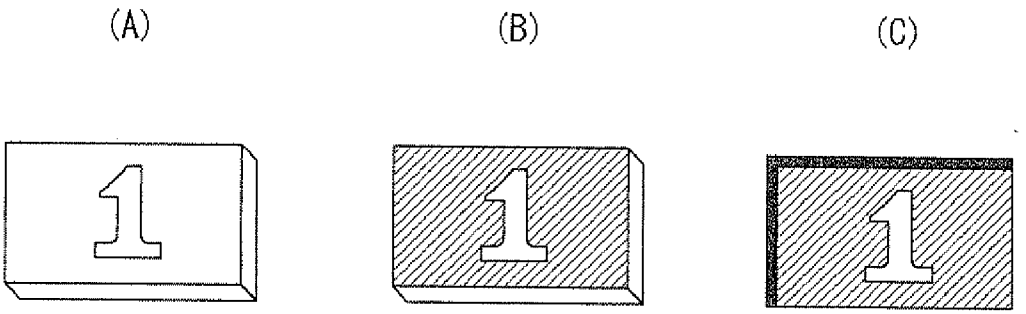

Start
S11
Display Input Object in Interrupting Manner
S12
Input to Input Unit ?
N
Y
S13
Input to Input Object Displayed in Interrupting Manner ?
N
Y
S14
Highlight Object
S15
P≧P2?
Y
N
S16
Input Released ?
N
Y
S18
Vibrate for P2 and Indicate Pressing
S19
P<P2?
N
Y
S20
Highlight Display and Validate (Confirm) Input
S22
Highlight Object
S23
P≧P1?
Y
N
S24
Input Released ?
N
Y
S25
Vibrate for P1 and Indicate Pressing
S26
P<P1?
N
Y
S27
Highlight Display and Validate (Confirm) Input
S21
Input Released ?
N
Y
S17
Cancel Highlight
End

FIG. 6



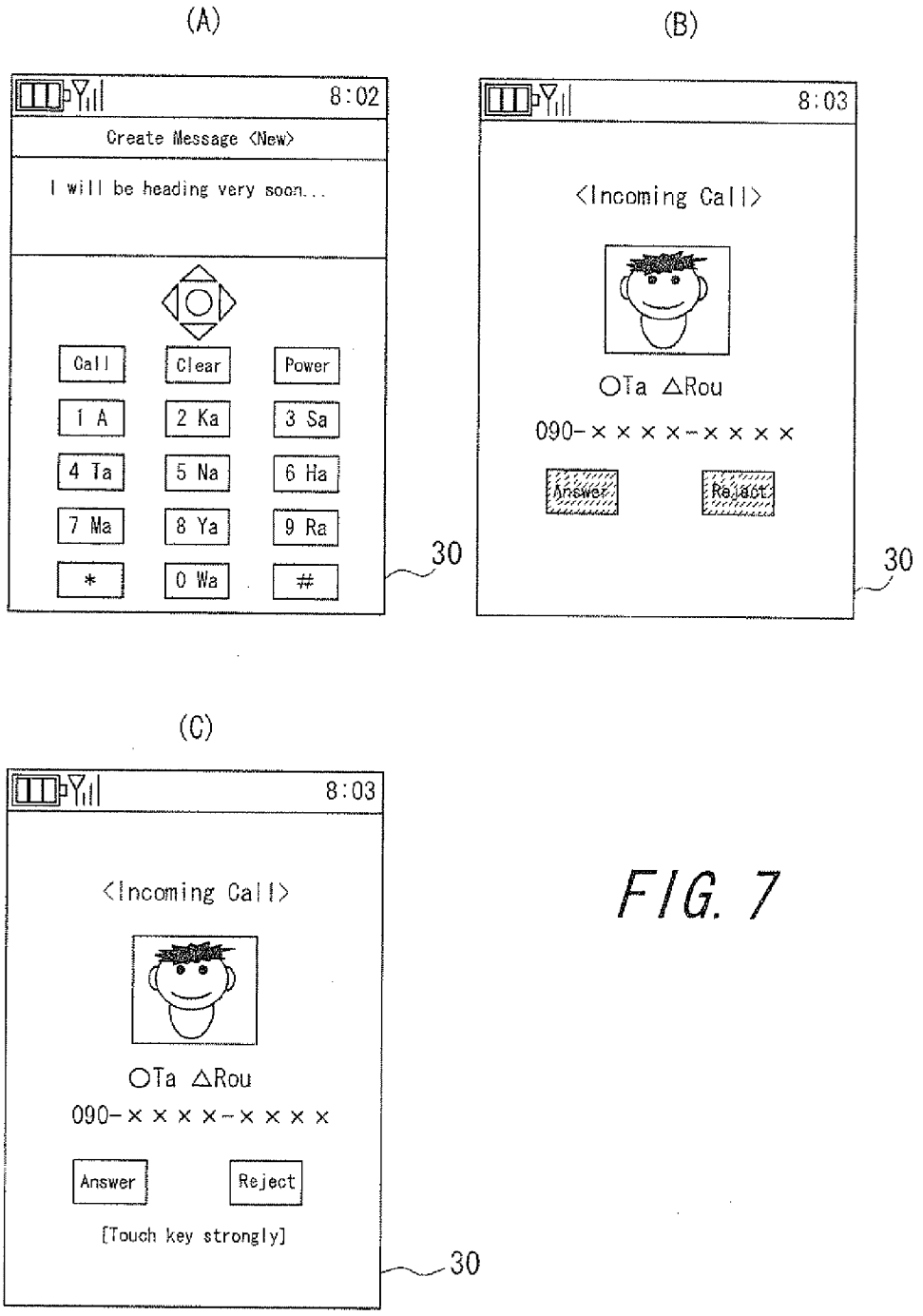

(A)
8:02
Create Message <New>
I will be heading very soon...
Call
Clear
Power
1 A
2 Ka
3 Sa
4 Ta
5 Na
6 Ha
7 Ma
8 Ya
9 Ra
*
0 Wa
#
30
(B)
8:03
<Incoming Call>
○Ta △Rou
090-××××-××××
Answer
Reject
30
(C)
8:03
<Incoming Call>
○Ta △Rou
090-××××-××××
Answer
Reject
[Touch key strongly]
30

FIG. 7

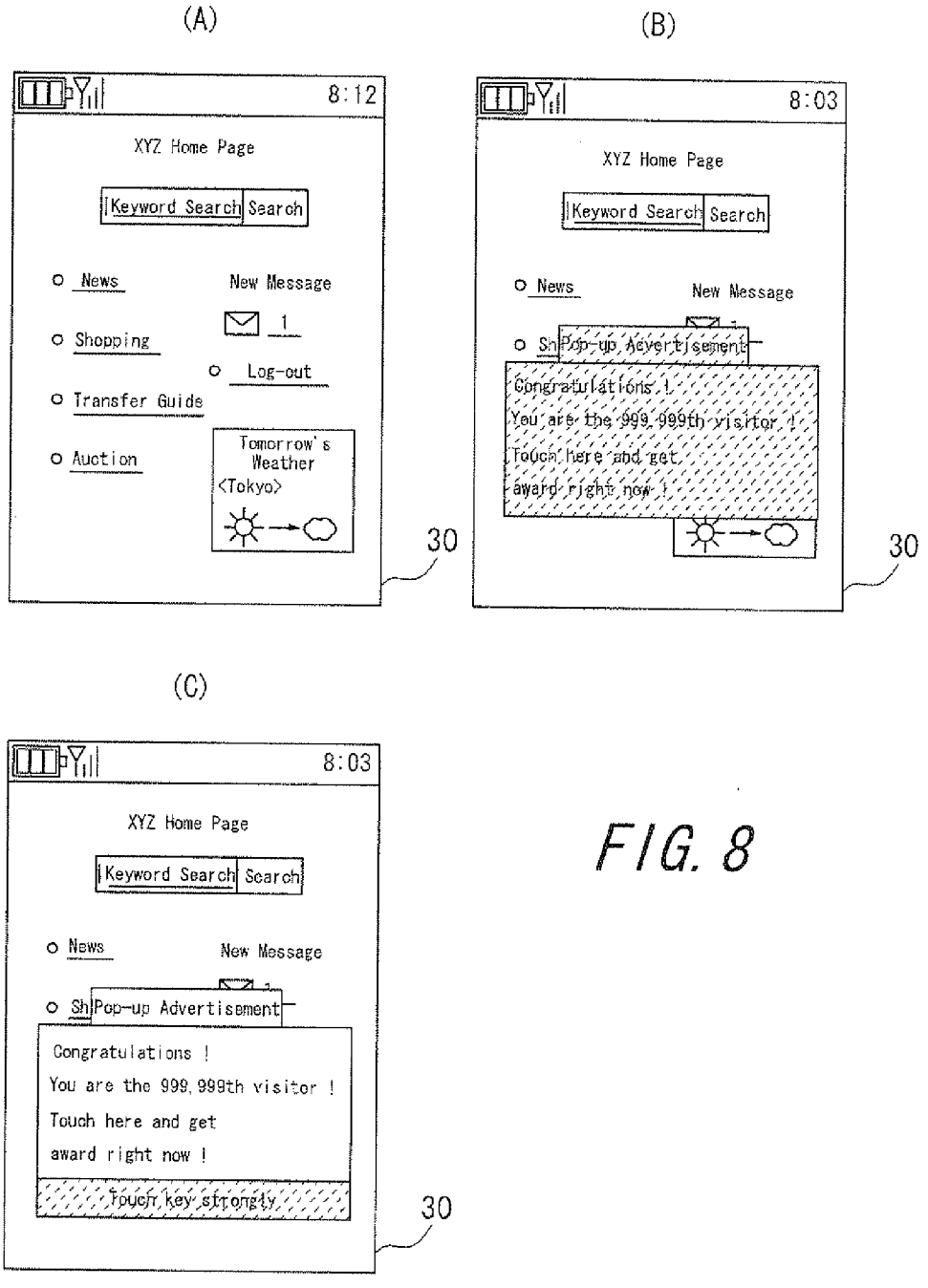

(A)
8:12
XYZ Home Page
Keyword Search
Search
News
New Message
1
Shopping
Log-out
Transfer Guide
Auction
Tomorrow's Weather
<Tokyo>
30
(B)
8:03
XYZ Home Page
Keyword Search
Search
News
New Message
Pop-up Advertisement
Congratulations !
You are the 999,999th visitor !
Touch here and get
award right now !
30
(C)
8:03
XYZ Home Page
Keyword Search
Search
News
New Message
Pop-up Advertisement
Congratulations !
You are the 999,999th visitor !
Touch here and get
award right now !
Touch key strongly
30

FIG. 8

FIG. 9

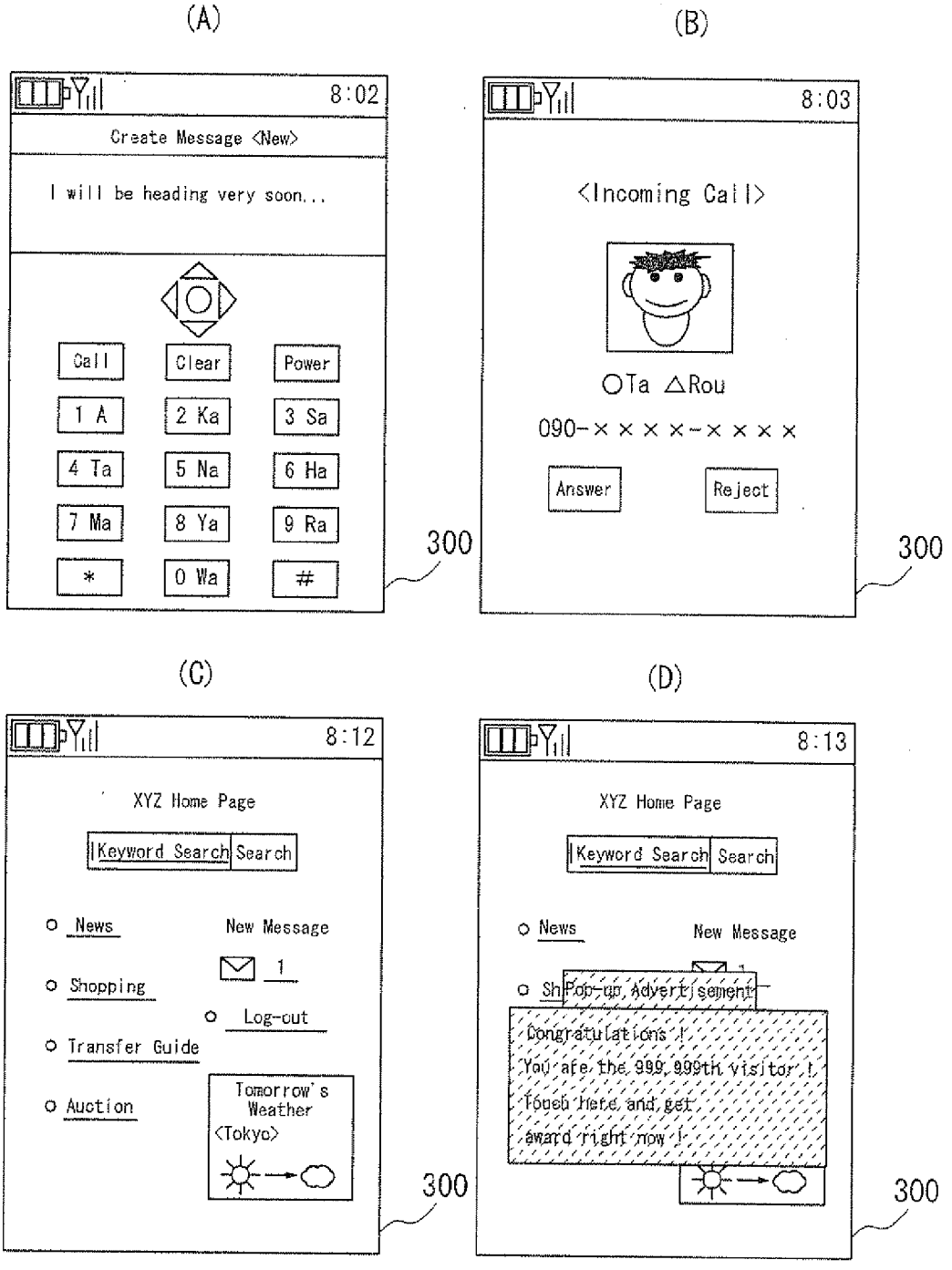
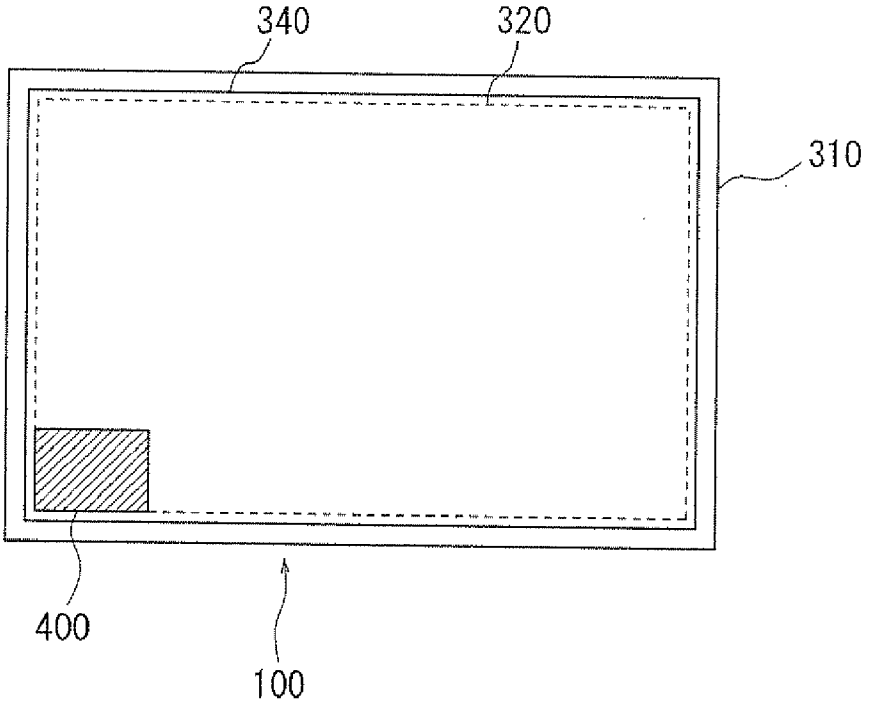
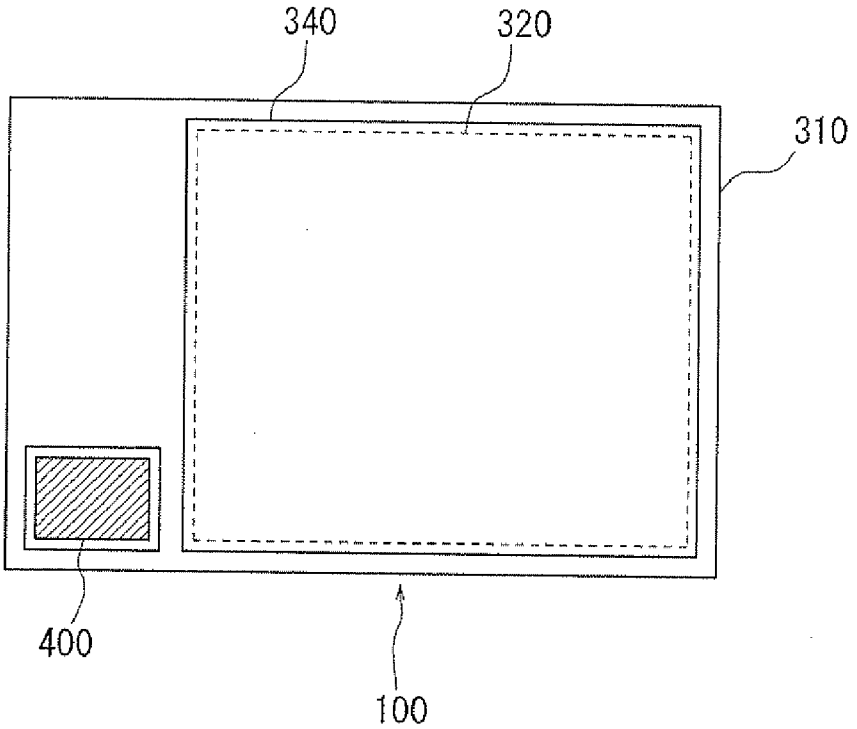

(A)
8:02
Create Message <New>
I will be heading very soon...
Call
Clear
Power
1 A
2 Ka
3 Sa
4 Ta
5 Na
6 Ha
7 Ma
8 Ya
9 Ra
*
0 Wa
#
300
(B)
8:03
<Incoming Call>
○Ta △Rou
090-××××-××××
Answer
Reject
300
(C)
8:12
XYZ Home Page
Keyword Search
Search
News
New Message
1
Shopping
Log-out
Transfer Guide
Auction
Tomorrow's Weather
<Tokyo>
300
(D)
8:13
XYZ Home Page
Keyword Search
Search
News
New Message
Pop-up Advertisement
Congratulations !
You are the 999,999th visitor !
Touch here and get
award right now !
300

FIG. 10

(A)




(B)



# INPUT APPARATUS

## CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority to and the benefit of Japanese Patent Application No. 2008-331304 filed on Dec. 25, 2008, the entire contents of which are incorporated herein by reference.

## TECHNICAL FIELD

**[0002]** The present invention relates to input apparatuses, and more particularly, to input apparatuses having touch panels.

## BACKGROUND ART

**[0003]** For mobile terminals such as mobile phones, various input apparatuses used by users to operate the terminals have been developed according to functions and usages of each of the terminals. In many cases, an input apparatus has mechanical keys or buttons arranged in advance on a surface of a body such that a user performs an input operation by directly pressing a finger or the like to the keys.

**[0004]** The mechanical keys (for example, a numerical keypad) of the input apparatus of the terminal are normally arranged in advance to suit a main usage of the terminal. Accordingly, it is generally not possible to change a physical arrangement of keys, once defined, later.

**[0005]** Recently, a variety of functions are incorporated in small mobile terminals. For example, the mobile phones have a digital camera function and a music player function. There are mobile terminals such as a mobile phone having numerous supplementary functions incorporated therein in addition to a function for a main usage of the terminal, and PDA (Personal Digital Assistant: mobile information terminal) having, as a single terminal, a plurality of main usages such as schedule management, an address book and the like. If such terminals have keys fixedly arranged, it may inconvenience the user significantly in using particular functions.

**[0006]** In order to resolve such inconvenience, there is disclosed an input apparatus having a touch panel designed such that a transparent input unit is arranged overlapping a front face of a liquid crystal display constituting a display unit (for example, see Patent Document 1). The input apparatus having such a touch panel is generally configured such that, when a graphical image of operation keys or buttons displayed on a display screen of the touch panel is pressed, the input unit at a corresponding position receives an input.

**[0007]** A folding mobile phone described in the above Patent Document 1 can display keys arranged arbitrarily on the display screen of the touch panel to receive operation inputs by the user, and thus key arrangements can be designed as desired. That is, this mobile phone provides an excellent operability as capable of changing the arrangement of the keys to suit a function of the terminal when each function of the terminal is switched. For example, when the user uses the digital camera function incorporated in the mobile phone, this mobile phone displays an operation unit for a digital camera on the touch panel and receives operation inputs. On the other hand, when the user inputs characters to create a message and the like, this mobile phone displays a keyboard like a personal computer (PC) on the touch panel and receives inputs. As stated above, this mobile phone having the touch panel can optimize a single input apparatus to suit each of a plurality of functions and receive operation inputs.

**[0008]** In addition, since the input apparatus having the touch panel receives an input in the form of a user's direct contact (touch) of a finger or the like to the graphical image (of the key or the button) displayed on the display unit, the user can operate it highly intuitively. That is, the user operates the input apparatus by directly touching the key or the button displayed on the screen with a finger or the like following a guide displayed on the screen of the touch panel. Accordingly, the user can control the terminal extremely easily through intuitive operations following the guide displayed on the screen, which even offers an effect to reduce erroneous operations as a result.

**[0009]** In recent years, the mobile terminal having the touch panel as stated above enables the user not only to make a normal telephone call and to perform operation inputs for creating a message but also to perform operation inputs to view (browse) contents delivered through the internet and websites. In addition, the input apparatuses having the touch panel are commonly used for not only the mobile terminals but also, for example, ATMs (Automatic Teller Machines) of a bank and the like and ticket vending machines at train stations. Moreover, in stores such as fast-food shops, terminal equipment with the input apparatus having the touch panel as above is used by a clerk to process orders from customers. When the touch panel is employed as the input apparatus, the mechanical buttons and keys such as a keyboard are not essential components any more. Accordingly, since only a small area is required to arrange mechanical buttons and the like on the terminal apparatus, it enables downsizing of overall terminal apparatus. Therefore, it offers a broader choice of installation sites of the terminal apparatus in stores and train stations.

**[0010]** In addition, the touch panel employed as an input apparatus eliminates necessity of separately having a display unit for displaying various information and an input unit for receiving operation inputs by the user as individual function units like a general design of conventional apparatus, and enables to configure the information display unit and the input unit on the same screen. Accordingly, it is possible, for example, to display keys of a keyboard on the touch panel for receiving an input by the user while displaying a result of the input near the keyboard on the touch panel. Thereby, the user can perform an operation input and confirm the result of the input on the same screen.

**[0011]** As described above, the touch panel provides merits to enable to configure the input unit and the display unit on the same screen and also to enable intuitive operation inputs. For that reason, the number of various terminal apparatuses having such input apparatus has been increased more and more.

**[0012]** However, the input apparatus with the touch panel has a specific problem because of its configuration to have the input unit and the display unit on the same screen and to receive the intuitive operation input. The problem is that, if timing for the terminal to receive the operation input through the touch panel does not match timing for the user to actually perform the operation input to the touch panel, the terminal may receive an operation input unintended by the user.

**[0013]** For example, it is considered a case, as shown in FIG. **9**(A), in which a numerical keypad for receiving operation input is displayed on the touch panel **300** by a message creation function of the mobile phone and a result of the input is displayed in a display area in an upper area of the touch

panel **300**. FIG. **9**(A) shows a state in which the user touches (performs a pressure input to) the numerical keypad on the touch panel **300** and thereby characters "I will be heading very soon . . . " are displayed. At this point, since the user has not finished creating the message yet, the user tries to continue an input operation by touching the numerical keypad on the touch panel **300**. It is to be noted that, since it is a conventional art known as a "multi-tap input method" to input each character in a message using a numerical keypad of a mobile terminal, such as the mobile phone, by transiting kana characters associated with each key according to the number of input times of the key, a description thereof is omitted.

**[0014]** If the mobile phone receives an incoming call with its telephone function while receiving input of characters in the message as stated above, the touch panel **300** of the mobile phone displays a screen as shown in FIG. **9**(B). In this manner, it is general to display information such as a reception of an incoming call or a message that requires immediacy in an interrupting manner on a screen currently in use, even when another function such as the message creation function is being used. It may be considered that, at the moment that the user tries to touch the touch panel **300** to input a next character in the message in a state shown in FIG. **9**(A), the display of the touch panel **300** is changed to an incoming call screen as shown in FIG. **9**(B). In this case, the user may touch a spot, where the user intended to touch before the display is changed, immediately after the display is changed.

**[0015]** For example, in creating the message shown in FIG. **9**(A), if the display is changed to the incoming call screen shown in FIG. **9**(B) at the moment that the user tries to touch a key "6 (Ha)" on the touch panel **300**, the user may touch a "Reject" key on the touch panel **300** shown in FIG. **9**(B). Accordingly, it results in rejecting the incoming call by the user unintentionally even if it was call from a person with whom the user needs to talk.

**[0016]** In addition, in creating the message shown in FIG. **9**(A), if the display is changed to the incoming call screen shown in FIG. **9**(B) at the moment that the user tries to touch a key "4 (Ta)" on the touch panel **300**, the user may touch an "Answer" key on the touch panel **300**. Accordingly, it results in answering the incoming call by the user unintentionally even if it was a call from a person with whom the user does not wish to talk.

**[0017]** Similar cases may happen not only when receiving an incoming call but also when receiving a message. For example, if the mobile terminal receives a new message while creating another message, the display may be changed to a screen for selecting whether to open the new message received at the moment that the user tries to input a next character. In such a case, the user may unintentionally perform an operation to open the new message, resulting in opening Spam (nuisance message).

**[0018]** In addition, for example, a pop-up advertisement may be displayed in an interrupting manner on the touch panel **300** as shown in FIG. **9**(D) when a user views an internet website by using a web browser function of the mobile phone as shown in FIG. **9**(C). The web browser function enables jump to a corresponding page or website in response to a touch (pressure input) to underlined characters by the user. In this case, the pop-up advertisement shown in FIG. **9**(D) may be displayed at the moment that the user tries to touch characters "Transfer Guide" displayed on the touch panel **300** shown in FIG. **9**(C). As a result, the user unintentionally touches the pop-up advertisement.

**[0019]** It is reported recently that there is so-called phishing which prompts the user to access a fraudulent website from a malicious pop-up display or advertisement. Accordingly, it may penalize the user because of an unintended operation input to such pop-up display and the like.

**[0020]** In operation of the personal computers (PC), unlike the mobile terminals, it is possible to perform operation input to small keys and buttons displayed on a relatively large display screen (monitor) by using an input device such as a mouse. In this case, a display area of objects such as the keys and the buttons and that of the pop-up advertisement are relatively small in comparison to an entire display screen. Accordingly, even if the objects such as the keys and the buttons and the pop-up advertisement are suddenly displayed on the display screen, the probability for them to overlap an object the user intended to input may be low.

**[0021]** As for the mobile terminal, however, since portability is valued, the display screen is limited in size and thus the touch panel in a large size is not normally mounted. In addition, in consideration of the operability, objects such as keys and buttons displayed on the touch panel cannot be too small. Accordingly, in case of the mobile terminal, it is a prominent problem that an interrupting object, suddenly displayed on the touch panel, overlaps another object to which the user intends to input.

**[0022]** In order to avoid a risk to receive an unintended input from the user as stated above, there is suggested an input apparatus capable of switching validation/invalidation of an operation by the touch panel (for example, see Patent Document 2). A shown in FIG. **10**(A), the Patent Document 2 discloses an input apparatus **100** having a touch panel **310** with an input unit **340** on top of a display unit **320**.

## PRIOR ART DOCUMENTS

### Patent Documents

**[0023]** Patent Document 1: Japanese Patent Laid-Open No. 2006-311224

**[0024]** Patent Document 2: Japanese Patent Laid-Open No. 08-076925

## SUMMARY OF INVENTION

### Technical Problem

**[0025]** As shown in FIG. **10**(A), the input apparatus **100** described in Patent Document 2 has an area for an operation validating switch unit **400** for validating an operation input, at a part of the input unit **340**. The operation validating switch unit **400** receives an operation input by the user to validate/invalidate an operation input to the input unit **340**. The input apparatus **100** validates an input to the input unit **340** if the operation validating switch unit **400** is ON, whereas it invalidates the input to the input unit **340** if the operation validating switch unit **400** is OFF. The Patent Document 2 also discloses an input apparatus **100** having the operation validating switch unit **400** separately from the input unit **340**, as shown in FIG. **10**(B).

**[0026]** As stated above, the input apparatus **100** described in Patent Document 2 can invalidates the operation input to the input unit **340** of the touch panel **310** based on an operation of the operation validating switch unit **400** by the user. Accordingly, if the user does not intend the operation input

using the touch panel **310**, it is possible to avoid an erroneous operation unintended by the user by invalidating the input unit **340**.

**[0027]** However, the input apparatus **100** described in Patent Document 2 sets in advance validation/invalidation of input to the touch panel based on user's intention. Therefore, it is not possible to completely handle the incoming call and the pop-up advertisement suddenly displayed on the screen in the interrupting manner as stated above (as shown in FIG. **9**).

**[0028]** That is, the input apparatus described in the above Patent Document 2 requires a user to set in advance invalidation of input to the touch panel in order to avoid an input to the incoming call screen or the pop-up advertisement. Accordingly, it is not possible to handle the incoming call screen or the pop-up advertisement suddenly displayed on the touch panel in the interrupting manner while the user inputs using the touch panel such as when writing a message.

**[0029]** In addition, although the input apparatus described in the above Patent Document 2 can prevent the input to the incoming call screen and the pop-up advertisement suddenly displayed by setting in advance invalidation of input to the touch panel. However, since such setting disables normal operation inputs as well, the user cannot input to the incoming call screen or the pop-up display based on the user's own intention. In order to respond to the incoming call screen or the pop-up display displayed in an interrupting manner, it is necessary for the user first to perform an operation input to validate inputs (that is, an operation input to cancel invalidation) to the touch panel separately. It inconveniences the user when the user wishes to answer the incoming call immediately.

**[0030]** A main characteristic of the touch panel is to be capable of providing high operability allowing a free configuration of a user interface with the objects such as the keys and the buttons arranged (displayed) as desired. However, it may diminish advantages of the touch panel such as easy operation and convenience to provide a switch separately from keys and buttons for receiving operation inputs to the touch panel and to require the user to operate the switch to validate/invalidate inputs to overall touch panel.

**[0031]** Accordingly, an object of the present invention in consideration of such conditions is to provide an input apparatus capable of receiving operation inputs intended by the user while avoiding operation inputs unintended by the user, without diminishing the advantages of the touch panel having the input unit and the display unit.

## Solution to Problem

**[0032]** In order to achieve the above object, an input apparatus according to a first aspect of the present invention includes:

**[0033]** a display unit for displaying an input object;

**[0034]** an input unit for receiving a pressure input to the input object displayed on the display unit;

**[0035]** a load detection unit for detecting a pressure load on the input unit; and

**[0036]** a control unit for controlling to receive the pressure input when the pressure load detected by the load detection unit satisfies a load standard, wherein

**[0037]** the control unit controls such that a load standard for receiving a pressure input to an input object displayed on the display unit in an interrupting manner is higher than a load standard for receiving a pressure input to the input object which has been displayed on the display unit.

## BRIEF DESCRIPTION OF DRAWINGS

**[0038]** FIG. **1** is an external perspective view of a mobile phone having an input apparatus according to an embodiment of the present invention;

**[0039]** FIG. **2** is a functional block diagram illustrating an internal configuration of the mobile phone according to the embodiment of the present invention;

**[0040]** FIG. **3** shows diagrams illustrating an exemplary implementation structure of a touch panel, a load detection unit and a vibration unit of the mobile phone shown in FIG. **2**;

**[0041]** FIG. **4** is a graph schematically illustrating an exemplary chronological change in a load (pressure) detected by the load detection unit when a user presses an input unit of the touch panel;

**[0042]** FIG. **5** is a flowchart illustrating processing and operation according to the present embodiment;

**[0043]** FIG. **6** is a diagram illustrating a highlight display and a pressed-down display according to the present embodiment;

**[0044]** FIG. **7** shows exemplary displays of a display unit based on the processing according to the present embodiment;

**[0045]** FIG. **8** shows other exemplary displays of the display unit based on the processing according to the present embodiment;

**[0046]** FIG. **9** shows exemplary displays of the display unit based on the processing by a conventional mobile phone; and

**[0047]** FIG. **10** shows external front views illustrating schematic configurations of a conventional input apparatus.

## DESCRIPTION OF EMBODIMENTS

**[0048]** Embodiments of the present invention will be described with reference to the accompanying drawings. In the following embodiments, a mobile phone is used as an exemplary mobile terminal with an input apparatus according to the present invention. However, the mobile terminal to which the input apparatus according to the present invention is applicable is not only the mobile phone but also any mobile terminal having a touch panel such as a PDA, for example. In addition, the present invention is applicable not only to the mobile terminal having the touch panel but also to any input terminal having the touch panel such as ATMs of a bank and ticket vending machines at a train station as stated above.

**[0049]** FIG. **1** is an external perspective view illustrating a schematic configuration of a mobile phone **10** having the input apparatus according to an embodiment of the present invention. The mobile phone **10** has a display unit **32**, a part of which is displayed in the figure, on a front face of a terminal body, for displaying a variety of information and graphical images of keys and buttons on a liquid crystal display (LCD), an organic EL display or the like. The mobile phone **10** also has an input unit **34** constituted of a matrix switch and the like for receiving an input by a user's finger or a stylus at a front face of the display unit **32**. According to the present embodiment, a touch panel **30** includes the display unit **32** and the input unit **34**. The mobile phone **10** further includes an audio input unit **70** constituted of a microphone and the like, an audio output unit **80** constituted of a speaker and the like, and a key input unit **90** constituted of at least one mechanical key.

**[0050]** Although the mobile phone **10** may additionally have a digital camera function unit, a One-seg broadcast tuner, a Near Field Communication unit such as an infrared communication function unit, various interfaces and the like according to necessary functions, figures and detailed descriptions thereof are omitted.

**[0051]** FIG. **2** is a functional block diagram illustrating a schematic internal configuration of the mobile phone **10**. As shown in FIG. **2**, the mobile phone **10** has a control unit **20**, a touch panel **30**, a load detection unit **40**, a vibration unit **50**, a memory unit **60**, the audio input unit **70**, the audio output unit **80** and the key input unit **90**. The control unit **20** controls and manages the entire mobile terminal **10** as well as each functional block of the mobile terminal **10**. As stated above, the touch panel **30** has a structure that the input unit **34** for receiving input from a user is arranged overlapping the front face of the display unit **32**. Thereby, the touch panel **30** receives operation inputs by the user as well as displaying a variety of information such as a result of an input according to each application program (hereinafter, abbreviated to an "application").

**[0052]** The input unit **34** of the touch panel **30**, upon detection of an input by a contact (pressure) of a user's finger or a stylus, outputs a signal corresponding to a position where such input is detected. The touch panel **30** is made as a know type such as, for example, a resistance film type, a capacitance type or the like. The display unit **32** performs display according to each application, as well as displaying a graphical image of user interface, composed of various keys and buttons for receiving operation inputs to the input unit **34** by the user, in a predetermined display area. Hereinafter, the graphical images of various keys, buttons and pop-up advertisements displayed on the display unit **32** for receiving an operation input to the input unit **34** of the touch panel **30** by the user are referred to as "input objects".

**[0053]** The load detection unit **40** may be a strain gauge sensor, for example, and detects a pressure load on the touch panel **30** (or the input unit **34**). The vibration unit **50** may be, for example, a piezoelectric element or an ultrasonic transducer and vibrates the touch panel **30**. A constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** will be described below.

**[0054]** The memory unit **60** stores various applications and a variety of input information, as well as functioning as a work memory. In addition, the memory unit **60** also stores a plurality of templates including various input objects to be used according to each application.

**[0055]** The audio input unit **70** converts user's voice and the like into input signals and transmits them to the control unit **20**. The audio output unit **80** converts voice signals transmitted from the control unit **20** into voice. The key input unit **90** transmits a signal corresponding to an operation input by the user to the control unit **10**. Usages and functions of the various keys constituting the key input unit **90** are defined according to an application to be used.

**[0056]** The mobile phone **10** further includes various function units necessary for providing functions as a usual mobile phone such as an antenna and a wireless communication unit for transmitting and receiving a variety of information such as voice call and e-mail data to/from a base station via the internet, wireless communication and the like. However, since such function units have no particular distinction from known arts, descriptions thereof are omitted.

**[0057]** Next, the constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** is described.

**[0058]** FIG. **3** is a diagram illustrating an exemplary implementation structure of the touch panel **30**, the load detection unit **40** and the vibration unit **50** of the mobile phone **10** shown in FIG. **2**. FIG. **3**(A) is a cross-sectional view of a main section, whereas FIG. **3**(B) is a plane view of the main section.

**[0059]** The display unit **32** for displaying various input objects on the touch panel **30** is housed in a housing **12**. In the input apparatus according to the present embodiment, the input unit **34** is supported on the display unit **32** via insulators **36** made of elastic members. In the input apparatus according to the present embodiment, the display unit **32** and the input unit **34** are rectangular in a planar view. Although the touch panel **30** is square in FIG. **3**, it may be oblong in accordance with specifications of the mobile terminal mounting the touch panel **30**. In the input apparatus, the input unit **34** is supported on the display unit **32** via the insulators **36** arranged at four corners outside a display area A of the display unit **32** indicated by virtual lines in FIG. **3**(B).

**[0060]** In addition, in the input apparatus, the housing **12** is provided with an upper cover **14** for covering a surface area of the input unit **34** outside the display area of the display unit **32**. Insulators **16** made of elastic members are arranged between the upper cover **14** and the input unit **34**.

**[0061]** The input unit **34** has a surface, that is, a face for receiving input operations, formed of a transparent film, and a rear face formed of a glass. The input unit **34** may be designed such that the transparent film of the surface slightly bends (strains) in proportion to pressure when an operation face is pressed.

**[0062]** In addition, in the input apparatus according to the present embodiment, a strain gauge sensor for detecting the pressure load (pressure) applied on the input unit **34** is provided, adhered or the like, to the transparent film on the surface of the input unit **34** near each side covered by the upper cover **14**. Moreover, in the input apparatus, the piezoelectric element or the ultrasound transducer for vibrating the input unit **34** is provided, adhered or the like, to the face of the glass on the rear side of the input unit **34** near each of two opposed sides. That is, in the input apparatus shown in FIG. **3**, the load detection unit **40** and the vibration unit **50** shown in FIG. **2** include four strain gauge sensors and two vibrators, respectively. It is to be noted that the housing **12**, the upper cover **14** and the insulator **16** shown in FIG. **3**(A) are omitted in FIG. **3**(B).

**[0063]** In the input apparatus according to the present embodiment, the control unit **20** monitors an input detected by the input unit **34** and a pressure load detected by the load detection unit **40**. If a pressure input detected by the input unit **34** is an input to an input object displayed on the display unit **32** and the pressure load detected by the load detection unit **40** satisfies a predetermined standard for receiving an input, the control unit **20** receives such an input as a normal input. Hereinafter, this "standard for receiving an input" is referred to as a "load standard", simply. In addition, when the input satisfies the load standard, the control unit **20** controls the vibration unit **50** to generate vibration such that the vibration is given to an object pressing the input unit **34** such as the user's finger or the stylus. The load detection unit **40** detects the load from, for example, an average output value of the four strain gauge sensors. Additionally, the vibration unit **50**

drives, for example, two ultrasound transducers in phase. Since the vibration unit **50** generates vibration when the load standard is satisfied, the user can recognize that the pressure input by the user is received appropriately.

**[0064]** Next, a summary of processing according to the present embodiment, carried out when interruption by an input object occurs, is described. Here, an "interruption" by the input object indicates a state in which, during reception of an input by the user to an input object being displayed based on operation by an application, another input object is displayed on the same screen based on activation of another application and the like. It is considered that such an "interruption" may occur when there is a request to display an input object on the same position of another input object displayed based on an application already running, other than a case where another application is activated. In order to carry out the processing, the control unit **20** first predefines the load standard for determining an input to the input unit **34** as a normal input to the input object displayed on the display unit **32** before the interruption occurs. The following is a description of the load standard.

**[0065]** FIG. **4** is a graph schematically illustrating an exemplary chronological change in the pressure load (pressure) detected by the load detection unit **40** when the user performs operation inputs by pressing the input unit **34** of the touch panel **30**. Generally, when performing operation to press (pressure input) the input unit **34** of the touch panel **30**, the user continues to increase pressure on the input unit **34** (that is, the user presses the input unit **34** down) from when the user touches the input unit **34** until determining that the input is received. From a point determining that the input is received, the user reduces the pressure on the input unit **34** (that is, releases a finger or the like from the input unit **34**). Accordingly, as represented by a curved line shown in FIG. **4**, the load detected by the load detection unit **40** is first increased upward and then reduced downward with time passing from the left side to the right side.

**[0066]** As a premise of the processing carried out when the interruption by the input object occurs, the control unit **20** first sets a load standard value P**1** based on a normal pressure at a normal operation input to the display unit **32** (or the input unit **34**) by the user. Based on this setting, when the load detection unit **40** detects a pressure load exceeding the P**1** (A**1**), which is the normal pressure at the normal operation input by the user, the control unit **20** determines that the input object displayed on the display unit **32** is pressed. In addition, if the load detection unit **40** detects that the load pressure on the input object being pressed drops under the P**1** (A**2**) (after A**1**), the control unit **20** determines that the operation input to the input object being pressed down is completed (confirmed).

**[0067]** It is preferred to use the load standard value P**1** as a load standard value for operation inputs not only before the interruption by the input object but also when there is a normal operation input to the input unit **43** (that is, when the interruption by the input object does not occur). Setting the load standard value P**1** as stated above prevents from determining a slight touch to the input unit **34** by the user as an input, thereby an unintended input by the user may be avoided.

**[0068]** In addition, setting the load standard value P**1** as stated above enables the user to perform a repetitive tapping by pressing the same spot (the same input object) on the input unit **34** multiple times continually, without releasing the finger from the input unit **34** each time. That is, even if the user's finger keeps touching the input unit **34**, the user can make the input unit **34** recognize such an input as the repetitive tapping, by adjusting strength of pressure by the finger to increase and decrease across the load standard value P**1**. Since this input method needs only small strokes of the user's finger, the user mastering this method may quickly and easily input with a smaller movement of the finger.

**[0069]** Next, according to the present embodiment, the control unit **20** sets a load standard value P**2** based on a pressure larger than the normal pressure at the normal operation input to the input unit **34** by the user. According to the present embodiment, a pressure exceeding the load standard value P**2** set in this manner is received as an input in the processing carried out when the interruption by the input object occurs. When the load detection unit **40** detects a pressure load exceeding the P**2** (B**1**), which is larger than the normal pressure (P**1**) at the normal operation input by the user, on an input object displayed in an interrupting manner, the control unit **20** determines that the input object is pressed. In addition, if the load detection unit **40** detects that the pressure load on the input object being pressed down drops under the P**2** (B**2**) (after B**1**), the control unit **20** determines that the operation input to the input object being pressed down is completed (confirmed). That is, the control unit **20** controls such that the load standard for receiving a pressure input to the input object displayed in the interrupting manner on the display unit **32** is higher than the load standard for receiving a pressure input to the input object which has been displayed on the display unit **32**.

**[0070]** Accordingly, even if the input object displayed in the interrupting manner is pressed with a normal pressure (under P**2**) at the normal input operation by the user, the control unit **20** does not receive such a pressure input as an input to this object. However, only if a pressure exceeding the P**2** larger than the normal pressure (P**1**) of the normal operation input by the user is applied on this input object, the control unit **20** accepts such a pressure input as an input.

**[0071]** In the above description, the load standard value is used as a "pressure load threshold" and it is determined that "the load standard is satisfied" if it is exceeded, by way of example. Although a determination in this manner is applied in the following descriptions, there may also be other conditions to determine that "the load standard is satisfied". For example, it is possible to determine that "the load standard is satisfied" if the pressure load of the pressure input to an input object by the user reaches the above load standard value. In addition, it is also possible to determine that "the load standard is satisfied" if the pressure load indicating the above load standard value is detected by the load detection unit **40**.

**[0072]** Next, the processing and operations carried out when the interruption by an input object occurs is described. FIG. **5** is a flowchart illustrating the processing and the operations of the input apparatus according to the present embodiment carried out when the interruption by an input object occurs. The following is a description of a case that an input object is displayed in the interrupting manner while a message creation application is running to display character input objects on the display unit **32** and inputs to the input unit **34** by the user are received.

**[0073]** It is considered that the interruption by an input object occurs when, for example, an application to inform the user of reception of an incoming call or a new message is activated, as stated above. Activation of the application based

on an input intended by the user is not regarded as the interruption by the input object. In addition, it is also considered that a request to display an entry form, a pop-up window or the pop-up advertisement interrupts a web browser application which has been running. Since the processing and the operations in response to a normal operation input except the processing when the interruption by an input object occurs are the same as those of conventional arts, descriptions thereof are omitted.

**[0074]** According to the present embodiment, upon start of the processing for when the interruption by the input object occurs, the control unit **20** first displays the input object on the display unit **32** of the touch panel **30** in the interrupting manner (step S**11**). Then, the control unit **20** determines whether an input by a user's finger or a stylus (hereinafter, abbreviated to a "user's input") to the input unit **34** of the touch panel **30** is detected (step S**12**).

**[0075]** If the user's input to the input unit **34** is detected at step S**12**, the control unit **20**, based on an input from the input unit **34**, determines a position on the display unit **32**, corresponding to a position on the input unit **34** received the input (step S**13**). In addition, based on a result of such determination, the control unit **20** determines whether the position on the display unit **32** corresponding to the position where the input is detected corresponds to a position of the input object displayed in the interrupting manner. If such input position corresponds to the position of the input object displayed in the interrupting manner (Yes of step S**13**), the control unit **20** highlights this input object (step S**14**).

**[0076]** The highlight display at step S**14** is an emphasizing display in order to inform the user that a finger or the like touches the input object. For example, when the user's input to the input object of a numeric key as shown in FIG. **6**(A) is detected, the control unit **20** highlights the input object as shown in FIG. **6**(B). Thereby, the user can visually recognize that the input by the finger or the like touching the input unit **34** is appropriately detected by the input apparatus. Such highlight display indicates a state that the user's finger or the like is simply touching the input unit **34** and, hence, it is not yet recognized at this point that the input is received (that is, the key is pressed).

**[0077]** Next, the control unit **20** determines whether the pressure load value P detected by the load detection unit **40** exceeds the load standard value P**2** (step S**15**). For the input object displayed in the interrupting manner, the control unit **20** does not perform the processing for when an input is received unless there is an input exceeding the load standard value P**2**. Accordingly, if the pressure load value P exceeding the load standard value P**2** is not detected by the load detection unit **40** at step S**15**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**16**).

**[0078]** If it is determined at step S**16** that the input is not released (that is, the user has not released the finger or the like from the input unit **34**), the control unit **20** returns to step S**15** to monitor the pressure load value P detected by the load detection unit **40**. If it is determined at step S**16** that the user's input to the input unit **34** is released, it is regarded that there is no input to the input object touched by the user and the control unit **20** cancels the highlight display (step S**17**) and ends the processing.

**[0079]** Cancellation of the highlight display at step S**17** is a display to inform the user that the input by the user's finger or the like to the input unit **34** at a position corresponding to the input object is no longer detected. For example, the control unit **20** cancels the highlight display of the input object to which the user's input is detected, on the display unit **32** and returns to a display as shown in FIG. **6**(A). Thereby, the user can visually recognize that the input apparatus appropriately detects that the user's finger or the like which was touching the input unit **34** is now released from the input unit **34**.

**[0080]** In contrast, if the pressure load value P exceeding the load standard value P**2** is detected by the load detection unit **40** at step S**15**, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user of the pressure load value P exceeding the load standard value P**2** (step S**18**). Although a vibration generated by the vibration unit **50** in this case may be in the same pattern as vibrations for any input types of inputs, it is preferred to vibrate in a specific pattern such that the user can recognize that the pressure load value P exceeds the load standard value P**2**.

**[0081]** In addition, the control unit **20**, at step S**18**, changes display of the display unit **32** in order to indicate that the input object to which the input is detected is pressed. That is, the control unit **20** switches display from the highlight display of the input object as shown in FIG. **6**(B) to the display indicating that the input object is pressed as shown in FIG. **6**(C). Thereby, the user can visually recognize that the pressure input by the user's finger or the like touching the input unit **34** is appropriately received as a pressure input to the input object by the input apparatus.

**[0082]** After step S**18**, the control unit **20** determines whether the pressure of the user's input to the input unit **34** is reduced and the pressure load value P detected by the load detection unit **40** becomes equal to or lower than the load standard value P**2** (step S**19**). If it is determined at step S**19** that the pressure load value P becomes equal to or lower than the load standard value P**2**, the control unit **20** accepts that the operation input, being received, to the input object displayed in the interrupting manner is confirmed (step S**20**). That is, in the input processing according to the present embodiment, if compared to a mechanical key, reception of an input to a key is not confirmed when the key is pressed down but is confirmed when the key is released.

**[0083]** At step S**20**, in addition, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure on the input object to which the input is detected is released. That is, for example, the control unit **20** returns the display indicating that the input object is pressed as shown in FIG. **6**(C) to the highlight display of the input object as shown in FIG. **6**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as the input and that the input apparatus appropriately recognizes that the pressure on the input object is reduced.

**[0084]** After step S**20**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**21**). If it is determined at step S**21** that the input is not released (that is, the user has not released the finger or the like from the input unit **34**), the control unit **20** continues to monitor the pressure load value P detected by the load detection unit **40**. If it is determined at step S**21** that the user's input to the input unit **34** is released, the control unit **20** shifts to the above step S**17** to cancel the highlight display and ends the processing.

**[0085]** As stated above, after confirmation of the operation input at the pressure load exceeding the P**2** to the input object displayed in the interrupting manner, with regard to all input

objects including this input object, an input is received at a normal pressure load exceeding the P1. That is, it is preferred that the processing according to the present embodiment is carried out for an input object first displayed in the interrupting manner when there is no other input object displayed in that manner. Thereby, it can adequately avoid the unintended input by the user. In addition, it allows the user to continue the input operation with a normal light pressure after the user once confirmed the input to the input object displayed in the interrupting manner with an intended pressure input at a heavy pressure load (exceeding the P2).

**[0086]** On the other hand, if at step S13 the input position does not correspond to the position of the input object displayed in the interrupting manner, the control unit **20** shifts to step S22 to highlight a corresponding input object. It is to be noted that the processing shifts from step S13 to step S22 if the user's input to the input object is detected but the input object is not displayed in the interrupting manner. In this case, the input object is highlighted in the same manner as the highlight display at step S14.

**[0087]** Next, the control unit **20** determines whether the pressure load value P detected by the load detection unit **40** exceeds the load standard value P1 (step S23). For the input object not displayed in the interrupting manner, if there is an input exceeding the load standard value P1 but smaller than the P2, the control unit **20** carries out the processing for when the input is received in the same manner as the normal operation input. Accordingly, if the load pressure value P exceeding the load standard value P1 is not detected by the load detection unit **40** at step S23, the control unit **20** determines whether the user's input to the input unit **34** is released (step S24).

**[0088]** If it is determined at step S24 that the user's input is not released (that is, the user's finger or the like is not released from the input unit **34**), the control unit **20** returns to step S23 to monitor the pressure load value P detected by the load detection unit **40**. If it is determined at step S24 that the user's input to the input unit **34** is released, the control unit **20** regards that there is no input to the input object the user was touching, cancels the highlight display (step S17) and then ends the processing.

**[0089]** In contrast, if the pressure load value P exceeding the load standard value P1 is detected by the load detection unit **40** at step S23, the control unit **20** controls the vibration unit **50** to vibrate in order to inform the user of the pressure load value P exceeding the load standard value P1 (step S25). In this case also, although the vibration generated by the vibration unit **50** may be in the same pattern as that for any types of inputs, it is preferred to vibrate in a specific pattern such that the user can recognize that the pressure load value P exceeds the load standard value P1.

**[0090]** At step S25, additionally, the control unit **20** changes the display of the display unit **32** to indicate that the input object to which the input is detected is pressed. That is, for example, the highlight display of the input object as shown in FIG. **6**(B) is switched to the display indicating that the input object is pressed as shown in FIG. **6**(C). Thereby, the user can visually recognize that the input apparatus appropriately receives the pressure input by the user's finger or the like touching the input unit **34** as an input to the input object.

**[0091]** After step S **25**, the control unit **20** determines whether the pressure of the user's input to the input unit **34** is reduced and the pressure load value P detected by the load detection unit **40** becomes equal to or lower than the load standard value P1 (step S26). If it is determined at step S26 that the pressure load value P becomes equal to or lower than the load standard value P1, the control unit **20** accepts that the operation input to the input object currently receiving the input is confirmed (step S27).

**[0092]** At step S27, additionally, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure on the input object to which the input is detected is released. That is, for example, the control unit **20** returns the display indicating that the input object is pressed as shown in FIG. **6**(C) to the display highlighting the input object as shown in FIG. **6**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as an input, and that the input apparatus appropriately recognizes that the pressure on the input object is reduced.

**[0093]** After step S27, the control unit **20** determines whether the user's input to the input unit **34** is released (step S21). If it is determined at step S21 that the input is not released (that is, the user has not released the finger or the like from the input unit **34**), the control unit **20** continues to monitor the pressure load value P detected by the load detection unit **40**. If it is determined at step S21 that the user's input to the input unit **34** is released, the control unit **20** shifts to the above step S17 to cancel the highlight display and ends the processing.

**[0094]** The operations by the processing as stated above will be described in detail by using a typical embodiment. As shown in FIG. **7**(A), for example, it is assumed that the message creation application is running to display the character input objects on the display unit **32** of the touch panel **30** and the user's input to the input unit **34** is being received. The normal operation input such as a character input to create a message as stated above is performed at a pressure load exceeding the load standard value P1 at 1 N (Newton), for example, based on the normal pressure of the normal operation input by the user.

**[0095]** It is assumed that an incoming call is received while the character input is received by the message creation application. When the incoming call is received, an application for a telephone call is activated and input objects "Answer" and "Reject" are displayed in the interrupting manner as shown in FIG. **7**(B). In order to input effectively to the input object displayed in the interrupting manner, the user needs to perform an operation input at a pressure load exceeding the load standard value P2 (B1), which is 3 N for example, larger than the normal pressure (P1) of the normal operation input.

**[0096]** Accordingly, even if the user inputs to the input unit **34** being unaware of an incoming call screen suddenly displayed during the character input to create a message, such an unintended input to the "Answer" key or the "Reject" key is not received. Also, even if the user inputs to the input unit **34** as it is too late to change operation from being aware of the incoming call screen suddenly displayed while the user inputs characters in a message, such an unintended input to the key is not received, either.

**[0097]** According to the present embodiment, as stated above, a load greater (heavier) than the pressure load based on the normal operation input is set only for a first pressure input to the input object displayed in the interrupting manner on the display unit **32**. A type of such an input by the pressure load greater (heavier) than that of the normal operation input differs from various input types (for example, holding down and a double pressing such as a double click) regarded as normal

input methods. Accordingly, since an input in one of the various input types regarded as the normal input methods to the input object displayed in the interrupting manner is not received, an incorrect input unintended by the user is not received as an effective input. That is, an input by an unintended operation by the user is avoided.

**[0098]** Additionally, if the user is aware of the incoming call screen suddenly displayed while inputting characters in a message, the user purposely performs the operation input with a pressure heavier to some extent than the normal pressure of the normal operation input. Thereby, the pressure input to the "Answer" key or the "Reject" key according to a user's intention is effectively received.

**[0099]** In the processing according to the present embodiment, when an input object is displayed in the interrupting manner, it is preferred to indicate, for the user, that this input object needs to be pressed with a pressure heavier than that of the normal operation input. For example, as the input objects of the "Answer" key and the "Reject" key shown in FIG. **7**(B), it is possible to emphasize input objects being displayed in the interrupting manner by displaying the input objects on the display unit **32** at a display state with different colors or the like from keys of other input objects. It is also possible to display the input objects displayed in the interrupting manner on the display unit **32** together with a note such as "Touch key strongly", for example, as shown in FIG. **7**(C).

**[0100]** Now, another embodiment is described. It is assumed that the web browser application is running to display an internet website on the display unit **32** of the touch panel **30** and the user's inputs to the input unit **34** are being received as shown in FIG. **8**(A), for example. In the screen shown in FIG. **8**(A), underlined character strings (links) are input objects that allow the user to jump to another page (site) upon being pressed. The normal operation input such as a pressure input to the link to another page is performed by a pressure load exceeding the pressure standard value P**1**, which is 1 N for example, based on the normal pressure of the normal operation input by the user.

**[0101]** It is assumed that there is a request to the web browser application to display a pop-up advertisement while the pressure input to the link is performed using the application. When the request to display the pop-up advertisement is processed, the input object of the pop-up advertisement is displayed in the interrupting manner on the display unit **32** as shown in FIG. **8**(B). In order that an input to the input object displayed in the interrupting manner is effectively received, it is necessary for the user to perform an operation input with a pressure load exceeding the load standard value P**2** (B**1**), which is 3 N for example, greater than the normal pressure (P**1**) of the normal operation input.

**[0102]** Accordingly, even if the user inputs to the input unit **34** being unaware of the pop-up advertisement suddenly displayed at the moment that the user tires to press the link to jump, such an unintended input to the pop-up advertisement is not received. Also, even if the user inputs to the input unit **34** as it is too late to change operation from being aware of the pop-up advertisement suddenly displayed at the moment that the user tires to press the link to jump, such an unintended input to the pop-up advertisement is not received, either.

**[0103]** Additionally, if the user is aware of the pop-up advertisement suddenly displayed, the user purposely performs an operation input to it with a pressure heavier to some extent than the normal pressure of the normal operation input. Thereby, the input to the pop-up advertisement according to a user's intention is effectively accepted.

**[0104]** In the processing according to the present embodiment, when the input object such as the pop-up advertisement and the like is displayed in the interrupting manner, it is preferred to indicate, for the user, that this input object needs to be pressed with a pressure larger than that of the normal operation input. For example, as the input object of the pop-up advertisement shown in FIG. **8**(B), it is possible to emphasize the input object being displayed in the interrupting manner by displaying the input object on the display unit **32** at a display state with different colors or the like from keys of other input objects. It is also possible to display the input object displayed in the interrupting manner on the display unit **32** together with the note such as "Touch key strongly", for example, as shown in FIG. **8**(C).

**[0105]** There may be a case that a plurality of input objects such as input objects originally displayed and another input object displayed in the interrupting manner are mixed, as shown in FIGS. **8**(B) and (C). In this case also, by the processing according to the present embodiment, the user can perform a normal operation input with a normal pressure exceeding the P**1** to the input objects originally displayed. In contrast, an input to the input object displayed in the interrupting manner is not regarded as an input unless the pressure exceeds the P**2** greater than that of the normal operation input. Accordingly, even when a plurality of input objects are mixed, it is possible to distinctively input to the input object originally displayed and an input to the input object displayed in the interrupting manner.

**[0106]** It is to be understood that the present invention is not limited to the embodiments set forth above but may be modified or varied in a multiple manner. For example, although in the above embodiments it is assumed to predefine the load standard values P**1** and P**2**, it is desired to allow the user to change or adjust them appropriately as necessary. Thereby, it is possible to appropriately adjust the values later if the user feels uncomfortable about them during operation.

**[0107]** In the processing according to the above embodiment, it is determined that an input is not confirmed yet when the pressure load value exceeds the P**1** or the P**2** but it is confirmed when the pressure load falls down to equal to or less than the P**1** or P**2** after exceeding the P**1** or the P**2**. However, it is also possible to simplify the processing by confirming the input at a point when the pressure load value reaches or exceeds the P**1** or the P**2**.

**[0108]** In addition, in the above embodiments the vibration unit **40** is vibrated when the pressure load of the user's input exceeds the P**1** or the P**2**, in order to inform the user accordingly. However, in such a case it is not essential to vibrate but it is possible to generate a specific sound from the audio output unit **80**. Additionally, it is also possible to indicate that the pressure load of the user's input exceeds the P**1** or the P**2**, by altering the color or a display state of the input object receiving the input on the display unit **32**.

**[0109]** Moreover, in addition to embodiments described above, it is also possible to vibrate the vibration unit **40** at steps S**20** and S**27**, for example, in order to indicate that user's input is appropriately processed.

## INDUSTRIAL APPLICABILITY

**[0110]** According to the present invention, the load standard for receiving a pressure input to an input object displayed in the interrupting manner is set higher than the load

standard for receiving a pressure input to a normal input object (not displayed in the interrupting manner). Thereby, it is possible to perform the normal pressure input to a normal input object (not displayed in the interrupting manner) based on a user's intention. In contrast, an operation input to an input object displayed in the interrupting manner is not received unless it has a pressure load satisfying the load standard higher than that for the normal input. Accordingly, it is possible to avoid an unintended operation input by the normal input to the input object suddenly displayed in the interrupting manner. In addition, in order to perform an input operation with intention of inputting to the input object displayed in the interrupting manner, the user performs a pressure input with a pressure load satisfying the load standard higher than that for the normal input. Thereby, the user can perform the operation input based on the user's intention.

REFERENCE SIGNS LIST

**[0111]** **10** mobile phone
**[0112]** **20** control unit
**[0113]** **30** touch panel
**[0114]** **32** display unit
**[0115]** **34** input unit
**[0116]** **40** load detection unit
**[0117]** **50** vibration unit
**[0118]** **60** memory unit
**[0119]** **70** audio input unit
**[0120]** **80** audio output unit
**[0121]** **90** key input unit

**1**. An input apparatus comprising:
a display unit for displaying an input object;
an input unit for receiving a pressure input to the input object displayed on the display unit;
a load detection unit for detecting a pressure load on the input unit; and
a control unit for controlling to receive the pressure input when the pressure load detected by the load detection unit satisfies a load standard, wherein
the control unit controls such that a load standard for receiving a pressure input to an input object displayed on the display unit in an interrupting manner is higher than a load standard for receiving a pressure input to the input object which has been displayed on the display unit.

* * * * *

# Exhibit D

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(54) **INPUT APPARATUS**

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(52) **U.S. Cl.** ..... **345/173**

(57) **ABSTRACT**

The input apparatus has an input unit for receiving a pressure input to an input object displayed on the display unit, a load detection unit for detecting a pressure load on the input unit, and a control unit for controlling to receive the pressure input if the pressure load satisfies a load standard. The control unit controls such that load standards for receiving pressure inputs to a plurality of adjacent input objects are differently set to a first load standard and a second load standard higher than the first load standard, and controls such that if a pressure load of a pressure input to an input object with the first load standard satisfies the second load standard, the pressure input is not received.

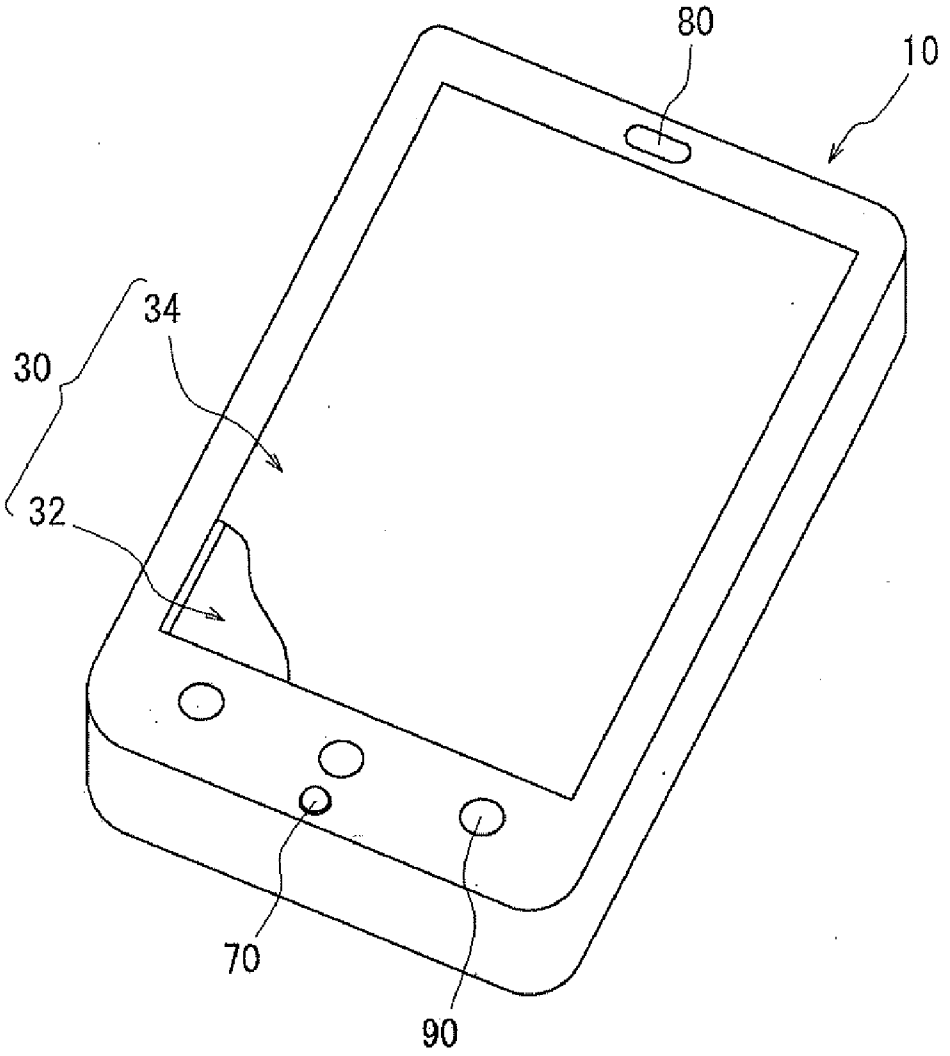


FIG. 1

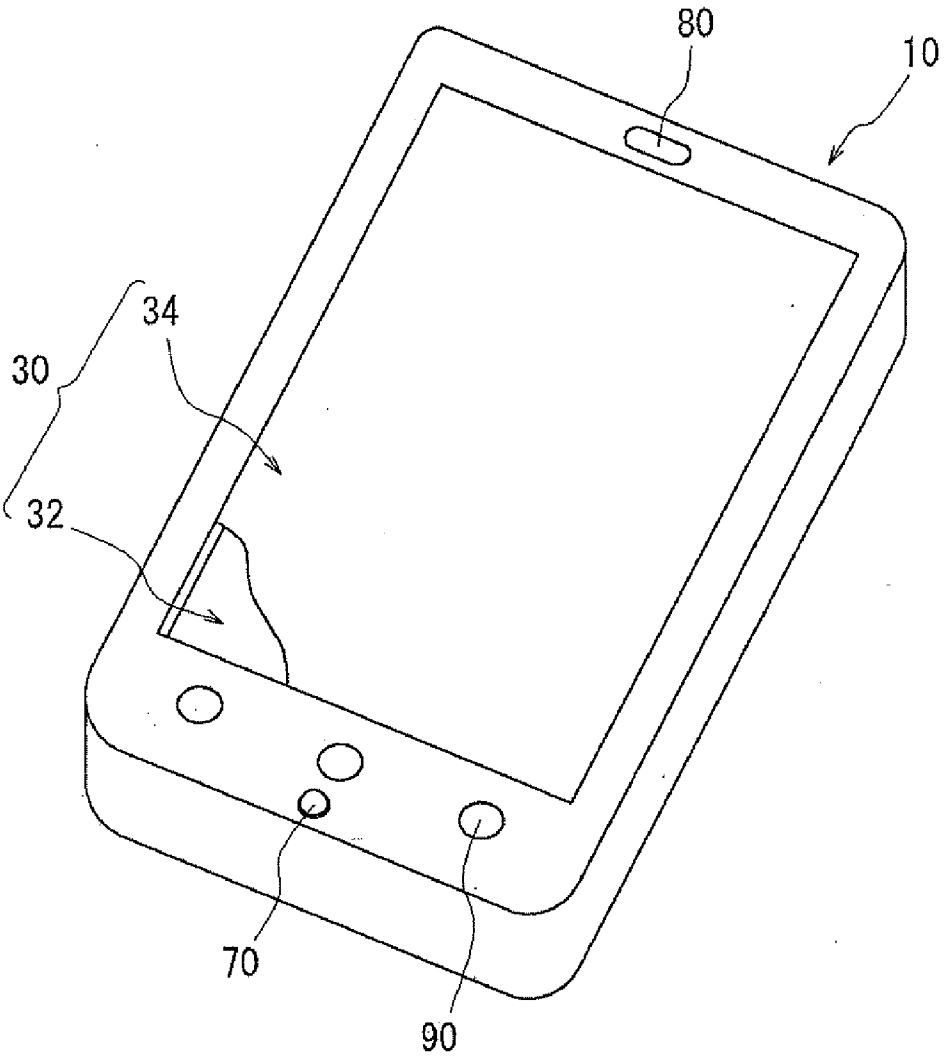


FIG. 2

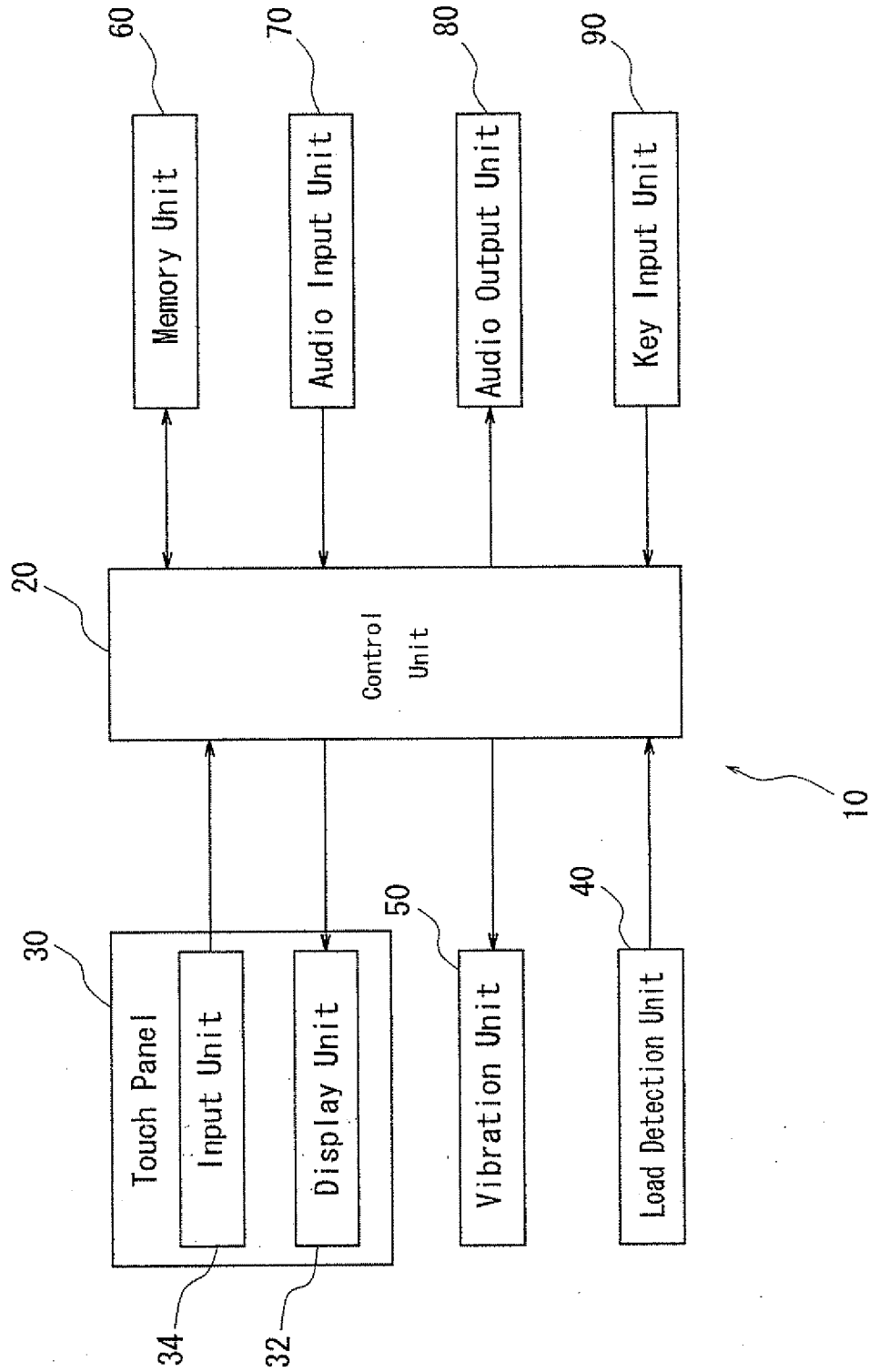

60
Memory Unit
70
Audio Input Unit
80
Audio Output Unit
90
Key Input Unit
20
Control Unit
10
30
Touch Panel
Input Unit
Display Unit
50
Vibration Unit
40
Load Detection Unit
34
32

FIG. 3

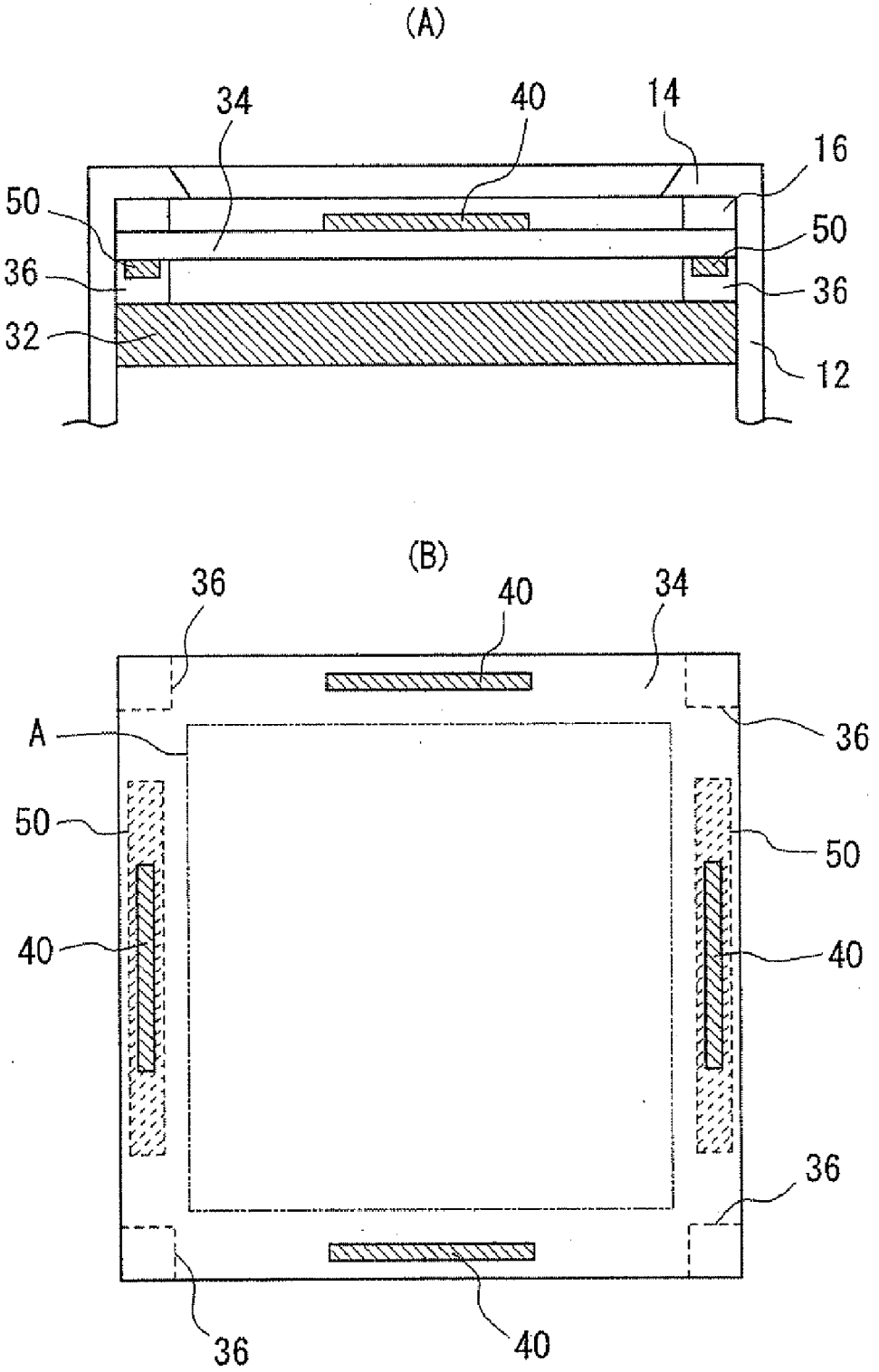


FIG. 4

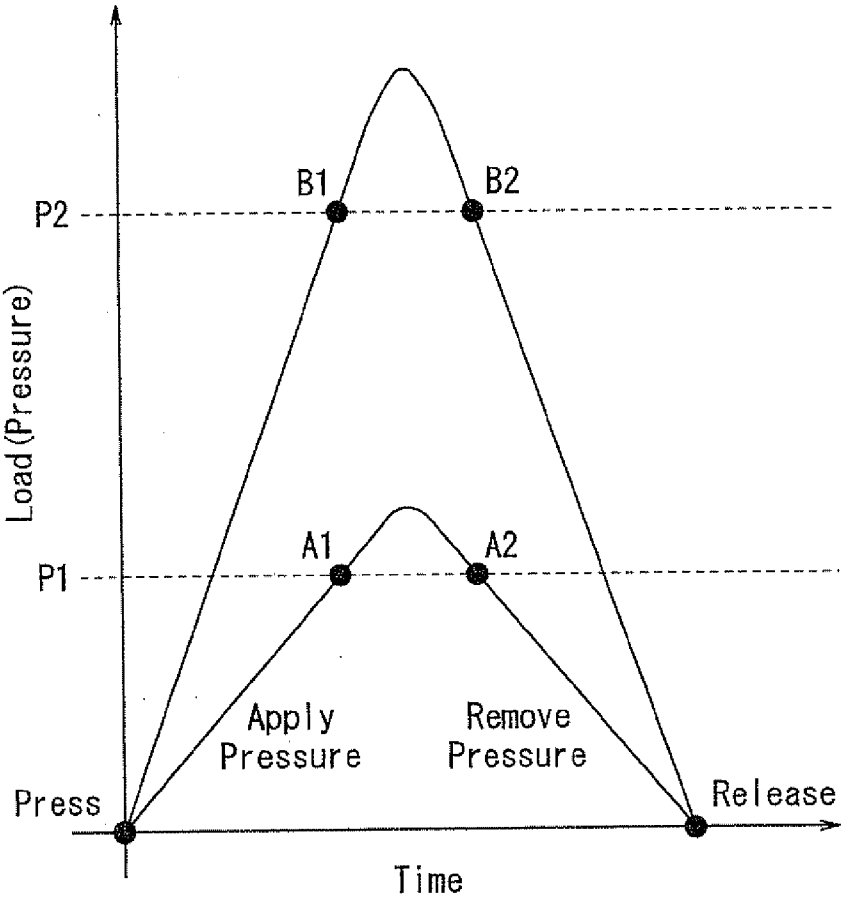

B1
B2
P2
Load (Pressure)
A1
A2
P1
Apply Pressure
Remove Pressure
Press
Release
Time

FIG. 5

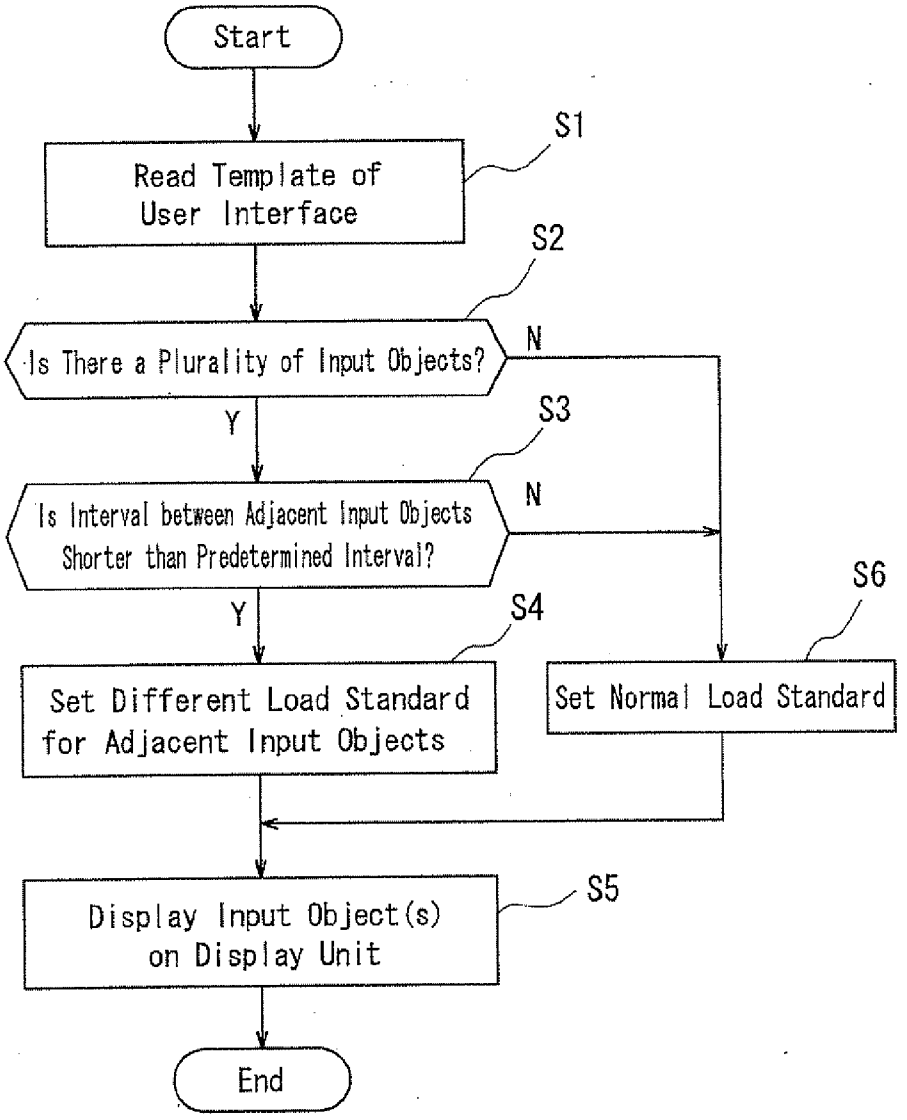

Start
S1
Read Template of User Interface
S2
Is There a Plurality of Input Objects?
N
Y
S3
Is Interval between Adjacent Input Objects Shorter than Predetermined Interval?
N
Y
S4
Set Different Load Standard for Adjacent Input Objects
S6
Set Normal Load Standard
S5
Display Input Object(s) on Display Unit
End

FIG. 6

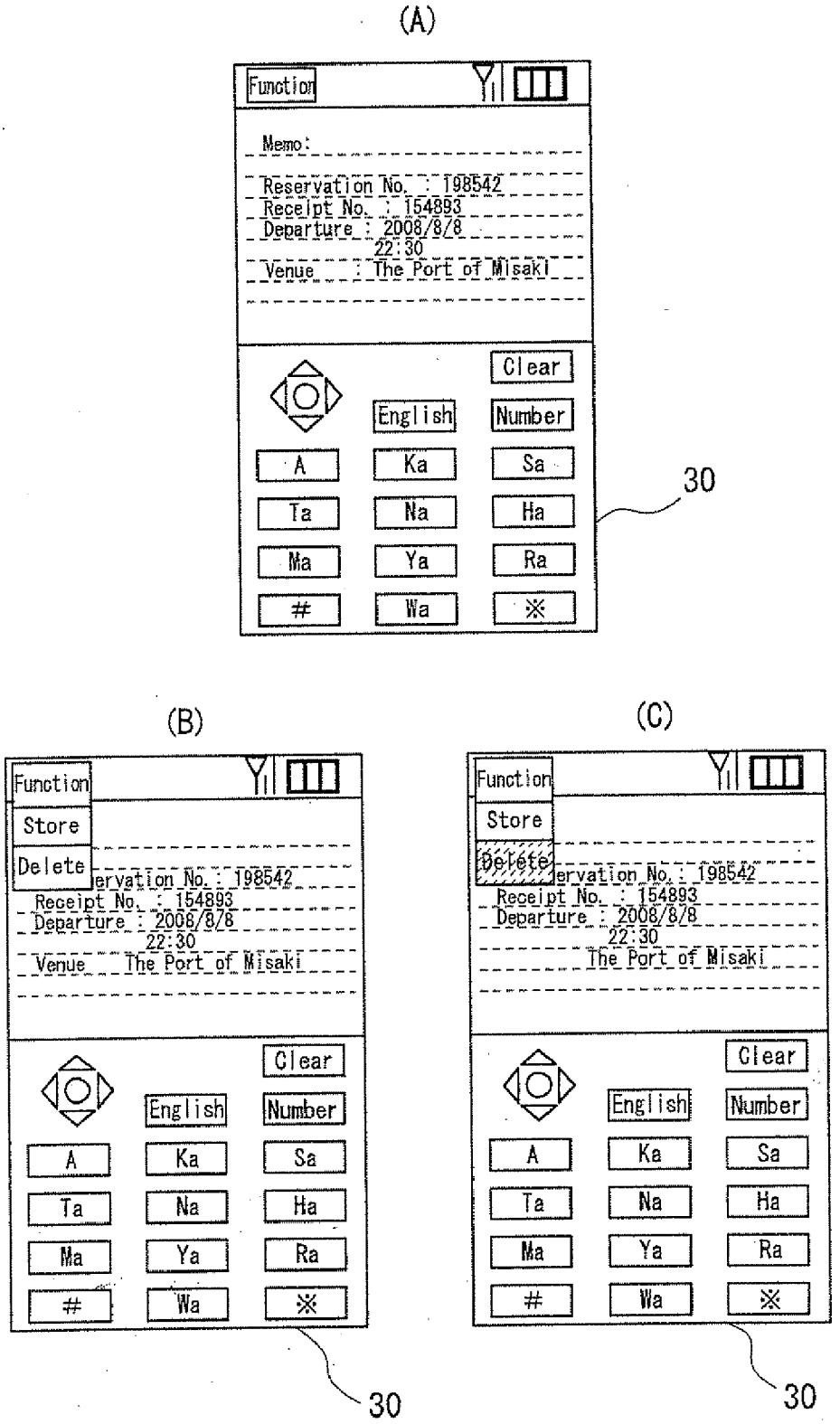

(A)
Function
Memo:
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue : The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30
(B)
Function
Store
Delete
ervation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30
(C)
Function
Store
Delete
ervation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30

FIG. 7

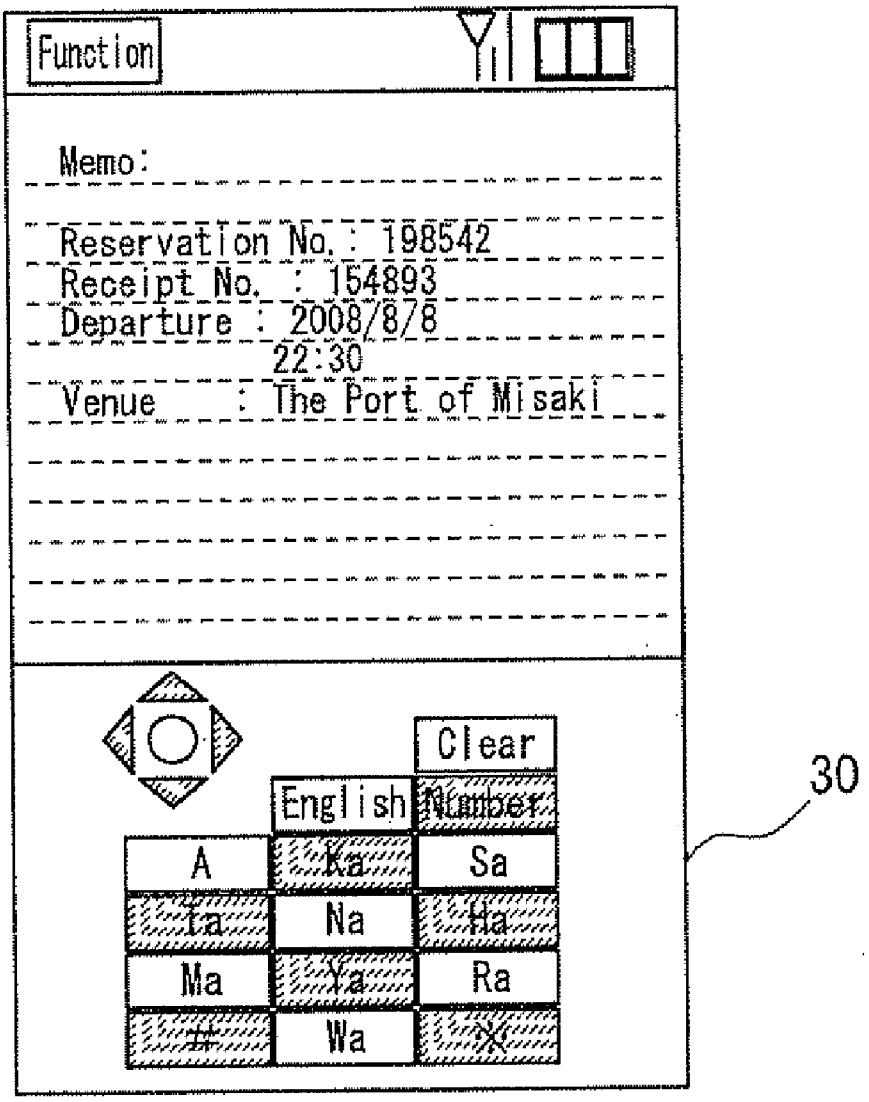

Function
Memo:
Reservation No. : 198542
Receipt No. : 154893
Departure : 2008/8/8
22:30
Venue : The Port of Misaki
Clear
English
Number
A
Ka
Sa
Ta
Na
Ha
Ma
Ya
Ra
#
Wa
※
30

FIG. 8

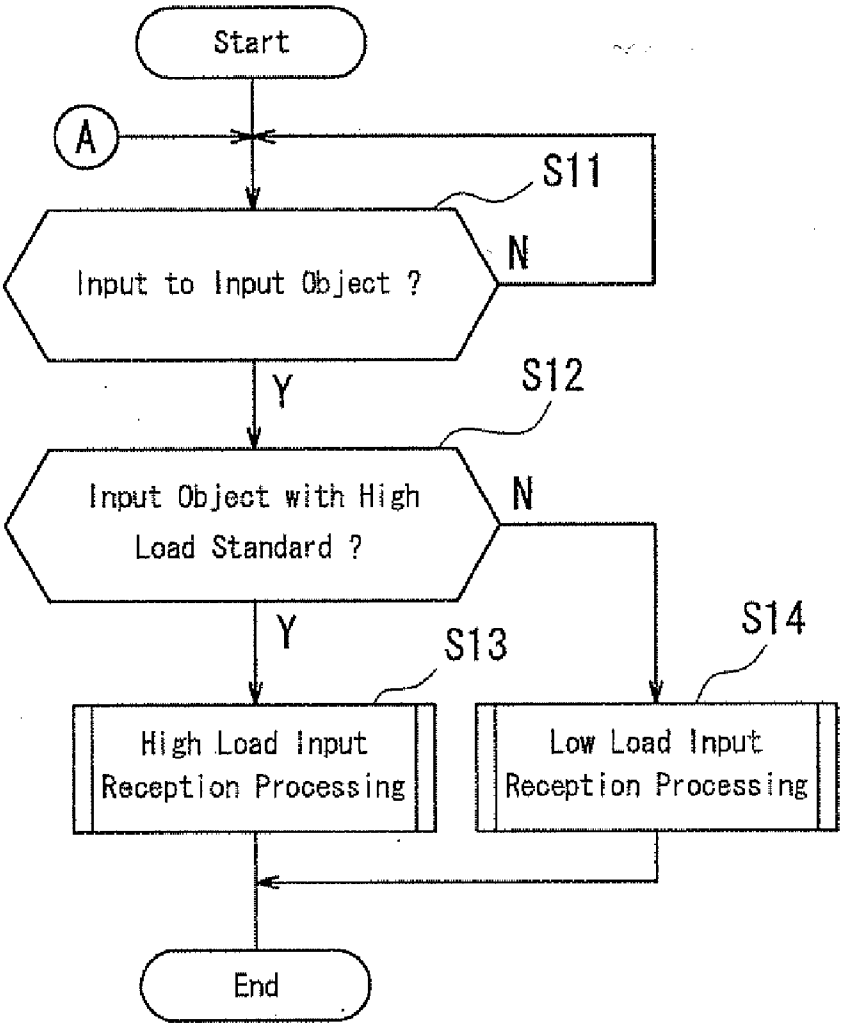

Start
A
S11
Input to Input Object ?
N
Y
S12
Input Object with High Load Standard ?
N
Y
S13
S14
High Load Input Reception Processing
Low Load Input Reception Processing
End

FIG. 9

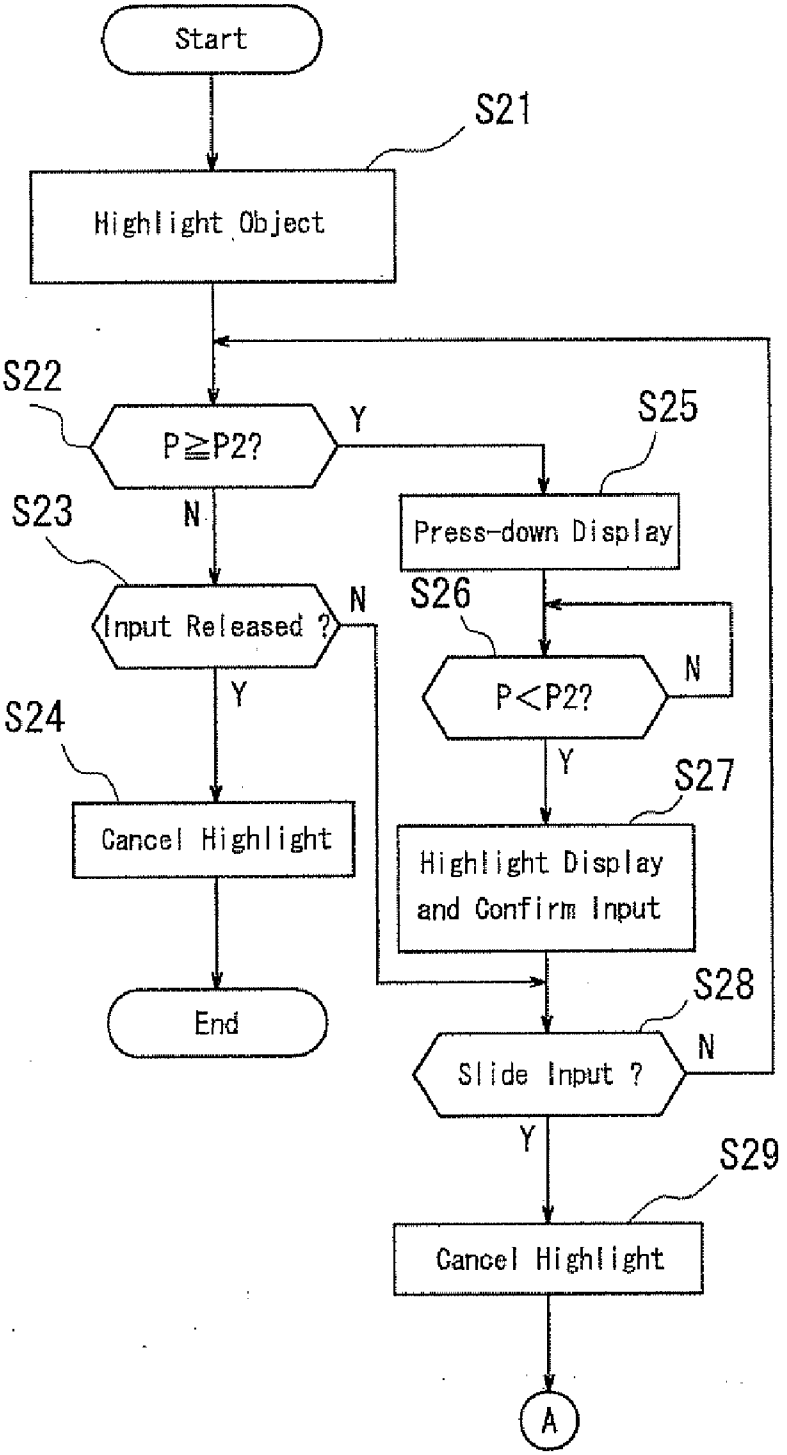

Start
S21
Highlight Object
S22
P≧P2?
Y
S25
N
S23
Press-down Display
Input Released ?
N
S26
Y
P<P2?
N
S24
Y
S27
Cancel Highlight
Highlight Display and Confirm Input
End
S28
Slide Input ?
N
Y
S29
Cancel Highlight
A

FIG. 10

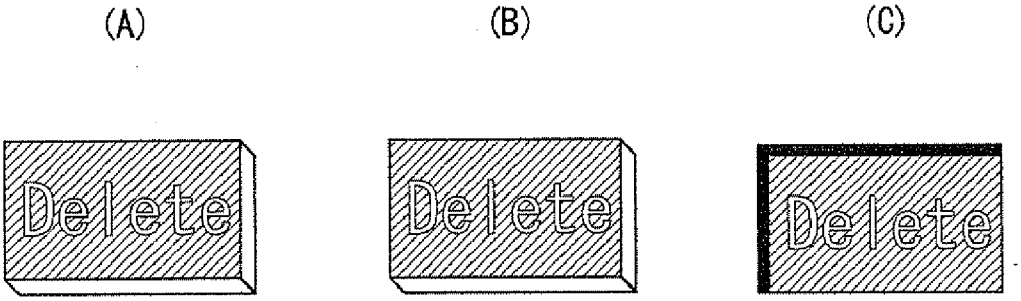


FIG. 11

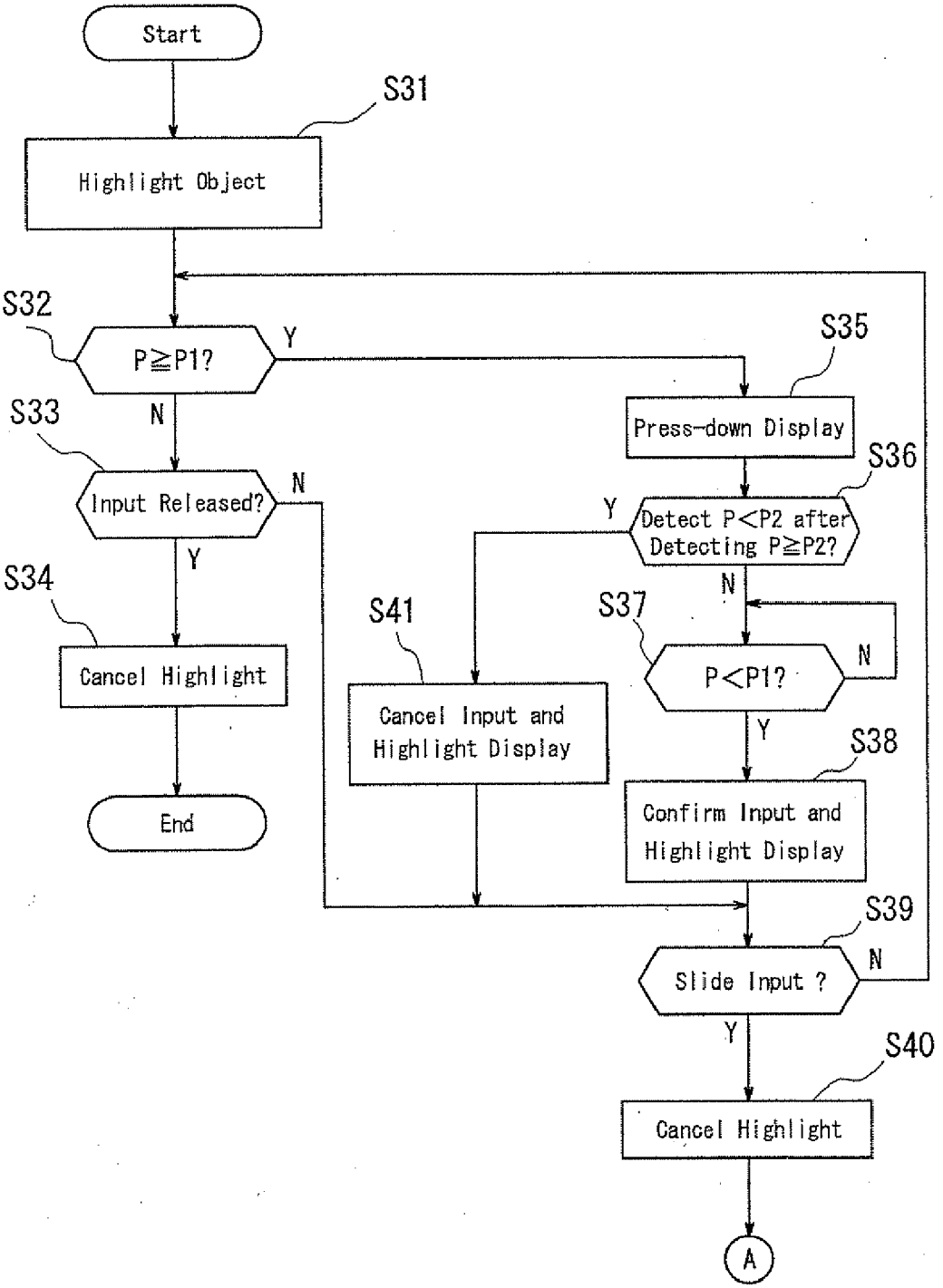

Start
S31
Highlight Object
S32
P≧P1?
Y
S35
N
S33
Press-down Display
Input Released?
N
S36
Y
Detect P<P2 after Detecting P≧P2?
Y
S34
N
S41
S37
Cancel Highlight
Cancel Input and Highlight Display
P<P1?
N
Y
S38
End
Confirm Input and Highlight Display
S39
Slide Input ?
N
Y
S40
Cancel Highlight
A

FIG. 12

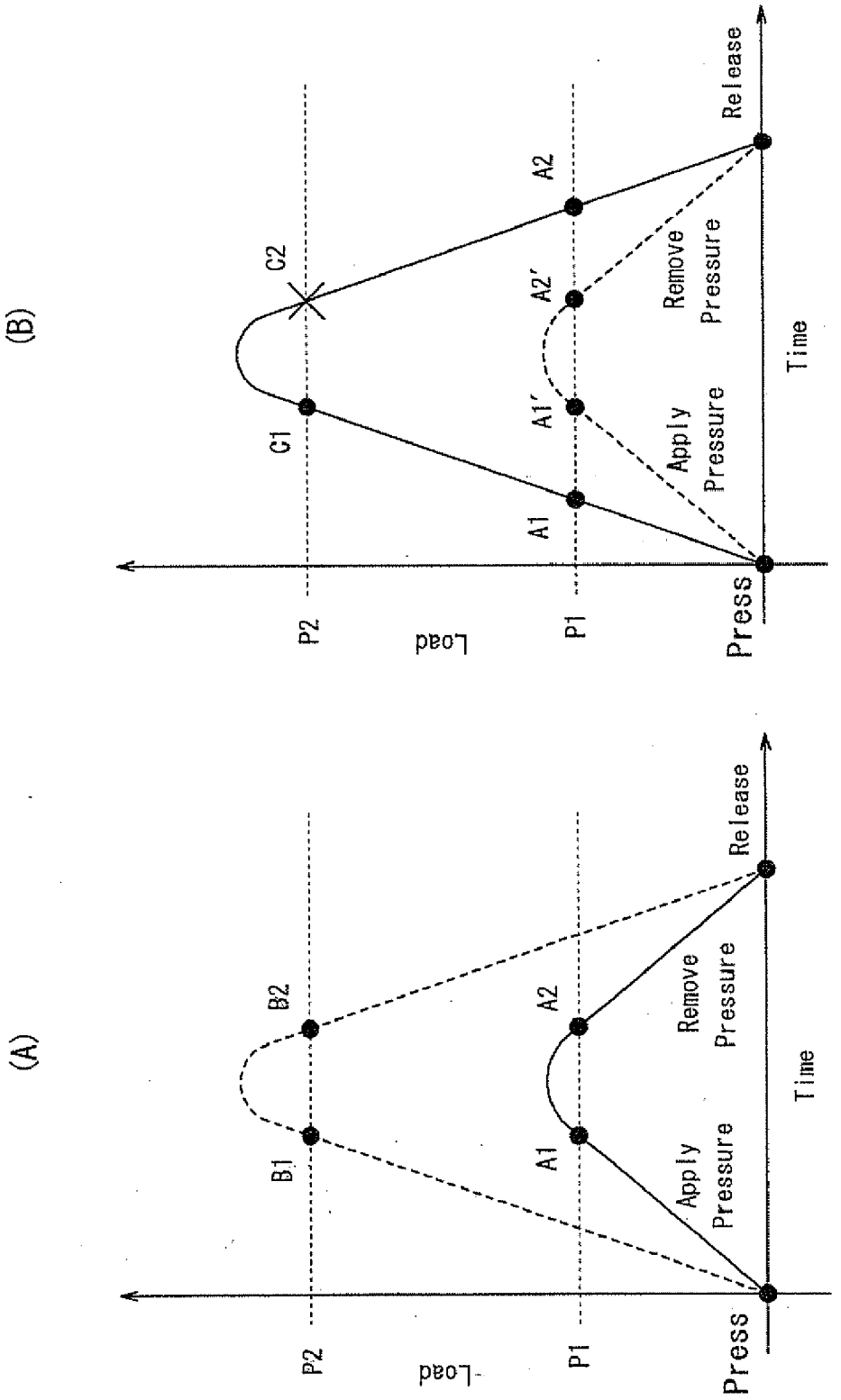

(A)
B2
B1
A2
A1
Remove Pressure
Apply Pressure
Release
Time
P2
Load
P1
Press
(B)
C2
C1
A2'
A1'
A2
A1
Remove Pressure
Apply Pressure
Release
Time
P2
Load
P1
Press

FIG. 13

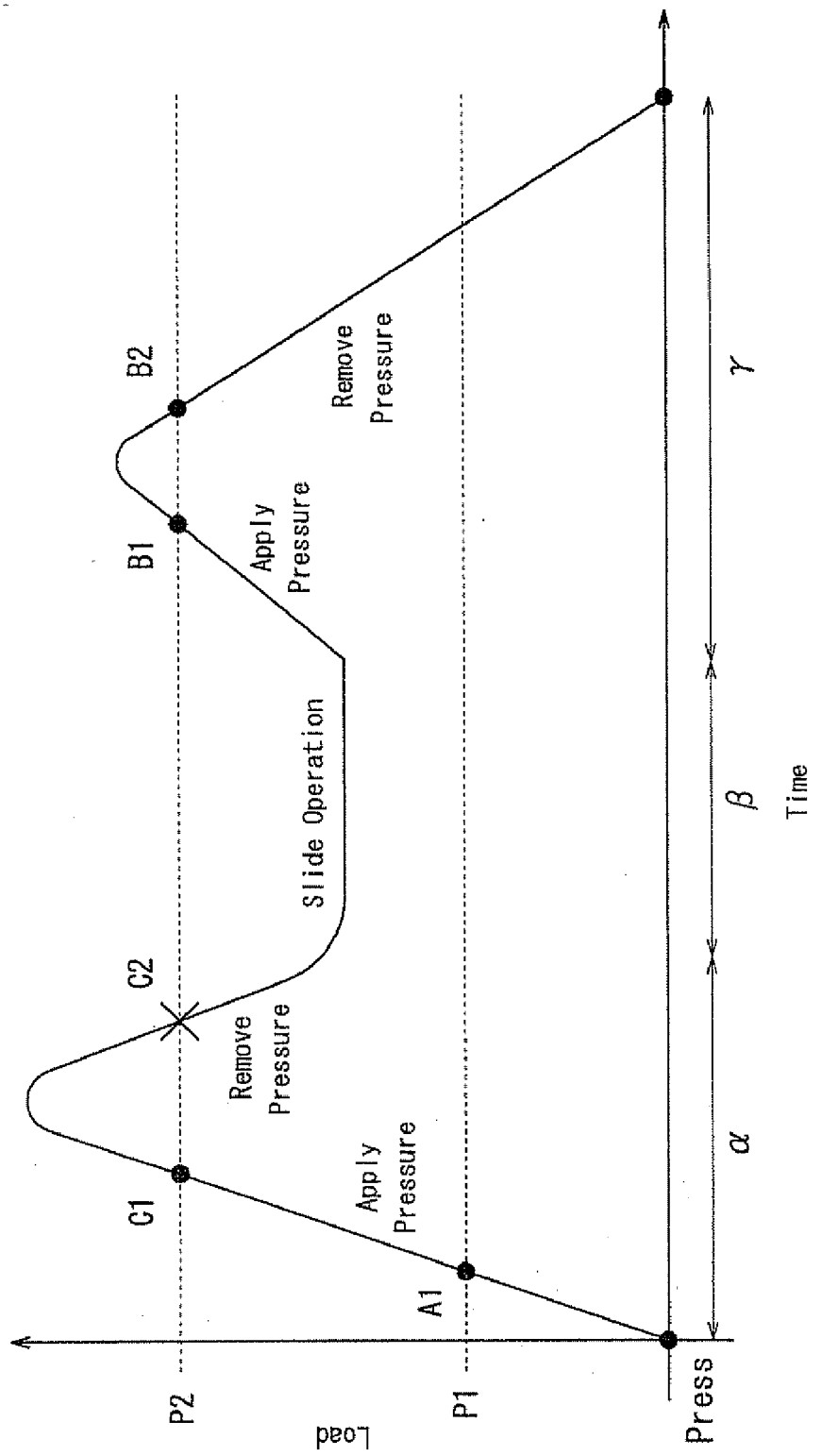
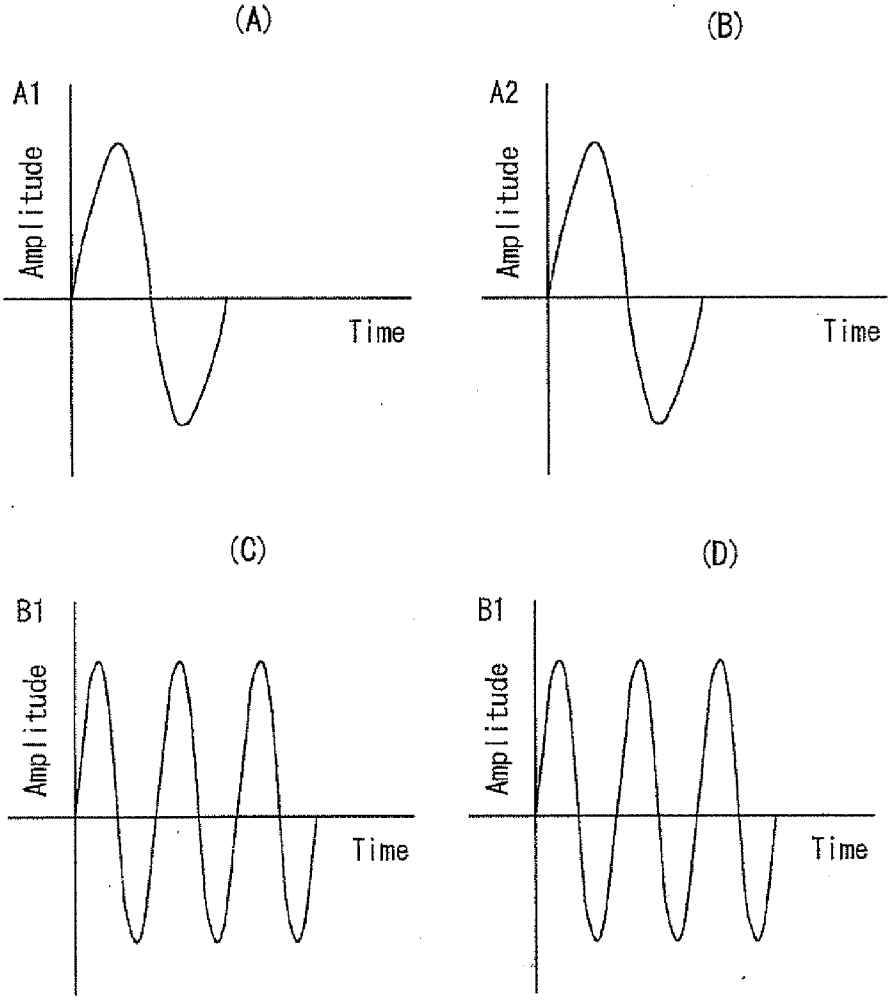

Load
Press
Time
P2
P1
C1
C2
B1
B2
A1
Apply Pressure
Remove Pressure
Slide Operation
Apply Pressure
Remove Pressure
α
β
γ

FIG. 14


(A)
A1
Amplitude
Time
(B)
A2
Amplitude
Time
(C)
B1
Amplitude
Time
(D)
B1
Amplitude
Time

# INPUT APPARATUS

## CROSS REFERENCE TO RELATED APPLICATION

**[0001]** This application claims priority to and the benefit of Japanese Patent Application No. 2008-331272 filed on Dec. 25, 2008, the entire contents of which are incorporated herein by reference.

## TECHNICAL FIELD

**[0002]** The present invention relates to input apparatuses, and more particularly, to input apparatuses having touch panels.

## BACKGROUND ART

**[0003]** For mobile terminals such as mobile phones, various input apparatuses used by users to operate the terminals have been developed in a variety of manners according to functions and usages of each of the terminals. In many cases, an input apparatus has mechanical keys or buttons arranged in advance on a surface of a body such that a user performs an input operation by directly pressing a finger or the like to the keys.

**[0004]** The mechanical keys (for example, a numerical keypad) of the input apparatus of the terminal are normally arranged in advance to suit a main usage of the terminal. Accordingly, it is generally not possible to change a physical arrangement of keys, once defined, later.

**[0005]** Recently, a variety of functions are incorporated in small mobile terminals. For example, the mobile phones have a digital camera function and a music player function. There are mobile terminals such as a mobile phone having numerous supplementary functions incorporated therein in addition to a function for a main usage of the terminal, and PDA (Personal Digital Assistant: mobile information terminal) having, as a single terminal, a plurality of main usages such as schedule management, an address book and the like. If such terminals have keys fixedly arranged, it may inconvenience the user significantly in using particular functions.

**[0006]** In order to resolve such inconvenience, there is disclosed an input apparatus having a touch panel designed such that a transparent input unit is arranged overlapping a front face of a liquid crystal display constituting a display unit (for example, see Patent Document 1). The input apparatus having such a touch panel generally displays graphical images of operation keys and buttons (hereinafter, referred to as "input objects") on a display screen of the touch panel. When the user presses an input object displayed on the display screen, an input unit at a corresponding position on the touch panel receives an input.

**[0007]** A folding mobile phone described in the above Patent Document 1 can display input objects arbitrarily arranged on the display screen of the touch panel to receive input operations by the user, and thus key arrangements can be designed as desired. Accordingly, this mobile phone may provide an excellent operability, as capable of changing the arrangement of the input objects as desired to suit a function when each function of the terminal is switched. For example, when the user uses a digital camera function implemented in the mobile phone, this mobile phone may display input objects constituting an operation unit for a digital camera on the touch panel and receive operation inputs. On the other hand, when the user inputs characters in messages using the mobile phone, the mobile phone may display an input object constituting a keyboard like a personal computer (PC) on the touch panel and receive inputs. As stated above, this mobile phone having the touch panel can optimize a single input apparatus to suit each of a plurality of functions and receive operation inputs.

**[0008]** In addition, since the input apparatus having the touch panel receives an input in the form of a user's direct contact (touch) of a finger or the like to the input object displayed on the display unit, the user can operate it highly intuitively. That is, the user operates the input apparatus by directly touching the input object displayed on the screen with a finger or the like following a guide displayed on the screen of the touch panel. Accordingly, the user can operate the terminal extremely easily through intuitive operations following the guide displayed on the screen, which offers an effect to reduce incorrect operations as a result.

**[0009]** In recent years, the mobile terminal having the touch panel as stated above enables the user not only to make a normal telephone call and to perform operation inputs for creating a message but also to perform operation inputs to view (browse) contents delivered through the internet and websites. In addition, the input apparatuses having the touch panel are commonly used for not only the mobile terminals but also, for example, ATMs (Automatic Teller Machines) of a bank and the like and ticket vending machines at train stations. Moreover, in stores such as fast-food shops, terminal equipment with the input apparatus having the touch panel as above is used by a clerk to process orders from customers. When the touch panel is employed as the input apparatus, the mechanical buttons and keys such as the keyboard are not essential components any more. Accordingly, since only a small area is required to arrange mechanical buttons and the like on the terminal apparatus, it enables downsizing of overall terminal apparatus. Therefore, it offers a broader choice of installation sites of the terminal apparatus in the stores and train stations.

**[0010]** In addition, the touch panel employed as the input apparatus eliminates the necessity of separately having a display unit for displaying various information and an input unit for receiving operation inputs by the user as individual function units like a general design of conventional apparatus, and enables to configure the information display unit and the input unit on the same screen. Accordingly, it is possible, for example, to display input object constituting keys of a keyboard on the touch panel to receive an input by the user while displaying a result of the input near the keyboard on the touch panel. Thereby, the user can perform an operation input and confirm the result of the input on the same screen.

**[0011]** As described above, the touch panel provides merits to enable to configure the input unit and the display unit on the same screen and also to enable intuitive operation inputs. For that reason, the number of terminal apparatuses having such input apparatus has been increased more and more.

**[0012]** However, the input apparatus with the touch panel has a specific problem because of its configuration to have the input unit and the display unit on the same screen and to receive the intuitive operation input. That is, although the touch panel can constitute the display unit arranging the input objects as desired, it is difficult for the user to determine a boundary between an input object and another area by a tactile sensation because a surface of the input unit is generally flat. In addition, since the user directly touches the input unit with a finger or a stylus in order to input to the touch

panel, the input object is covered at the moment of the pressure input, preventing the user from visually confirming the input object to receive the operation input.

**[0013]** Accordingly, since the user cannot determine, with a feeling on the finger, whether the finger is touching an input object, there is always a possibility to press an unintended position. That is, there is a risk of pressing a position elsewhere than an intended input object by pressing a position slightly off from it or a risk of pressing another input object adjacent to the intended input object. When pressing an input object with a finger, a risk of unintended input becomes higher, as the input object is covered with the finger.

**[0014]** In addition, if the unintended input of the user is received by the input apparatus, an operation that the user does not intend may be started in response to the input. In such a case, the user must perform an additional operation to stop (cancel) the unintended operation. Moreover, if an important processing or operation being performed is stopped because of the unintended operation, it may cause an unrecoverable situation. Accordingly, it is desired to reduce a risk that such an unintended operation is started based on the unintended input by the user, as much as possible.

**[0015]** As a scheme capable of handling such a condition, there is suggested an input apparatus having a means to detect an input pressure to the touch panel and is configured to change a height of a surface of the touch panel in accordance with a position and the pressure of the input to the touch panel by the user (for example, see Patent Document 2).

## PRIOR ART DOCUMENTS

### Patent Documents

**[0016]** Patent Document 1: Japanese Patent Laid-Open No. 2006-311224

**[0017]** Patent Document 2: Japanese Patent No. 4039344

## SUMMARY OF INVENTION

### Technical Problem

**[0018]** According to the input apparatus described in the above Patent Document 2, when there is a user's input to an input object displayed on the display unit of the touch panel, it is possible to indicate that the user is touching the input object, by changing the height of the touch panel. That is, when the user touches an input object, this input apparatus indicates that the position touched by the user corresponds to an input object, by lifting the surface of the touch panel higher than a level when the user touches an area elsewhere than an input object. In addition, when recognizing a light touch by the user to a position corresponding to an input object of the touch panel, this input apparatus enlarges an image of the input object to allow for better viewability (for example, see FIG. 7 and FIG. 10 of Patent Document 2). With a variety of measures taken as stated above, the input apparatus described in Patent Document 2 helps the user to input avoiding erroneous operations.

**[0019]** According to this input apparatus, the user can determine, with the feeling on the finger, whether there is an input object at a position of the touch panel that the finger is touching. In addition, as capable of enlarging the image of the input object being touched by the user, this input apparatus can relatively reduce an area covered with the finger touching the input object. Accordingly, this input apparatus can reduce the risk of receiving unintended inputs by the user.

**[0020]** However, there are disadvantages when such a technique is applied to a small mobile terminal such as the mobile phone, for example. That is, a mechanism to change the height of the surface of the touch panel as stated above requires a considerable width wider than the variation width of the surface of the touch panel. This is because a mechanical drive apparatus to change the height of the touch panel needs to be in a certain size at least and also because it is necessary to secure a space to allow for a change in the height of overall touch panel. In recent development of the mobile phone, it is desired to minimize its size as much as possible and thus it is anticipated to present a technical difficulty in mounting such a mechanism for changing the height of the surface of the touch panel in a body of the mobile phone.

**[0021]** In addition, in case of a small mobile terminal such as a mobile phone, unlike large terminals such as the ATMs of a bank and the ticket vending machines at a train station, the touch panel serving also as a display unit is substantially limited in size, and thus the display unit for displaying input objects is small in size inevitably. On the other hand, although being small in size, the mobile terminal needs to display a number of input objects of various types, in order to receive various inputs to the touch panel by the user. Accordingly, it is considered that there is difficulty for the mobile terminal to display an enlarged image of an input object when a user touches the input object.

**[0022]** Moreover, when a number of input objects are displayed on the touch panel limited in size, it is considered that it is difficult to virtually indicate whether the location the user is touching corresponds to an input object, by changing the height of the touch panel as stated above. Especially, if a number of input objects limited in size are arranged at adjacent positions, there is little or no space between them. Therefore, it is considered that it is very difficult to enable the user to recognize an edge portion (a portion corresponding to an edge of a key) of each of the input objects by changing the height of the touch panel. Accordingly, it is considered that, when a number of small input objects are displayed at adjacent positions on the touch panel of the small mobile terminal such as the mobile phone, it is difficult to reduce user's incorrect inputs by applying the above scheme described in the Patent Document 2.

**[0023]** If multiple input objects are displayed at adjacent positions on a small touch panel, it is generally difficult for the user to distinctly input to each of the input objects. Accordingly, there is a possibility that the user performs an incorrect operation against an intention and an unintended operation starts based on the incorrect operation.

**[0024]** In addition, the small mobile terminal such as the mobile phone has a particular condition not only to display multiple input objects on the touch panel limited in size but also to receive user's inputs while the user is walking or performing another operation. It is desired to receive inputs to multiple input objects as intended by the user and also to avoid incorrect operations by the user, even if the user is not looking at the input unit. Moreover, an input apparatus is desired which, if the user performs an incorrect input unintentionally, avoids starting an unintended operation based on the input.

**[0025]** Accordingly, an object of the present invention in consideration of such conditions is to provide an input apparatus capable of avoiding incorrect operations based on a user's incorrect operation in receiving pressure inputs to a

plurality of adjacent input objects on a touch panel mounted on, for example, a mobile phone.

Solution to Problem

**[0026]** In order to achieve the above object, an input apparatus according to a first aspect of the present invention includes:

**[0027]** a display unit for displaying an input object;

**[0028]** an input unit for receiving a pressure input to the input object displayed on the display unit;

**[0029]** a load detection unit for detecting a pressure load on the input unit; and

**[0030]** a control unit for controlling to receive the pressure input if the pressure load detected by the load detection unit satisfies a load standard, wherein

**[0031]** the control unit controls such that load standards for receiving pressure inputs to a plurality of adjacent input objects are differently set to a first load standard and a second load standard higher than the first load standard, and controls such that a pressure input is not received if a pressure load of the pressure input to an input object with the first load standard satisfies the second load standard.

**[0032]** A second aspect of the present invention is that, in the input apparatus according to the first aspect, the control unit controls such that a pressure input is not received if a pressure load of the pressure input to an input object with the first load standard falls down to be lower than the second load standard after satisfying the second load standard.

BRIEF DESCRIPTION OF DRAWINGS

**[0033]** FIG. **1** is an external perspective view of a mobile phone having an input apparatus according to an embodiment of the present invention;

**[0034]** FIG. **2** is a functional block diagram illustrating an internal configuration of the mobile phone according to the embodiment;

**[0035]** FIG. **3** shows diagrams illustrating an exemplary implementation structure of a touch panel, a load detection unit and a vibration unit of the mobile phone shown in FIG. **2**;

**[0036]** FIG. **4** is a graph schematically illustrating an exemplary chronological change in a load (pressure) detected by the load detection unit when a user presses an input unit of the touch panel;

**[0037]** FIG. **5** is a flowchart illustrating the input object load standard setting processing according to the embodiment;

**[0038]** FIG. **6** shows exemplary displays on the display unit based on the input object load standard setting processing according to the embodiment;

**[0039]** FIG. **7** shows another exemplary display on the display unit based on the input object load standard setting processing according to the embodiment;

**[0040]** FIG. **8** is a flowchart illustrating the pressure input reception processing of an input object according to the embodiment;

**[0041]** FIG. **9** is a flowchart illustrating the high load input reception processing according to the embodiment;

**[0042]** FIG. **10** shows diagrams illustrating a highlight display and a pressed-down display according to the embodiment;

**[0043]** FIG. **11** is a flowchart illustrating the low load input reception processing according to the embodiment;

**[0044]** FIG. **12** shows graphs schematically illustrating exemplary chronological changes in the loads (pressures) detected by the load detection unit in the pressure input reception processing of an input object;

**[0045]** FIG. **13** is a graph schematically illustrating an exemplary chronological change in the load (pressure) of an input including a slide input detected by the load detection unit in the pressure input reception processing of an input object; and

**[0046]** FIG. **14** shows diagrams illustrating exemplary waveforms of vibrations generated by the vibration unit of the mobile phone according to the embodiment.

DESCRIPTION OF EMBODIMENT

**[0047]** An embodiment of the present invention will be described with reference to the accompanying drawings. In the following embodiments, a mobile phone is used as an exemplary mobile terminal with an input apparatus according to the present invention. However, the mobile terminal to which the input apparatus according to the present invention is applicable is not only the mobile phone but also any mobile terminal having a touch panel such as a PDA, for example. In addition, the present invention is applicable not only to the mobile terminal having the touch panel but also to any input terminal having the touch panel such as ATMs of a bank and ticket vending machines at a train station as stated above.

**[0048]** FIG. **1** is an external perspective view illustrating a schematic configuration of a mobile phone **10** having an input apparatus according to an embodiment of the present invention. The mobile phone **10** has a display unit **32**, a part of which is displayed in the figure, on a front face of a terminal body, for displaying a variety of information and graphical images of keys and buttons on a liquid crystal display (LCD), an organic EL display or the like. The mobile phone **10** also has an input unit **34** constituted of a matrix switch or the like for receiving an input by a user with a finger or a stylus at a front face of the display unit **32**. According to the present embodiment, a touch panel **30** includes the display unit **32** and the input unit **34**. The mobile phone **10** further includes an audio input unit **70** constituted of a microphone or the like, an audio output unit **80** constituted of a speaker or the like, and a key input unit **90** constituted of at least one mechanical key.

**[0049]** Although the mobile phone **10** may additionally have a digital camera function unit, a One-seg broadcast tuner, a Near Field Communication unit such as an infrared communication function unit, various interfaces and the like according to necessary functions, figures and detailed descriptions thereof are omitted.

**[0050]** FIG. **2** is a functional block diagram illustrating a schematic internal configuration of the mobile phone **10**. As shown in FIG. **2**, the mobile phone **10** has a control unit **20**, a touch panel **30**, a load detection unit **40**, a vibration unit **50**, a memory unit **60**, the audio input unit **70**, the audio output unit **80** and the key input unit **90**. The control unit **20** controls and manages the entire mobile terminal **10** as well as each functional block of the mobile terminal **10**. As stated above, the touch panel **30** has a structure that the input unit **34** for receiving input from a user is arranged overlapping the front face of the display unit **32**. Thereby, the touch panel **30** receives an operation input by the user as well as displaying a variety of information such as a result of the input according to each application program (hereinafter, abbreviated to an "application").

**[0051]** The input unit **34** of the touch panel **30**, upon detection of an input by a contact (pressure) of a user's finger or a stylus, outputs a signal corresponding to a position where such input is detected. The touch panel **30** is made as a known type such as, for example, resistance film type, capacitance type or the like. The display unit **32** performs display according to each application, as well as displaying a graphical image of user interface, composed of various keys and buttons for receiving operation inputs to the input unit **34** by the user in a predetermined display area. According to the present embodiment, the images of the various keys and buttons displayed on the display unit **32** for receiving operation inputs to the input unit **34** of the touch panel **30** by the user are referred to as "input objects".

**[0052]** The load detection unit **40** may be a strain gauge sensor, for example, and detects a pressure load on the touch panel **30** (or the input unit **34**). The vibration unit **50** may be, for example, a piezoelectric element or an ultrasonic transducer and vibrates the touch panel **30**. A constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** will be described below.

**[0053]** The memory unit **60** stores various applications and a variety of input information, as well as functioning as a work memory. In addition, the memory unit **60** also stores a plurality of templates including various input objects to be used according to each application.

**[0054]** The audio input unit **70** converts user's voice and the like into input signals and transmits them to the control unit **20**. The audio output unit **80** converts voice signals transmitted from the control unit **20** into voice. The key input unit **90** transmits a signal corresponding to an operation input by the user to the control unit **20**. Usages and functions of the various keys constituting the key input unit **90** are defined according to an application to be used.

**[0055]** The mobile phone **10** further includes various function units necessary for providing functions as a usual mobile phone such as an antenna and a wireless communication unit for transmitting and receiving a variety of information such as voice call and e-mail data to/from a base station via the internet, wireless communication and the like. However, since such function units have no particular distinction from known arts, descriptions thereof are omitted.

**[0056]** Next, the constitutional relationship among the load detection unit **40**, the vibration unit **50** and the touch panel **30** is described.

**[0057]** FIG. **3** is a diagram illustrating an exemplary implementation structure of the touch panel **30**, the load detection unit **40** and the vibration unit **50** of the mobile phone **10** shown in FIG. **2**. FIG. **3**(A) is a cross-sectional view of a main section, whereas FIG. **3**(B) is a plane view of the main section.

**[0058]** The display unit **32** for displaying various input objects on the touch panel **30** is housed in a housing **12**. In the input apparatus according to the present embodiment, the input unit **34** is supported on the display unit **32** via insulators **36** made of elastic members. In the input apparatus according to the present embodiment, the display unit **32** and the input unit **34** are rectangular in a planar view. Although the touch panel **30** is square in FIG. **3**, it may be oblong in accordance with specifications of the mobile terminal mounting the touch panel **30**. In the input apparatus, the input unit **34** is supported on the display unit **32** via the insulators **36** arranged at four corners outside a display area A of the display unit **32** indicated by virtual lines in FIG. **3**(B).

**[0059]** In addition, in the input apparatus, the housing **12** is provided with an upper cover **14** for covering a surface area of the input unit **34** outside the display area of the display unit **32**. Insulators **16** made of elastic members are arranged between the upper cover **14** and the input unit **34**.

**[0060]** The input unit **34** has a surface, that is, a face for receiving input operations, formed of a transparent film, and a rear face formed of a glass. The input unit **34** may be designed such that the transparent film of the surface slightly bends (strains) in proportion to pressure when an operation face is pressed.

**[0061]** In addition, in the input apparatus according to the present embodiment, the strain gauge sensor for detecting the pressure load (pressure) applied on the input unit **34** is provided, adhered or the like, to the transparent film on the surface of the input unit **34** near each side covered by the upper cover **14**. Moreover, in the input apparatus, the piezoelectric element or the ultrasound transducer for vibrating the input unit **34** is provided, adhered or the like, to the face of the glass on the rear side of the input unit **34** near each of two opposed sides. That is, in the input apparatus shown in FIG. **3**, the load detection unit **40** and the vibration unit **50** shown in FIG. **2** include four strain gauge sensors and two vibrators, respectively. It is to be noted that the housing **12**, the upper cover **14** and the insulator **16** shown in FIG. **3**(A) are omitted in FIG. **3**(B).

**[0062]** In the input apparatus according to the present embodiment, the control unit **20** monitors an input detected by the input unit **34** and a pressure load detected by the load detection unit **40**. If the pressure input detected by the input unit **34** is an input to an input object displayed on the display unit **32** and the pressure load detected by the load detection unit **40** satisfies a predetermined standard for receiving an input, the control unit **20** receives such an input as a normal input. Hereinafter, this "standard for receiving an input" is referred to as a "load standard", simply. The load detection unit **40** detects the load from, for example, an average output value of the four strain gauge sensors.

**[0063]** Additionally, the vibration unit **50** drives, for example, two ultrasound transducers in phase. When there is a predetermined pressure input on the input unit **34**, the control unit **20** controls the vibration unit **50** to generate vibration in order to transmit the vibration to an object, such as the user's finger or the stylus, pressing the input unit **34**. With the vibration generated by the vibration unit **50** when the predetermined input is performed, the user can recognize that the pressure input by the user is received appropriately by the input apparatus.

**[0064]** Next, the load standard of an input object according to the present embodiment is described. FIG. **4** is a graph schematically illustrating an exemplary chronological change in a pressure load (pressure) detected by the load detection unit **40** when the user performs an operation input by pressing the input unit **34** of the touch panel **30**. Generally, when performing operation to press (pressure input) the input unit **34** of the touch panel **30**, the user continues to increase pressure on the input unit **34** (that is, the user presses the input unit **34** down) from when touching the input unit **34** until determining that the input is received. In addition, upon determining that the input is received, the user reduces the pressure on the input unit **34** (that is, the user releases a finger or the like from the input unit **34**). Accordingly, as represented by a curved line shown in FIG. **4**, the load detected by the load

detection unit **40** is first increased upward and then reduced downward with time passing from the left side to the right side.

**[0065]** The following is a description of an initial setting preparing for input object load standard setting processing. In order to perform the input object load standard setting processing according to the present embodiment, a load standard P**1** is set for determining that there is an input to the input unit **34** as a normal operation input to an input object displayed on the display unit **32**. The load standard P**1** is set by the control unit **20** based on a normal pressure at the normal operation input to the display unit **32** by the user. Based on this setting, if a pressure load exceeding the P**1** (A**1**), as the normal pressure at the normal operation input by the user, is detected by the load detection unit **40**, the control unit **20** determines that the input object displayed on the display unit **32** is pressed. In addition, if the load detection unit **40** detects that the load pressure on the input object being pressed drops under the P**1** (A**2**) (after A**1**), the control unit **20** determines that the operation input to the input object being pressed is completed (confirmed).

**[0066]** The load standard P**1** set as stated above prevents the input apparatus from determining a slight touch to the input unit **34** by the user as an input. Thereby, it is possible to avoid an unintended input by the user.

**[0067]** In addition, the load standard P**1** set as stated above enables the user to perform a repetitive tapping by pressing the same spot (the same input object) on the input unit **34** multiple times continually, without releasing the finger from the input unit **34** each time. That is, even if the user's finger keeps touching the input unit **34**, the user can make the input unit **34** recognize such an input as the repetitive tapping, by adjusting strength of pressure by the finger to increase and decrease across the load standard P**1**. Since this input method needs only small strokes of the user's finger, the user mastering this method may quickly and easily input with a smaller movement of the finger.

**[0068]** Next, according to the present embodiment, the control unit **20** sets a load standard P**2** based on a pressure larger (heavier) than the normal pressure at the normal operation input to the input unit **34** by the user. According to the present embodiment, a pressure exceeding the load standard P**2** set in this manner is received as an input to another input object adjacent to the input object with the load standard P**1** described above. Accordingly, if a pressure load, exceeding the load standard P**2** (B**2**) greater than the P**1** on another input object adjacent to the input object with the load standard P**1**, is detected by the load detection unit **40**, the control unit **20** determines that this adjacent input object is pressed. In addition, if the load detection unit **40** detects that the load pressure on the adjacent input object being pressed drops under the P**2** (B**2**) (after B**1**), the control unit **20** determines that the operation input to the input object being pressed is completed (confirmed). That is, the control unit **20** controls such that the load standard (P**2**) for receiving a pressure input to another input object adjacent to the input object displayed on the display unit **32** is higher than the load standard P**1** for receiving a pressure input to the input object.

**[0069]** Accordingly, even if the user presses another input object adjacent to the input object with the load standard P**1** at a normal pressure (under P**2**) of the normal operation input, the control unit **20** does not receive this pressure input as an input to this adjacent input object. However, only if the user presses the adjacent input object at a pressure exceeding the P**2** greater than the normal pressure (P**1**) at the normal operation input, the control unit **20** receives this pressure input as an input to this input object.

**[0070]** In the above description, the load standards (P**1**, P**2**) are used as "pressure load thresholds" to determine that "the load standard is satisfied" if it is exceeded, for example. Although a determination in this manner is applied to the following descriptions, there may also be other conditions to determine that "the load standard is satisfied". For example, it is possible to determine that the load standard is satisfied if the pressure load of a pressure input by the user to an input object "reaches" the above load standard. In addition, it is also possible to determine that the load standard is satisfied if the pressure load indicating the above load standard is "detected" by the load detection unit **40**.

**[0071]** Next, the input object load standard setting processing according to the present embodiment is described with reference to a flowchart shown in FIG. **5**. The input object load standard setting processing according to the present embodiment starts upon reception, by the control unit **20**, of a request (command) to activate an application to display a user interface composed of input objects on the display unit **32** of the touch panel **30**. First, upon reception of the command to activate the application to display the user interface, the control unit **20** reads a template corresponding to the request among templates of various user interfaces stored in the memory unit **60** (step S**1**).

**[0072]** After reading the template of the user interface, the control unit **20** determines whether there is a plurality of input objects included in the template (step S**2**). If there is a plurality of input objects included in the template, the control unit **20** next determines whether the specification needs to arrange adjacent input objects at intervals narrower than a predetermined interval (step S**3**). The predetermined interval will be described below If there is a plurality of input objects included in the template and the adjacent input objects arranged at intervals narrower than the predetermined interval, the control unit **20** sets a load standard of each of the input objects (step S**4**) such that load standards (P**1** and P**2**) for receiving pressure inputs to these input objects are different from each other (step S**4**).

**[0073]** Upon completion of setting the load standard of each of the input objects at step S**4**, the control unit **20** displays these input objects on the display unit **32** to receive an input by the user (step S**5**). If the number of input objects is not more than 1 at step S**2**, that is, if there is only one input object, the normal load standard (P**1**) is set for this input object (step S**6**), and then the control unit **20** shifts to step S**5**. Also, if a plurality of input objects is arranged at intervals wider than the predetermined interval at step S**3**, the normal load standard (P**1**) is set for all of these input objects (step S**6**), and then the control unit **20** shifts to step S**5**.

**[0074]** Thereby, if a plurality of input objects is arranged at adjacent positions, different load standards for receiving pressure inputs are set to the input objects, respectively. The predetermined interval stated above is an interval at which, if the input objects are arranged at intervals narrower than that, it is highly possible for the user to press an input object other than an intended input object by mistake. Here, the predetermined interval may be a distance from an end of one input object to an end of another input object or a distance from a center of one input object to a center of another input object. The following is a detailed description of a result of the above processing with reference to a typical embodiment.

**[0075]** The following is a description of a case in which a user memo writing application is activated as shown in FIG. **6**(A), for example. This application displays character input objects in an approximately lower half portion of the display unit **32** of the touch panel **30** in order to receive user's inputs to the input unit **34**. This user memo writing application displays the character input objects arranged at predetermined intervals or wider. In this example, accordingly, there is a less probability for the user to press an input object other than an intended input object by mistake. Therefore, the control unit **20** sets the normal load standard (P**1**) for each of these input objects. Since it is a conventional art known as a "multi-tap input method" to input each character using a numerical keypad associated with kana characters by transiting kana characters corresponding to each key according to the number of input times of the key in order of "Hiragana", a description thereof is omitted.

**[0076]** When the user stores a memo in the memory unit (memory) **60** after completing inputs of the characters as shown in FIG. **6**(A), the control unit **20**, in response to a pressure input to an input object "Function" displayed in the upper left portion of the display unit **32** of the touch panel **30**, displays a so-called pull-down menu as shown in FIG. **6**(B). The pull-down menu of a "Function" includes input objects "Store" and "Delete". If these two input objects are arranged at an interval narrower than the predetermined interval (for example, adjacent to each other), different load standards for receiving pressure inputs are set for the input objects "Store" and "Delete" by the load standard setting processing stated above. In this case, if one of the adjacent input objects, is related to an unrecoverable (important) operation such as the input object "Delete" in this case, the load standard P**2**, which is **3**N (Newton), for example, is set for this input object. Additionally, the load standard P**1**, which is 1N, for example, is set for the input object, such as the input object "Store", adjacent to the input object with the load standard P**2**.

**[0077]** As stated above, it is possible, by setting different load standards for the input objects, to prevent a disadvantage caused if the user presses the input object "Delete" by mistake in spite of an intention to press the input object "Store". That is, even if there is an input with a normal pressure (under P**2**) at a normal operation input to the input object "Delete", the input apparatus according to the present embodiment does not receive this as an input. In order to input to the input object "Delete", it is necessary for the user to purposely perform an operation input with a pressure load exceeding the load standard (P**2**) greater than the load standard (P**1**) at the normal pressure of the normal operation input.

**[0078]** In addition, when the touch panel **30** has a function to simultaneously receive input to a plurality of input objects, the same processing as stated above may be also performed. That is, for example, it may happen that the user presses both of the input objects "Store" and "Delete" simultaneously by mistake (or because a contact area of the finger pressing the input unit **34** protrudes from the input object "Store") in spite of an intention to press only the input object "Store". In this case also, the input to the input object "Delete" at a normal (under P**2**) pressure of a normal operation input is not received. A method to handle a case that, opposite to the case described above, the user presses the input object "Store" by mistake, in spite of an intention to press the input object "Delete", will be described below.

**[0079]** According to the present embodiment as stated above, a load greater (exceeding the P**2**) than the pressure load based on the normal operation input is set for an input object adjacent to an input object for receiving an input by a normal pressure based on the normal operation input (exceeding the P**1**). An input by a pressure load greater (heavier) than that at the normal operation input differs from various inputs (for example, holding down and double pressing such as double click) regarded as normal input methods. Accordingly, since the various inputs, regarded as the normal input methods, to the input object with the load standard P**2** is not received, an incorrect input unintended by the user is not received as a valid input. That is, an input by an unintended operation by the user is avoided.

**[0080]** If input objects are arranged at adjacent positions in the processing according to the present embodiment, it is preferred to indicate, for the user, that the input object with the load standard P**2** needs to be pressed at a pressure heavier than that of the normal operation input. As the input object of "Delete" key shown in FIG. **6**(C), for example, the input object to which a user needs to input with a strong pressure is displayed in a color different from other input objects on the display unit **32**. Thereby, it is possible to emphasize that the input object in the different color is the input object with the load standard P**2**. In addition, it is also possible to display such an input object, together with a note such as "Touch 'Delete' key strongly", for example, at a predetermined position on the display unit **32**.

**[0081]** Now, another embodiment is described. On a display panel of the user memo writing application shown in FIG. **7**, although an arrangement of the character input objects displayed on the display unit **32** of the touch panel **30** is similar to that shown in FIG. **6**, a larger area is provided to display a result (memo) of user's inputs. Accordingly, an area to arrange the character input objects for receiving pressure inputs by the user is relatively small. In this case, as shown in FIG. **7**, each of the input objects is reduced in size and the intervals between the input objects are narrowed. If the intervals between the input objects are narrower than a predetermined interval, the control unit **20** sets different load standards for the adjacent input objects based on the input object load standard setting processing according to the present embodiment.

**[0082]** In the load standard setting processing according to the present embodiment, the input objects with different load standards are arranged alternately, as shown in FIG. **7**, for example. In an example shown in FIG. **7**, in order to indicate that the adjacent input objects have different load standards, the input objects to which a user needs to input with a stronger pressure, are displayed in a different color. That is, it is indicated in FIG. **7** that the load standard (P**2**) greater than the load standard (P**1**) at the normal input operation is set for the input objects in a dark color (hatched with broken lines). It is also indicated that the normal load standard (P**1**) is set for the input objects in a normal (white) color, in contrast.

**[0083]** As a result of setting of the load standards as described above, the input object, for which the load standard (P**2**) greater than the normal load standard (P**1**) is set, is arranged adjacent to the input object, for which the normal load standard (P**1**) is set, on the input unit **34** of the touch panel **30**. That is, the input objects for which the normal load standard (P**1**) is set and the input objects for which the load standard (P**2**) greater than the normal load standard (P**1**) is set are arranged alternately. Hence, it is possible for the user to input to these input objects distinctively even if multiple input objects are closely arranged at adjacent positions.

**[0084]** As a result of setting of the load standards as described above, it is possible to handle a case that the user presses the input object with the high load standard (P**2**) at a normal pressure by mistake, in spite of an intention to press the input object with the low load standard (P**1**). However, this setting alone cannot handle a case that the user presses strongly the input object with the low load standard (P**1**) by mistake, in spite of an intention to press the input object with the high load standard (P**2**). That is, in this case, the user presses the input unit **34** with a high pressure, which exceeds the low load standard (P**1**) as well, as intending to press the input object with the high load standard (P**2**). Therefore, the control unit **20** receives the input to the input object with the low load standard (P**1**) against the user's intention.

**[0085]** According to the present embodiment, in order to handle such a disadvantage, in the pressure input reception processing of an input object carried out after arrangement of the input objects by the input object load standard setting processing described with reference to FIG. **5**, an input is canceled in certain cases. The following is a description of a series of processing carried out in such cases.

**[0086]** First, with reference to a flowchart shown in FIG. **8**, it is described about a summary of the pressure input reception processing of an input object carried out after arrangement of the input objects by the input object load standard setting processing described with reference to FIG. **5**. This processing starts upon reception of an input to the input unit **34** by the user after activating the user memo writing application or the like, for example, and the input objects are displayed at adjacent positions on the display unit **32** by the processing described with reference to FIG. **5**.

**[0087]** Upon start of the pressure input reception processing of an input object according to the present embodiment, the control unit **20** determines whether an input by the user's finger, the stylus or the like (hereinafter, abbreviated as a "user's input") to the input unit **34** corresponding to an input object on the touch panel **30** is detected (step S**11**).

**[0088]** If the user's input to the input unit **34** corresponding to the input object is detected at step S **11**, the control unit **20** determines whether a position on the display unit **32** where the input is detected corresponds to an input object for which the load standard (P**2**) greater (higher) than the normal load standard (P**1**) is set (step S**12**). If the input position corresponds to the input object with the load standard (P**2**) greater than the normal load standard (P**1**) (Yes of step S**12**), the control unit **20** performs high load input reception processing (step S**13**).

**[0089]** In contrast, at step S**12**, if the input position does not correspond to the input object for which the load standard P**2** is set (No of step S**12**), the control unit **20** performs low load input reception processing (step S**14**). Here, the processing shifts from step S**12** to step S**14** if the input object to which a user's input is detected is an input object for which the load standard P**1** is set.

**[0090]** Next, with reference to a flowchart in FIG. **9**, it is described in detail about the high load input reception processing at step S**13** shown in FIG. **8**. The high load input reception processing is carried out if an input position of a pressure input to the input unit **34** by the user corresponds to an input object with the load standard (P**2**) greater than the normal load standard (P**1**), that is, the input object with the high load standard (Yes of step S**12**).

**[0091]** Upon start of the high load input reception processing, the control unit **20** first performs a highlight display of this input object (step S**21**). The highlight display is an emphasizing display to inform the user that a finger or the like touches the input object. For example, if a user's input to the input object "Delete" as shown in FIG. **10**(A) is detected, the control unit **20** highlights the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the input by the finger or the like to the input unit **34** is appropriately detected by the input apparatus. It is to be noted that the highlight display indicates simply that the user's finger or the like is touching the input unit **34** and, hence, it is not yet determined at this point that the input is received (that is, the key is pressed).

**[0092]** Next, the control unit **20** determines whether the pressure load P detected by the load detection unit **40** exceeds the load standard P**2** (step S**22**). As to the input object with the load standard P**2**, the control unit **20** does not regard that an input is received, unless there is an input with a pressure load exceeding the load standard P**2**. Accordingly, if the pressure load P exceeding the load standard P**2** is not detected by the load detection unit **40** at step S**22**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**23**).

**[0093]** If this input is not released (that is, the user's finger or the like is not released from the input unit **34**) at step S**23**, the control unit **20** shifts to step S**28**. The control unit **20**, at step S**28**, determines whether a so-called slide input by which a position of a pressure input detected by the input unit **34** is moved is detected. Here, the slide input is performed by the user moving a finger or the like while pressing the finger or the like to the input unit **34** such that an input position is moved from an input object originally pressed to another input object.

**[0094]** If the slide input is not detected at step S**28**, the control unit **20** returns to step S**22** to monitor the pressure load P detected by the load detection unit **40**. If it is determined at step S**23** that the user's input to the input unit **34** is released, the control unit **20** regards that there is no input to the input object touched by the user, cancels the highlight display (step S**24**) and then ends the processing.

**[0095]** Cancellation of the highlight display at step S**24** informs the user that the input by the user's finger or the like to the input unit **34** at a position corresponding to an input object is no longer detected. For example, the control unit **20** changes the highlight display of the input object on the display unit **32** in response to a detection of a user's input back to a display as shown in FIG. **10**(A). Thereby, the user can visually recognize that the input apparatus appropriately recognizes that the user's finger or the like, which was touching the input unit **34**, is released therefrom.

**[0096]** In contrast, if the pressure load P exceeding the load standard value P**2** (B**1** shown in FIG. **4**) is detected by the load detection unit **40** at step S**22**, the control unit **20** displays that the input object to which the input is detected is pressed down (step S**25**). This press-down display is a display of the display unit **32** to indicate that the input object, on which the input is being detected, is pressed as a key. That is, the control unit **20** changes the highlight display of the input object as shown in FIG. **10**(B) to the display indicating that the input object is being pressed as shown in FIG. **10**(C). Thereby, the user can visually recognize that the pressure input P exceeds the load standard P**2** and that the pressure input by the user's finger or the like touching the input unit **34** is appropriately received as the pressure input to the input object by the input apparatus.

**[0097]** After step S**25**, the control unit **20** determines whether the pressure of the user's input to the input unit **34** is reduced and the pressure load P detected by the load detection unit **40** becomes equal to or lower than the load standard P**2** (B**2** shown in FIG. **4**) (step S**26**). If it is determined at step S**26** that the pressure load P becomes equal to or lower than the load standard P**2**, the control unit **20** accepts that the operation input to the input object with the load standard P**2**, currently receiving the input, is confirmed (step S**27**). That is, in the input processing according to the present embodiment, if compared to a mechanical key, reception of an input to the key is confirmed not when the key is pressed but when the key is released.

**[0098]** At step S**27**, in addition, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure load to the input object to which the input is detected becomes equal to or lower than the P**2**. That is, for example, the control unit **20** returns the display indicating that the input object is pressed as shown in FIG. **10**(C) to the highlight display of the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as an input and also that the input apparatus appropriately recognizes that the pressure, on the input object is reduced.

**[0099]** After step S**27**, the control unit **20** determines whether the slide input as described above is detected by the input unit **34** (step S**28**). If the slide input is detected by the input unit **34** at step S**28**, the control unit **20** returns to step S**22** to continue to monitor the pressure load P detected by the load detection unit **40**. In this case, the control unit **20** subsequently waits for the user's input to the input unit **34** to be released (step S**23**) or waits for another pressure input (that is, a continuous pressure input) to the input object to which the input is being detected to be detected.

**[0100]** In contrast, if the slide input is detected at step S**28** while the pressure load on the input unit **34** does not fall to zero, the control unit **20** shifts to step S**29**. At step S**29**, the control unit **20** cancels the press-down display of the input object to which an original pressure input is detected (before the slide input), and then returns to step S**11** in FIG. **8** to continue the processing.

**[0101]** After the slide input (step S**28**), through step S**11**, the control unit **20**, at step S**12**, determines whether the input position, by the slide input, is moved to the input object with the low load standard (P**1**) or the input object with the high load standard (P**2**). That is, according to the present embodiment, after detection of the pressure on the input object with the load standard P**2**, the user can carry over an input not exceeding the load standard P**2** or an input confirmed as an input after exceeding the load standard P**2**, to an input to another input object without releasing the pressure.

**[0102]** Accordingly, the user can change an intended input object without releasing the finger from the input unit **34** of the touch panel **30**. Hence, by utilizing the slide input, the user can change the input object even after once touching the input unit **34** if the input is not received (confirmed) yet. Also, since the slide input enables the user to input continuously only by adjusting the strength of the pressure load while touching the input unit **34**, the user having mastered this input method can input quickly.

**[0103]** A curved line passing B**1** to B**2** shown in FIG. **4** is an exemplary chronological change in the pressure load on the input unit **34** detected by the load detection unit **40** when a reception of the input is confirmed by the high load input reception processing stated above, after the pressure input to the input unit **34** by the user is detected. As shown in FIG. **4**, an input to the input object with the load standard P**2** is received at a point (B**1**) when the pressure load exceeds the pressure standard P**2** and confirmed at a point (B**2**) when the pressure load falls down equal to or lower than the pressure standard P**2**.

**[0104]** Next, with reference to a flowchart in FIG. **11**, it is described in detail about the low load input reception processing at step S**14** shown in FIG. **8**. The low load input reception processing is carried out if an input position of a pressure input to the input unit **34** by the user corresponds to an input object for which the normal load standard (P**1**), that is, the low load standard is set (No of step S**12**).

**[0105]** Upon start of the low load input reception processing, the control unit **20** first highlights the input object (step S**31**). In this case, the input object is highlighted in the same manner as the highlight display at step S**21**.

**[0106]** Next, the control unit **20** determines whether the pressure load P detected by the load detection unit **40** exceeds the load standard value P**1** (step S**32**). Similarly to a normal operation input to the input object with the load standard P**1**, the control unit **20** receives an input if the load pressure exceeds the load standard P**1**. In contrast, if the load pressure P exceeding the load standard P**1** is not detected by the load detection unit **40** at step S**32**, the control unit **20** determines whether the user's input to the input unit **34** is released (step S**33**).

**[0107]** If it is determined at step S**33** that the input is not released (that is, the user's finger or the like is not released from the input unit **34**), the control unit **20** shifts to step S**39** to determine whether the slide input is detected. If it is determined at step S**39** that the slide input is not detected, the control unit **20** returns to step S**32** to monitor the pressure load P detected by the load detection unit **40**. If it is determined at step S**33** that the user's input to the input unit **34** is released, the control unit **20** regards that there is no input to the input object touched by the user, cancels the highlight display (step S**34**) and then ends the processing.

**[0108]** In contrast, if the pressure load P exceeding the load standard P**1** (A**1** shown in FIG. **4**) is detected by the load detection unit **40** at step S**32**, the control unit **20** displays the press-down display of the input object to which the input is detected (step S**35**). The press-down display is to change the display of the display unit **32** to indicate that the input object to which the input is being detected is pressed as the key. That is, the control unit **20** changes the highlight display of the input object as shown in FIG. **10**(B) to the display indicating that the input object is being pressed as shown in FIG. **10**(C). Thereby, the user can visually recognize that the pressure load P exceeds the load standard P**1** and that the input apparatus appropriately receives the pressure input by the user's finger or the like touching the input unit **34** as a pressure input to the input object.

**[0109]** In the low load input reception processing, the control unit **20**, after step S**35**, determines whether the pressure load P detected by the load detection unit **40** falls down equal to or lower than the load standard P**2** after once exceeding the P**2** (step S**36**). Here, if the pressure load P falls down equal to or lower than the load standard P**2** after once exceeding the P**2**, the pressure input for an input object with the high load standard (P**2**) is received to the input object with the low load standard (P**1**) and confirmed. In this case, it is considered that the user presses the input object with the load standard P**1** by

mistake, in spite of the intention to press an input object with the load standard P2. Processing in this case will be described below.

**[0110]** At step S36 after step S35, if the pressure load P<P2 after detection of the pressure load P≧P2 is not detected, that is, if it is considered that the user inputs correctly according to the user's intention, the control unit **20** shifts to step S37. At step S37, the control unit **20** determines whether the input pressure to the input unit **34** by the user is reduced and the pressure load P detected by the load detection unit **40** becomes equal to or lower than the load standard P1 (A2 shown in FIG. **4**). If it is determined at step S37 that the pressure load P becomes equal to or lower than the load standard P1, the control unit **20** accepts that the operation input to the input object with the load standard P1 currently receiving the input is confirmed (step S38).

**[0111]** At step S38, additionally, the control unit **20** returns the display of the display unit **32** to the highlight display in order to indicate that the pressure load on the input object to which the input is detected becomes equal to or lower than the P1. That is, for example, the control unit **20** changes the display indicating that the input object is pressed as shown in FIG. **10**(C) back to the highlight display of the input object as shown in FIG. **10**(B). Thereby, the user can visually recognize that the pressure input to the input object is confirmed as an input and also that the input apparatus appropriately recognizes that the pressure on the input object is reduced.

**[0112]** After step S38, the control unit **20** determines whether the slide input to the input unit **34** is detected (step S39). If it is determined at step S39 that the slide input is not detected by the input unit **34**, the control unit **20** returns to step S22 to continue to monitor the pressure load P detected by the load detection unit **40**. In this case, the control unit **20** subsequently waits for the input to the input unit **34** by the user to be released (step S33) or waits for another input (that is, a continuous pressure input) to the input object to which the input is being detected to be detected. However, if the slide input is detected at step S39 while the pressure load to the input unit **34** does not fall to zero, the control unit **20** shifts to step S40. At step S40, after canceling the press-down display of the input object to which the pressure input is originally detected (before the slide input), the control unit **20** returns to S11 in FIG. **8** to continue the processing.

**[0113]** After the slide input (step S39), if the control unit **20** shifts to step S12 via step S11, processing the same as the high load input reception processing described above is carried out. That is, according to the present embodiment, after detection of a pressure on the input object with the load standard P1, the user can carry over the input not exceeding the load standard P1 or the input confirmed as an input after exceeding the load standard P1 to an input to another input object, without releasing the pressure.

**[0114]** A curved line passing A1 and A2 shown in FIG. **4** is an exemplary chronological change in the pressure load to the input unit **34** detected by the load detection unit **40** when the pressure input to the input unit **34** by the user is detected and the reception of the input is confirmed by the low load input reception processing described above. As shown in FIG. **4**, the input to the input object with the load standard P1 is received at a point (A1) when the pressure load exceeds the pressure standard P1 and confirmed at a point (A2) when the pressure load falls down equal to or lower than the load standard P1.

**[0115]** In contrast, if it is determined at step S36 that the pressure load P detected by the load detection unit **40** falls down equal to or lower than the load standard P2 after once exceeding the P2, the control unit **20** shifts to step S41. The control unit **20** confirms a reception of the operation input to the input object with the load standard P1 to which the input is detected, if the pressure load P detected by the load detection unit **40** falls down equal to or lower than the P1 (A2) after once exceeding the load standard P1 (A1). However, when the control unit **20** shifts from step S36 to step S41, the pressure input for an input object with the load standard P2 is received and confirmed, even though the pressure input with a pressure load exceeding the P1 can be performed to the input object with the load standard P1. In this case, it is considered that the user presses the input object with the load standard P1 by mistake, in spite of the intention to press an input object with the load standard P2.

**[0116]** At step S41, accordingly, if the pressure load exceeding the P2 is detected on the input object with the load standard P1, the control unit **20**, at a point when it is subsequently detected that the pressure load falls down equal to or lower than the P2, cancels the pressure input to this input object with the load standard P1. At step S41, in addition, in order to indicate that the pressure input to the input object with the load standard P1 receiving the input is cancelled, the control unit **20** returns the display indicating that the input object is pressed to the highlight display. After step S41, the control unit **20**, in the same manner as the above processing after step S38, continues the processing to determine whether the slide input to the input unit **34** is detected (step S39).

**[0117]** As stated above, the processing from step S36 to step S41 in the low load input reception processing can handle a case that the user presses the input object with the load standard P1 by mistake, in spite of the intention to press the input object with the load standard P2.

**[0118]** The following is a description of a method to handle a user's input to an incorrect input object against a user's intention by the pressure input reception processing of an input object according to the present embodiment, with reference to FIG. **12**.

**[0119]** First, as to the input object with the high load standard (P2), if the pressure load falls down equal to or lower than the P2 (B2) after once exceeding the high load standard P2 (B1) as shown by a curved dotted line in FIG. **12**(A), a reception of the operation input is confirmed. Accordingly, even if the user presses the input object with the load standard P2 at a normal pressure by mistake in spite of an intention to press the input object with the load standard P1, this input is not received. In this case, the pressure input by the user, like the pressure of the normal operation, exceeds the low load standard P1 (A1) and subsequently falls down equal to or lower than the P1 (A2), as shown by a curved solid line in FIG. **12**(A). Thereby, an input unintended by the user is avoided.

**[0120]** Next, as to the input object with the low load standard (P1), if the pressure load falls down equal to or lower than P1 (A2') after once exceeding the low load standard P1 (A1') as shown by a curved dotted line in FIG. **12**(B), a reception of the operation input is confirmed. However, if the user presses strongly the input object with the load standard P1 by mistake in spite of the intention to press an input object with the load standard P2, the pressure load exceeds the low load standard P1 (A1) as shown by a curved solid line in FIG. **12**(B). At this point, although it is determined that the input object with the load standard PI is pressed, a reception of the

input is not confirmed yet. Accordingly, when the pressure load subsequently falls down to be equal to or lower than P2 (C2) after once exceeding the load standard P2 (Cl), the reception of the input to the input object with the load standard P1 determined as being pressed is canceled. Therefore, if the user presses strongly the input object with the load standard P1 by mistake, in spite of the intention to press an input object with the load standard P2, it is regarded that there is not input to the input object with the load standard P1. Accordingly, in this case either, an input unintended by the user is not received.

**[0121]** The following is a description of a method for the user to simply repress a correct input object with the load standard P2, if the user presses strongly the input object with the load standard P1 by mistake, in spite of the intention to press the input object with the load standard P2.

**[0122]** If the user presses strongly the input object with the load standard P1 in spite of the intention to press the input object with the load standard P2, the pressure load exceeds the low load standard P1 (A1), as shown by a curved solid line in FIG. **13**. Then, after the pressure load exceeds the load standard P2 (C1) or at a point when the pressure load subsequently falls down equal to or lower than the P2 (C2), the control unit **20** informs the user that reception of the input to the input object is cancelled. In particular, the control unit **20** may control the audio output unit **80** to generate a sound (beep sound or the like) indicating the cancellation of the input or drive the vibration unit **50** to generate a vibration indicating the cancellation of the input. Thereby, the user can recognize that the pressure input by the user is not performed appropriately and thus is canceled. Those operations are shown in a range of a on a time axis in FIG. **13**.

**[0123]** Subsequently, when recognizing the cancellation of the input, the user may carry over a pressure input to the input unit **34** to an intended input object with the load standard P2, by moving the pressure input without releasing it as the slide input described above. This operation is shown in a range of β on the time axis in FIG. **13**. After moving the pressure input to the intended input object with load standard P2 by the slide input, the user may perform the pressure input at the pressure load exceeding the load standard P2 to the input object with the load standard P2. This operation is shown in a range of γ on the time axis in FIG. **13**. Thereby, the user can easily correct the first incorrect input and input to the correct input object.

**[0124]** It is to be understood that the present invention is not limited to the embodiment set forth above but may be modified or varied in a multiple manner. For example, although it is assumed in the above embodiment to preset the load standards P1, P2 of the input objects and the predetermined interval, it is desired that the user can change or adjust them as necessary. Thereby, it is possible to appropriately adjust them afterward if the user feels uncomfortable with them during operations.

**[0125]** In the above embodiment, in order to simplify algorithm for determining an input, with regard to both of the input object with the load standard P1 and the input object with the load standard P2, reception of an input is confirmed not at a point exceeding the corresponding load standard but at a point falling down equal to or lower than the load standard. However, according to the present invention, it is also possible that an input to the input object with the load standard P1 is confirmed not at the point exceeding the load standard P1 but at the point falling down equal to or lower than the load standard P1 and that the input is cancelled at a point exceeding the load standard P2. That is, it is possible that the reception of the input to the input object with the load standard P1 is confirmed if the pressure load falls down equal to or less than the P1 after once exceeding it and cancelled if the pressure load subsequently exceeds the P2 as well after exceeding the P1.

**[0126]** Additionally, in the above embodiment, if the input objects are arranged at intervals narrower than the predetermined interval, different load standards are set to the input objects, in order to prevent an incorrect operation by the user. However, if each input object has a wide input reception area, there is a less probability for the user to perform an incorrect input, even if the adjacent input objects are arranged without any interval. Therefore, in such a case, if the input reception area of each of the input objects is larger than a predetermined size, it is not necessary to set different load standards for them. In addition, based on the fact that there is the less probability for the user to perform an incorrect input if the input reception area of each of the input objects is large, it is possible to change the predetermined interval, which is a standard for a determination whether to set different load standards, in accordance with the size of the input reception area of the input object. That is, in a case that the predetermined interval is set to 1 cm, the same load standard may be set if the input reception areas of the input objects are large (that is, if the input objects are large) and also the intervals between the input objects are wider than 0.1 cm, for example, whereas the different load standards may be set if the input reception areas are small and also the intervals are narrower than 2 cm, for example.

**[0127]** Although a case using two load standards P1 and P2 is employed as the simplest example in the above embodiment, it is possible to use three or more load standards.

**[0128]** In addition, according to the above embodiment, when the reception of the input to the input object is canceled, the vibration unit **50** vibrates to inform the user accordingly. Although it is not essential to notify the user with vibration in the present invention, vibration of the vibration unit **50** in response to the above various inputs, in addition to cancellation of the reception of the input, promises enhancement of usability.

**[0129]** For example, upon detection of a pressure load exceeding the P1 (A1) shown in FIG. **4** on the input object with the load standard P1 by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **14**(A). Then, upon detection of a pressure load equal to or lower than the P1 (A2) shown in FIG. **4** on this input object by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **14**(B). Moreover, upon detection of a pressure load exceeding the P2 (B1) shown in FIG. **4** on the input object with the load standard P2 by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **14**(C). Then, upon detection of a pressure load equal to or lower than the P2 (B2) shown in FIG. **4** on this input object by the load detection unit **40**, the control unit **20** controls the vibration unit **50** to generate vibration in a waveform shown in FIG. **14**(D).

**[0130]** Thereby, the user can distinctively recognize that the input by the load standard P1 or the input at the load standard P2 to each of the input objects is received appropriately by the input apparatus.

## INDUSTRIAL APPLICABILITY

**[0131]** According to the input apparatus of the present invention, the pressure load on the input unit of the touch

panel is detected, and sets a load standard for receiving a pressure input to an input object and a load standard for receiving a pressure input to another input object adjacent to the input object to be different from each other. Thereby, even if multiple input objects are displayed at adjacent positions on the input unit of a small touch panel, the user can distinctively input to each of the input objects.

**[0132]** Especially if a pressure load of a pressure input to an input object with the low load standard satisfies a load standard for receiving a pressure input to an input object with the high load standard, the pressure input to the input object with the low load standard is not received. Accordingly, even if the user performs a pressure input to the input object with the low load standard by mistake, in spite of the intention to perform the pressure input to the input object with the high load standard, the pressure input to the input object unintended by the user is not received. Thereby, it is possible to avoid start of an unintended operation because of the unintended input by the user.

REFERENCE SIGNS LIST

**[0133]** **10** mobile phone
**[0134]** **20** control unit
**[0135]** **30** touch panel
**[0136]** **32** display unit
**[0137]** **34** input unit
**[0138]** **40** load detection unit
**[0139]** **50** vibration unit
**[0140]** **60** memory unit
**[0141]** **70** audio input unit
**[0142]** **80** audio output unit
**[0143]** **90** key input unit

**1**. An input apparatus comprising:
a display unit for displaying an input object;
an input unit for receiving a pressure input to the input object displayed on the display unit;
a load detection unit for detecting a pressure load on the input unit; and
a control unit for controlling to receive the pressure input when the pressure load detected by the load detection unit satisfies a load standard, wherein
the control unit controls such that load standards for receiving pressure inputs to a plurality of adjacent input objects are differently set to a first load standard and a second load standard higher than the first load standard, and controls such that a pressure input is not received if a pressure load of the pressure input to an input object with the first load standard satisfies the second load standard.

**2**. The input apparatus according to claim **1**, wherein the control unit controls such that a pressure input is not received if a pressure load of the pressure input to an input object with the first load standard falls down to be lower than the second load standard after satisfying the second load standard.

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