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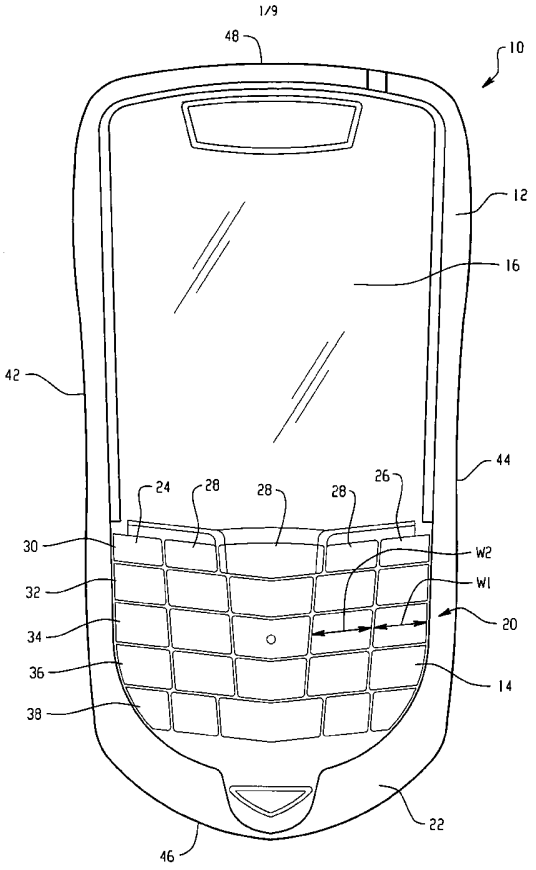
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(54) Title: KEY ARRANGEMENT FOR A KEYBOARD



(57) Abstract: A key arrangement includes a plurality of keys that are arranged in a regular grid of rows and columns. The columns include a first column, a last column, and at least one middle column. The keys in the first and last columns are smaller than the keys in the at least one middle column. A method for improving the ergonomics of a key arrangement on a keyboard of a fixed size is provided. A method for designing a key arrangement for a mobile communication device is also provided.

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KEY ARRANGEMENT FOR A KEYBOARD

Field

This technology relates to a key arrangement for a keyboard of an electronic device. In particular, the technology concerns a key arrangement for a handheld mobile communication device.

Background

Keyboards are used on many handheld devices, including telephones and mobile communication devices. The size of keyboards has been reduced over the years, as newer, smaller devices have become popular. Cell phones, for example, are now sized to fit in one's pocket or the palm of the hand. As the size of the devices has decreased, so has the size of the keyboards and the keys on the keyboard. As the size of the keys has decreased, it has become harder for a user to accurately select the desired keys, since large fingers have a tendency to depress more than one key at a time. Care must be taken to select the proper key when small keyboards are utilized.

In addition to smaller devices, larger keyboards have also become more popular. As the frequency of text messaging and wireless email transmission has increased, text-entry keyboards have become a necessity. As a result, many manufacturers are utilizing full alphabetic keyboards on their devices in arrangements that are familiar to users. Different standard alphabetic keyboard arrangements are known. The most widely used English-language alphabetic key arrangement is the QWERTY arrangement. Other types of standard English-language alphabetic key arrangements include QWERTZ, AZERTY and DVORAK, among other known arrangements. Mobile communication devices also utilize numbers for placing telephone calls. Numbers can be arranged on keyboards as a standard telephone keypad arrangement, or as a standard numeric keypad arrangement. The numeric keys may share keys with alphabetic characters, or may be positioned on separate keys. Alternatively, numbers can share or be arranged above the top row of letters, such as in a conventional typewriter keyboard. In addition to full size alphabetic keyboards, reduced size keyboards are also utilized, where the keyboard utilizes fewer rows or columns than the standard alphabetic arrangement. A known reduced size keyboard is present on a telephone, where the letters are arranged in alphabetic order.

When selecting keys on a mobile communication device keyboard, it is often easier for a user to properly depress keys around the periphery of the keyboard than it is to depress keys in the interior of the key arrangement. Keys on the periphery of the keyboard typically are not situated next to other keys, and a user's finger will typically span the selected key and a portion of the housing of the device. In contrast, in the interior of the keyboard, a user's finger is more likely to span more than one key and may occasionally improperly depress a key. This is a nuisance for a user, who must then correct this error.

Summary

In accordance with the teachings described herein, a key arrangement comprises a plurality of keys arranged in a regular grid of rows and columns. The columns comprise a first column, at least one middle column, and a last column. The keys in the first and last columns are smaller than the keys in the at least one middle column.

The plurality of keys may have a width and a height, and the width of the keys in the first and last columns is smaller than the width of the keys in the at least one middle column. Alternatively, the plurality of keys may have at least a first dimension and a second dimension, and the first dimension of the keys in the first and last columns is smaller than the first dimension of the keys in the at least one middle column.

The keys have a shape and the shape is one of regular or irregular. Each of the plurality of keys may have the same shape, with the keys in the first and last columns being a smaller version of the same shape. The plurality of keys may comprise keys having at least a first shape, a second shape and a third shape.

In another embodiment, a mobile communication device comprises a housing, a keyboard comprising the key arrangement discussed above coupled to the housing, and a display coupled to the housing. The housing may have a face with a top side, a bottom side, a left side, and a right side, and the first column is positioned adjacent the left side and the last column is positioned adjacent the right side.

In an alternative embodiment, a key arrangement comprises a first set of keys having at least one first size arranged in a pattern that has a plurality of sides, and a second set of keys positioned around at least two of the sides of the pattern. The second set of keys has a second size that is smaller than the at least one first size. The at least two sides may comprise part of the periphery of the pattern.

The first size may comprise a first width and the second size may comprise a second width, with the first width being greater than the second width. In another embodiment, the first size comprises a first height and a first width and the second size comprises a second height and a second width, with the first height being greater than the second height and the first width being greater than the second width. The pattern may comprise a plurality of rows and a plurality of columns, with keys in the outermost columns of the pattern being the second set of keys.

In another embodiment, a device comprises a housing having a face with a top, a bottom, a left side, and a right side. A display and a keyboard are coupled to the face of the housing. The keyboard comprises a plurality of keys arranged in a pattern that has a plurality of rows and a plurality of columns, with the plurality of columns including a first column, a last column, and at least one middle column. The keys in the first column are positioned adjacent the left side of the housing and the keys in the last column are positioned adjacent the right side of the housing. The keys in the first and last columns have a size that is smaller than the size of the keys in the at least one middle column.

In yet another embodiment, a method for improving the ergonomics of a key arrangement on a keyboard of a fixed size comprises providing a plurality of keys arranged in a plurality of columns and a plurality of rows, with the plurality of columns comprising a first column, a last column, and at least one middle column. The method also includes defining the key size for the keys in the at least one middle column to have at least one first size and defining the key size for the keys in the first and last columns to have a second size that is smaller than the corresponding at least one first size. The first size is at least one of a width and a height.

In a further embodiment, a method for designing a key arrangement for a mobile communication device is provided. The key arrangement includes a plurality of keys arranged in a grid pattern that includes a plurality of columns. The plurality of columns includes a plurality of middle columns that are flanked by outer columns. The method comprises measuring a width of a face of a mobile communication device, dividing the width of the face by a number corresponding to the number of columns of keys to determine a preliminary key width, and subtracting an amount from the preliminary key width to determine an outer column key width, with the amount corresponding to a decrease in width for keys in the outer columns of the grid pattern of keys. The method further includes multiplying the preliminary key width by the number of middle columns

to determine a preliminary total middle key width, adding the preliminary total middle key width to the amount multiplied by two to determine a final total middle key width, and

dividing the final total middle key width by the number of middle columns to determine a final key width for the keys in the middle columns.

Brief Description of the Drawing Figures

Fig. 1 is a plan view of a mobile communication device incorporating an example key arrangement;

Fig. 2 is a plan view of an alternative mobile communication device incorporating an example key arrangement;

Fig. 3 is a plan view of an example key arrangement;

Fig. 4 is a plan view of a mobile communication device incorporating an example key arrangement;

Fig. 5 is a plan view of an alternative example key arrangement;

Fig. 6 is a plan view of another alternative example key arrangement;

Fig. 7 is a plan view of yet another alternative example key arrangement;

Fig. 8 is a plan view of another alternative example key arrangement;

Fig. 9 is a plan view of yet another alternative example key arrangement;

Fig. 10 is an exploded view of a handheld mobile communication device incorporating an example key arrangement; and

Fig. 11 is a block diagram illustrating an example mobile communication device.

Detailed Description

With reference now to the drawings, Fig. 1-9 depict numerous key arrangements for a keyboard. Figs. 1, 2, and 4 depict an example key arrangement on a mobile communication device 10 while Figs. 3 and 5-9 depict example key arrangements. Any of the key arrangements may be utilized on any kind of input device, the example key arrangement not being limited to a particular application. Examples of mobile communication devices 10 that may derive a benefit from the example key arrangement include mobile stations, cellular telephones, wireless personal digital assistants (PDAs), two-way paging devices, and others. In addition, the example key arrangement may be utilized on conventional telephones, calculators, and other devices having keyboards or keypads.

The example key arrangement 20 utilizes a plurality of keys that are arranged in a grid pattern. In each of the embodiments shown, the grid pattern is regular, in that it utilizes a plurality of rows and columns. The example key arrangement 20 is also applicable to an irregular key arrangement, where keys are not necessarily arranged in a regular pattern, or where additional keys may be arranged around a regular grid pattern.

The example key arrangement 20 utilizes smaller keys around at least a part of the periphery of the keyboard 14. In the embodiments shown, the smaller keys are positioned near the sides of the device 10 such that a user, in the process of depressing keys, may at least partially depress the key while also touching the housing 12 of the device 10.

The smaller peripheral keys may be smaller in width, height, both width and height, or in general dimensions. By utilizing smaller keys around the periphery of the keyboard 14, more room is allocated in the interior or middle portion of the key arrangement 20. When comparing the example key arrangement 20 to a standard uniformly sized key arrangement, the keys in the middle of the arrangement may be made larger as a result of the smaller peripheral keys. Thus, the key arrangement will take up the same amount of space on the face 22 of the device 10, but the interior keys will be larger and the peripheral keys will be smaller. The larger interior keys are beneficial because a user will be more likely to depress the desired key and errors associated with smaller keys may be avoided.

Fig. 1 shows a mobile communication device 10 having a housing face 22, a display 16, and a keyboard 14. The keyboard has five rows and five columns of keys arranged in a generally regular grid pattern. The five columns include a first column 24, a last column 26, and a three middle columns 28. The five rows includes a first row 30, a second row 32, a third row 34, a fourth row 36, and a fifth row 38. In this embodiment, smaller peripheral keys are present in the first and last columns 24, 26, first through fourth rows 30, 32, 34, 36. The keys in the outer columns, i.e., the first and last columns 24, 26, have keys that have a width W1 that is less than the width W2 of the keys in middle columns 28 of their respective rows. The keyboard 14 takes up a fixed amount of space on the face 22 of the housing 12. By reducing the size of the peripheral keys in the first through fourth rows 30, 32, 34, 36, the interior keys in those same rows are made wider. Larger interior keys are easier to depress. In addition, the slightly narrower peripheral keys in the first and last columns 24, 26 are also easy to depress because a user's finger may overlap part of the housing 12 during the selection process without any adverse

results. The keys in the first and last columns 24, 26, first through fourth rows 30, 32, 34, 36 have the same width, while the keys in the middle columns 28 have a different width.

Fig. 2 depicts a mobile communication device 10 having a housing face 22, a display 16, and a keyboard 14. The keyboard 14 has five rows and five columns, although the top row is truncated and has fewer keys than rows two through five. The five columns include a first column 24, a last column 26, and three middle columns 28. The keys are arranged in a generally regular grid pattern, where the keys in each column and row are aligned with one another. The rows have an arcuate shape, and the columns angle inwardly toward a common center line X-X. In this embodiment, smaller peripheral keys are positioned in the first and last columns 24, 26, rows two through five 32, 34, 36, 38. The smaller peripheral keys have a width that is reduced relative to the other keys in their corresponding row. The height of all the keys is the same. The keys in the first and last columns 24, 26 are positioned near the sides of the housing face 22. As a result, a user may more easily select the outer peripheral keys without accidentally depressing an unwanted interior key. In addition, because the outer keys have a narrower width, the keys in the middle interior columns 28 are wider. As a result, the keys in the middle columns 28 may be more easily depressed by a user.

Fig. 3 depicts a key arrangement 20 for a keyboard 14 that has rectangular keys. The keys are arranged in a generally regular grid pattern of five columns and four rows. The keys in the columns and rows generally align with one another. The five columns include a first column 24, a last column 26, and three middle columns 28. Fig. 3 represents a reduced column QWERTY keyboard arrangement, where more than one alphabetic character is associated with a single key in three of the four rows. In addition, a telephone keypad is associated with the middle three columns 28 of keys, such that the keyboard 14 may be used for both text and numeric entry. In this embodiment, the keys all have the same height, other than the space key 40, which has a height slightly greater than the remainder of the keys. The keys in the first and last columns, 24, 26 however, have a width that is reduced relative to the other keys in their respective rows.

Fig. 4 depicts a mobile communication device 10 having a housing face 22, a display 16, and a keyboard 14. The keyboard 14 has five rows and five columns. The keys are arranged in a regular grid pattern, where the keys in each column and row are aligned with one another. The rows have an arcuate shape, and the columns are aligned with the longitudinal axis X-X of the housing. In this embodiment, the keys are oval and

the keys in the first and last columns 24, 26 have been truncated such that they have a shape that is different from the shape of the other keys. As a result of this truncation, the keys in the first and last columns 24, 26 have a width that is reduced relative to the other keys on the keyboard 14. The height of all the keys is the same. The keys in the first and last columns 24, 26 are positioned near the left side 42 and right side 44 of the housing 12. As a result, a user may more easily select the outer keys without accidentally depressing an unwanted key. In addition, because the outer keys have a different shape from the middle column 28 keys, they may be more easily discernable by touch. While this embodiment shows a key that is truncated on its side, keys may alternatively be truncated on their top and/or bottom surfaces, or on their right side .

Fig. 5 is another example key arrangement 20 where the keys are rectangular. The keys are arranged in a regular grid pattern of seven columns and four rows. The keys in the columns and rows align horizontally and vertically with one another. Fig. 5 represents a reduced column QWERTY keyboard arrangement, where more than one alphabetic character is associated with a single key in three of the four rows. In this embodiment, the keys all have the same height. The keys in the first and last columns 24, 26, however, have a width that is reduced relative to the other keys in their respective rows. Because the keys in the outer columns 24, 26 have a reduced width, the keys in the middle columns 28 may be made wider for a fixed size keyboard 14.

Fig. 6 is an example key arrangement 20 utilizing keys that are round. The keyboard 14 shown is a full-size alphabetic QWERTY keyboard 14, where the letters of the alphabet take up a total of 26 keys in the arrangement 20. In this embodiment, the keys in the first and last columns 24, 26 have both a reduced width and a reduced height relative to the other keys in the rows. The keys in the outer columns 24, 26 have a width W1 that is less than the width W2 in the middle columns 28. In addition, the keys in the outer columns 24, 26 have a height H1 that is smaller than a height H2 of the keys in the middle columns 28. This key arrangement 20 is designed so that the first and last columns 24, 26 of the key arrangement 20 are positioned on the left and right sides 42, 44 of a device 10, such that the fingers will more easily contact the smaller peripheral keys. Because the keys in the outer columns 24, 26 have a reduced size, the keys in the middle columns 28 may be made wider for a fixed size keyboard 14.

Fig. 7 is another example key arrangement 20 utilizing keys that are rectangular. Like the key arrangement 20 of Fig. 6, the key arrangement 20 shown is a full-size

alphabetic QWERTY keyboard, where the letters of the alphabet take up a total of 26 keys in the arrangement. The keys in the first and last columns 24, 26, i.e., left and right sides, of the keyboard 14 have a width W1 that is smaller than the width W2 of the keys in the middle columns 28. This key arrangement 20 is designed so that the first and last columns 24, 26 of the key arrangement 20 are positioned on the sides 42, 44 of a device 10, such that the user's fingers will more easily contact the smaller peripheral keys. Because the peripheral keys are smaller, the keys in the middle columns 28 may be made larger for a fixed size keyboard 14.

Fig. 8 is an example key arrangement 20 that also utilizes keys that are rectangular in shape. The keys are arranged in a reduced alphabetic key format, where fewer than 26 keys are utilized for the alphabetic characters. In this embodiment, four rows and five columns are utilized, with the first and last columns 24, 26 having a width that is smaller than the width of the keys in the middle columns 28.

Fig. 9 is an example key arrangement 20 for a standard telephone keypad. The keys have a rectangular shape, with the keys in the first and last columns 24, 26 having a width W1 that is less than the width W2 of the keys in the middle column 28.

The example key arrangement 20 is preferably associated with a physical keyboard 14 that includes a plurality of multi-functional keys. The keys are multi-functional in that they may be used to enter alphabetic characters, numbers, touch tones, symbols, and/or functions, or other known entries. The keyboard 14 is a physical keyboard in the sense that it utilizes keys that are movable to activate switches that are positioned beneath the keys.

The keyboard 14 may be used for text entry and telephony entry. In the embodiments shown, some of the keyboards 14 provide a first user interface that includes alphabetic characters comprising a standard alphabetic format, such as QWERTY, QWERTZ, AZERTY, or DVORAK, among other known formats, for text entry, and a second user interface that includes numeric characters for telephony entry. An example reduced key format keyboard is presented in U.S. Patent Application No. 10/785,790, filed on February 24, 2004 and International Application No. PCT/CA02/01961, filed on December 17, 2002, the disclosures of which are incorporated herein by reference in their entirety.

The example key arrangement 20 is useful with both full size and reduced size keyboards 14. In addition to the letters, numbers, and symbols shown, the keys may

further include symbols and functions that are typically utilized with keyboards. Example symbols include ".", ",", ";", """, "'", ":", "?", "/", ">", "<", "!", "@", "~", "$", "%", "^", "&", "(", ")", "_", "-", "+", "=", "[", "]", "{", "}", "|", and "\", among other known symbols. Example functions include "tab", "caps lock", "shift", "control", "alt", "return/enter", "backspace", "insert", "delete", "home", "end", "page up", "page down", "end", "escape", "pause", "break", "send", "end", "txt", "sym", and "scroll lock", among other known functions associated with text entry or telephony entry.

A variety of shapes are shown for the keys in the various embodiment. Other shapes may also be utilized, without limitation. In the embodiments shown, the keys in the first and last columns 24, 26 are shown as having a smaller size than the keys in the middle columns 28. In addition, for key arrangements that are positioned at the bottom of a mobile communication device 10, it may be desirable to have the keys in the bottom 46 row have a smaller size than the keys in the upper rows. The keys in the bottom row are preferably positioned near the bottom edge 46 of the face 22 of the housing 12 of the mobile communication device 10 such that the same principals of usage apply and the keys are easier to access because of their proximity to the edge of the device. Alternatively, for a device where the keyboard is positioned at the top 48 of the housing 12, the top row may have keys that are smaller in size than keys in the lower rows of the key arrangement 20.

Fig. 10 is an exploded view of the hardware of a mobile communication device 10 incorporating an example key arrangement 20 on the keyboard 14. The device includes a first device housing section 260 and a second device housing section 262. The housing sections are connected together with fasteners (not shown) that engage a plurality of holes 250, 254 to form a single integrated device housing that encloses the internal components of the mobile communication device 10. The fasteners may be screws, rivets or the like. Fasteners are but one example of possible components that may be used to couple the device housing sections together. Other components include flexible or rigid but deformable members, possibly integral with one of the device housing sections, which engage cooperating structures on the other or each device housing section or are deformed to hold the device housing sections together. The device housing sections might also or instead be coupled together by bonding, with adhesive, for example. However, the device housing sections are preferably coupled together using releasable fasteners such as screws.

The device 10 depicted in Fig. 10 includes a PCB (printed circuit board) 264. Most of the internal components of the mobile communication device 10 are preferably mounted on the PCB 264. The keyboard 14 is preferably formed by positioning a key web 233A over a plurality of switches 233B on the PCB 264. The key web 233A and plurality of switches 233B are preferably configured such that each key in the key web 233A contacts and operates one of the switches 233B when the key is depressed. Other configurations may also be implemented, in which the number of switches 233B may be less than the number of keys on the key web 233A, or the number of switches 233B may be greater than the number of keys on the key web 233A. The key web 233A and switches 233B are also positioned such that the apertures 235 on the first device housing section 260 at least partially expose the keyboard 14. Portions of the key web 233A are exposed by the apertures 235 to provide key surfaces that may be depressed by a user to provide data input to the device 10. Such data input may, for example, be used to generate data communications on the device 10.

A display 16 is preferably mounted on the PCB 264. When the first device housing section 260 and second device housing section 262 are coupled together, an aperture 223 in the first device housing section 260 at least partially exposes the display 16. The aperture 223 in the first device housing section 260 and the display 16 on the PCB 264 may be positioned such that a viewing area 225 of the display 16 is exposed. The frame and other components associated with the display 16 are preferably hidden from view when the first and second device housing sections 260, 262 are coupled together.

A speaker 234 is preferably mounted at or near the top of the PCB 264. One or more apertures 235 in the first device housing section 260 are positioned to at least partially expose the speaker 234 when the first and second device housing sections 260, 262 are coupled together. A microphone 236 is mounted in the second device housing section 262. The microphone 236 is at least partially exposed by the aperture 237B in the second device housing section, and coupled to the PCB and other device components. Audio or voice inputs to the microphone 236 may be used, for example, to generate voice communications. When the microphone 236 is positioned in the housing, an aperture (not shown) is provided in the first device housing section 260 to at least partially expose the microphone 236. The microphone 236 may alternatively be mounted in the first device housing section 260 or on the PCB 264.

The device housing sections 260, 262 may include further apertures to expose or partially expose other device components. In the first device housing section 260, apertures 270, 272 and 274 are configured to partially expose the auxiliary I/O devices. An aperture 268 is similarly positioned in the second device housing section 262 to at least partially expose an auxiliary I/O device 228D. An aperture 266 in the second device housing section 262 may be provided to accommodate a power supply such as a battery. Other apertures may also be provided in the device housing. as necessary.

Other internal components of the device 10 may also be mounted on the PCB 264. The device components are interconnected to provide at least data and voice communication functionality, possibly in addition to further local non-communication functions and short-range communication functions. Although these other internal components are not shown in Fig. 10, most of them are preferably mounted on the rear side of the PCB 264, opposite the side on which the keyboard 14, display 16 and speaker 234 are mounted, but some components may be mounted adjacent to the display 16 and/or keyboard 14 or on or along an edge of the PCB 264. The internal components of the device 10 are interconnected as necessary, through wired connections, PCB tracks, other types of connectors or connections, or combinations thereof.

The first and second device housing sections 260, 262, when coupled together, form a handheld mobile communication device housing 10 enclosing the PCB 264 and internal components. The apertures 235, 223, 235 and 237B at least partially expose the speaker 234, display 16, keyboard 14 and microphone 236 as described above. Partial exposure of these components allows a user to make use of these components while at the same time protecting the components from damage. Apertures 268, 270, 272, 274 similarly expose and protect auxiliary I/O devices. When access to a component will normally be required relatively infrequently, a removable cover element may be provided for a corresponding device housing aperture. In the above example of a device power supply, a cover (not shown) is preferably provided for the aperture 266. Access to the power supply is possible when required, but the battery remains protected when access is not necessary.

The mobile communication device 10 may also include a predictive text computer program that is used in conjunction with the keyboard. Predictive test software is useful in reduced format keyboards, such as the example keyboard, in order to identify the desired input from the combination of keystrokes of a user. A predictive text computer program

may, for example, be used to predict a complete word or phrase from one or more keystrokes. If the predictive text computer program does not successfully predict a desired word or phrase, then text-entry characters may be entered more precisely, albeit more slowly, by selecting the appropriate characters on the keys. An example predictive text computer program is described in the following co-owned patent applications, which are incorporated herein by reference in their entirety: "Customizable Predictive Text Method For Reduced Keyboards," U.S. Provisional Patent Application No. 60/397,680, filed July 23, 2002; "Systems and Methods of Building and Using Custom Word Lists," International Patent Application No. PCT/CA03/01103, filed July 23, 2003, and "Portable Electronic Device With Keyboard", International Patent Application No. PCT/CA02/00862, filed June 10, 2002.

The handheld mobile communication devices 10, presented in Figs. 1, 2, 4, and 10 include similar features, such as a housing 12, a keyboard 14 and an output device 16. The output device shown is a display 16, which is preferably a full graphic LCD. Other types of output devices may alternatively be utilized. A processing device 18, which is shown schematically in Fig. 11, is contained within the housing 12 and is coupled between the physical keyboard 14 and the display 16. The processing device 18 controls the operation of the display 16, as well as the overall operation of the mobile communication device 10, in response to actuation of keys on the keyboard 14 by the user.

The housing 12 may be elongated vertically, or may take on other sizes and shapes, including a clamshell housing structure, among other structures. The keyboard may include a mode selection key, or other hardware or software for switching between text entry and telephony entry.

In addition to the processing device 18, other parts of the mobile communication device 10 are shown schematically in Fig. 11. These include a communications subsystem 100; a short-range communications subsystem; the keyboard 14 and the display 16, along with other input/output devices 106, 108, 110 and 112; memory devices 116, 118; and various other device subsystems 120. The mobile communication device 10 is preferably a two-way RF communication device having voice and data communication capabilities. In addition, the mobile communication device 10 preferably has the capability to communicate with other computer systems via the Internet.

Operating system software executed by the processing device 18 is preferably stored in a persistent store, such as a flash memory 116, but may be stored in other types

of memory devices, such as a read only memory (ROM) or similar storage element. In addition, system software, specific device applications, or parts thereof, may be temporarily loaded into a volatile store, such as a random access memory (RAM) 118. Communication signals received by the mobile communication device may also be stored to the RAM 118.

The processing device 18, in addition to its operating system functions, enables execution of software applications 130A-130N on the device 10. A predetermined set of applications that control basic device operations, such as data and voice communications 130A and 130B, may be installed on the device 10 during manufacture. In addition, a personal information manager (PIM) application may be installed during manufacture. The PIM is preferably capable of organizing and managing data items, such as e-mail, calendar events, voice mails, appointments, and task items. The PIM application is also preferably capable of sending and receiving data items via a wireless network 140. Preferably, the PIM data items are seamlessly integrated, synchronized and updated via the wireless network 140 with the device user's corresponding data items stored or associated with a host computer system. An example system and method for accomplishing these steps is disclosed in "System And Method For Pushing Information From A Host System To A Mobile Device Having A Shared Electronic Address," U.S. Patent No. 6,219,694, which is owned by the assignee of the present application and incorporated herein by reference.

Communication functions, including data and voice communications, are performed through the communication subsystem 100, and possibly through the short-range communications subsystem. The communication subsystem 100 includes a receiver 150, a transmitter 152, and one or more antennas 154, 156. In addition, the communication subsystem 100 also includes a processing module, such as a digital signal processor (DSP) 158, and local oscillators (LOs) 160. The specific design and implementation of the communication subsystem 100 is dependent upon the communication network in which the mobile communication device 10 is intended to operate. For example, a mobile communication device 10 may include a communication subsystem 100 designed to operate with the Mobitex™, Data TAC™ or General Packet Radio Service (GPRS) mobile data communication networks and also designed to operate with any of a variety of voice communication networks, such as AMPS, TDMA, CDMA,

PCS, GSM, etc. Other types of data and voice networks, both separate and integrated, may also be utilized with the mobile communication device 10.

Network access requirements vary depending upon the type of communication system. For example, in the Mobitex and DataTAC networks, mobile devices are registered on the network using a unique personal identification number or PIN associated with each device. In GPRS networks, however, network access is associated with a subscriber or user of a device. A GPRS device therefore requires a subscriber identity module, commonly referred to as a SIM card, in order to operate on a GPRS network.

When required network registration or activation procedures have been completed, the mobile communication device 10 may send and receive communication signals over the communication network 140. Signals received from the communication network 140 by the antenna 154 are routed to the receiver 150, which provides for signal amplification, frequency down conversion, filtering, channel selection, etc., and may also provide analog to digital conversion. Analog-to-digital conversion of the received signal allows the DSP 158 to perform more complex communication functions, such as demodulation and decoding. In a similar manner, signals to be transmitted to the network 140 are processed (e.g. modulated and encoded) by the DSP 158 and are then provided to the transmitter 152 for digital to analog conversion, frequency up conversion, filtering, amplification and transmission to the communication network 140 (or networks) via the antenna 156.

In addition to processing communication signals, the DSP 158 provides for control of the receiver 150 and the transmitter 152. For example, gains applied to communication signals in the receiver 150 and transmitter 152 may be adaptively controlled through automatic gain control algorithms implemented in the DSP 158.

In a data communication mode, a received signal, such as a text message or web page download, is processed by the communication subsystem 100 and is input to the processing device 18. The received signal is then further processed by the processing device 18 for an output to the display 16, or alternatively to some other auxiliary I/O device 106. A device user may also compose data items, such as e-mail messages, using the keyboard 14 and/or some other auxiliary I/O device 106, such as a touchpad, a rocker switch, a thumb-wheel, or some other type of input device. The composed data items may then be transmitted over the communication network 140 via the communication subsystem 100.

In a voice communication mode, overall operation of the device is substantially similar to the data communication mode, except that received signals are output to a speaker 110, and signals for transmission are generated by a microphone 112. Alternative voice or audio I/O subsystems, such as a voice message recording subsystem, may also be implemented on the device 10. In addition, the display 16 may also be utilized in voice communication mode, for example to display the identity of a calling party, the duration of a voice call, or other voice call related information.

The short-range communications subsystem enables communication between the mobile communication device 10 and other proximate systems or devices, which need not necessarily be similar devices. For example, the short-range communications subsystem may include an infrared device and associated circuits and components, or a Bluetooth™ communication module to provide for communication with similarly-enabled systems and devices.

A method for improving the ergonomics of a key arrangement 10 on a keyboard 14 of a fixed size is also provided. The method includes providing a plurality of keys arranged in a plurality of columns and a plurality of rows. The plurality of columns comprise a first column 24, a last column 26, and one or more middle column 28 . The method also includes defining the key size for the keys in the middle columns 28 to have at least one first size and defining the key size for the keys in the first and last columns 24, 26 to have a second size that is smaller than the corresponding first size. The first size may be the width W of the keys, the height H of the keys, or some other dimension of the keys.

In another embodiment, a method for designing a key arrangement 20 for a mobile communication device 10 is provided. The key arrangement 20 includes a plurality of keys arranged in a grid pattern that includes a plurality of columns. The columns include one or more middle column 28. The middle columns 28 are flanked by outer columns. The outer columns are the first and last columns 24, 26. The first step in the method is measuring a width of a face 22 of the mobile communication device 10. The width of the face 22 is preferably the area in which the keyboard 14 is going to be positioned on the device 10. This width is then divided by the total number of columns of keys that form part of the keyboard 14. The width divided by the total number of columns provides a preliminary key width. The preliminary key width is approximate width that the keys would be in each column if all the keys have the same width.

The next step in the method involves subtracting a predetermined amount from the preliminary key width to determine an outer column key width. The amount corresponds to a decrease in width for keys in the outer columns of the grid pattern of keys. Then the preliminary key width is multiplied by the number of middle columns to determine a preliminary total middle key width. The preliminary total middle key width is added to the amount multiplied by two to determine a final total middle key width. Then, the final total middle key width is divided by the number of middle columns to determine a final key width for the keys in the middle columns.

The method also may include steps to take into account any part of width of the face 22 of the device 10 that is not covered by keys. This amount may be subtracted from the width of the face 22 before the width is divided by the total number of columns.

While various features of the claimed invention are presented above, it should be understood that the features may be used singly or in any combination thereof. Therefore, the claimed invention is not to be limited to only the specific embodiments depicted herein.

Further, it should be understood that variations and modifications may occur to those skilled in the art to which the claimed invention pertains. The embodiments described herein are exemplary of the claimed invention. The disclosure may enable those skilled in the art to make and use embodiments having alternative elements that likewise correspond to the elements of the invention recited in the claims. The intended scope of the invention may thus include other embodiments that do not differ or that insubstantially differ from the literal language of the claims. The scope of the present invention is accordingly defined as set forth in the appended claims.

CLAIMS:

1. A key arrangement comprising:

a plurality of keys arranged in a regular grid of rows and columns, said columns comprising a first column, at least one middle column, and a last column, wherein the keys in the first and last columns are smaller than the keys in the at least one middle column.

2. The key arrangement of claim 1, wherein the plurality of keys have a width and a height, and the width of the keys in the first and last columns is smaller than the width of the keys in the at least one middle column.

3. The key arrangement of claim 1, wherein the plurality of keys have at least a first dimension and a second dimension, and the first dimension of the keys in the first and last columns is smaller than the first dimension of the keys in the at least one middle column.

4. The key arrangement of claim 1, wherein the keys have a shape and the shape is one of regular or irregular.

5. The key arrangement of claim 1, wherein each of the plurality of keys has the same shape and the keys in the first and last columns are a smaller version of the same shape.

6. The key arrangement of claim 1, wherein the plurality of keys comprise keys having at least a first shape, a second shape and a third shape.

7. A mobile communication device comprising:

a housing;

a keyboard comprising the key arrangement of claim 1 coupled to the housing; and

a display coupled to the housing.

8. The mobile communication device of claim 7, wherein the housing has a face with a top side, a bottom side, a left side, and a right side, and the first column is positioned adjacent the left side and the last column is positioned adjacent the right side.

9. A key arrangement comprising:

a first set of keys having at least one first size arranged in a pattern that has a plurality of sides; and

a second set of keys positioned around at least two of the sides of the pattern, wherein the second set of keys has a second size that is smaller than the at least one first size.

10. The key arrangement of claim 9, wherein the at least two sides comprise part of the periphery of the pattern.

11. The key arrangement of claim 9, wherein the first size comprises a first width and the second size comprises a second width, and the first width is greater than the second width.

12. The key arrangement of claim 9, wherein the first size comprises a first height and a first width and the second size comprises a second height and a second width, with the first height being greater than the second height and the first width being greater than the second width.

13. The key arrangement of claim 9, wherein the pattern comprises a plurality of rows and a plurality of columns, with keys in the outermost columns of the pattern being the second set of keys.

14. A device comprising:

a housing having a face with a top, a bottom, a left side, and a right side;

a display coupled to the face of the housing; and

a keyboard coupled to the face of the housing, the keyboard comprising:

a plurality of keys arranged in a pattern that has a plurality of rows and a plurality of columns, with the plurality of columns including a first column, a last column, and at least one middle column, the keys in the first column being positioned adjacent the left side of the housing and the keys in the last column being positioned adjacent the right side of the housing, wherein the keys in the first and last columns have a size that is smaller than the size of the keys in the at least one middle column.

15. A method for improving the ergonomics of a key arrangement on a keyboard of a fixed size comprising:

providing a plurality of keys arranged in a plurality of columns and a plurality of rows, wherein the plurality of columns comprises a first column, a last column, and at least one middle column;

defining the key size for the keys in the at least one middle column to have at least one first size;

defining the key size for the keys in the first and last columns to have a second size that is smaller than the corresponding at least one first size.

16. The method of claim 15, wherein the first size is at least one of a width and a height.

17. A method for designing a key arrangement for a mobile communication device, the key arrangement including a plurality of keys arranged in a grid pattern that includes a plurality of columns, said plurality of columns including a plurality of middle columns that are flanked by outer columns, the method comprising:

measuring a width of a face of a mobile communication device;

dividing the width of the face by a number corresponding to the number of columns of keys to determine a preliminary key width;

subtracting an amount from the preliminary key width to determine an outer column key width, said amount corresponding to a decrease in width for keys in the outer columns of the grid pattern of keys;

multiplying the preliminary key width by the number of middle columns to determine a preliminary total middle key width;

adding the preliminary total middle key width to the amount multiplied by two to determine a final total middle key width;

dividing the final total middle key width by the number of middle columns to determine a final key width for the keys in the middle columns.

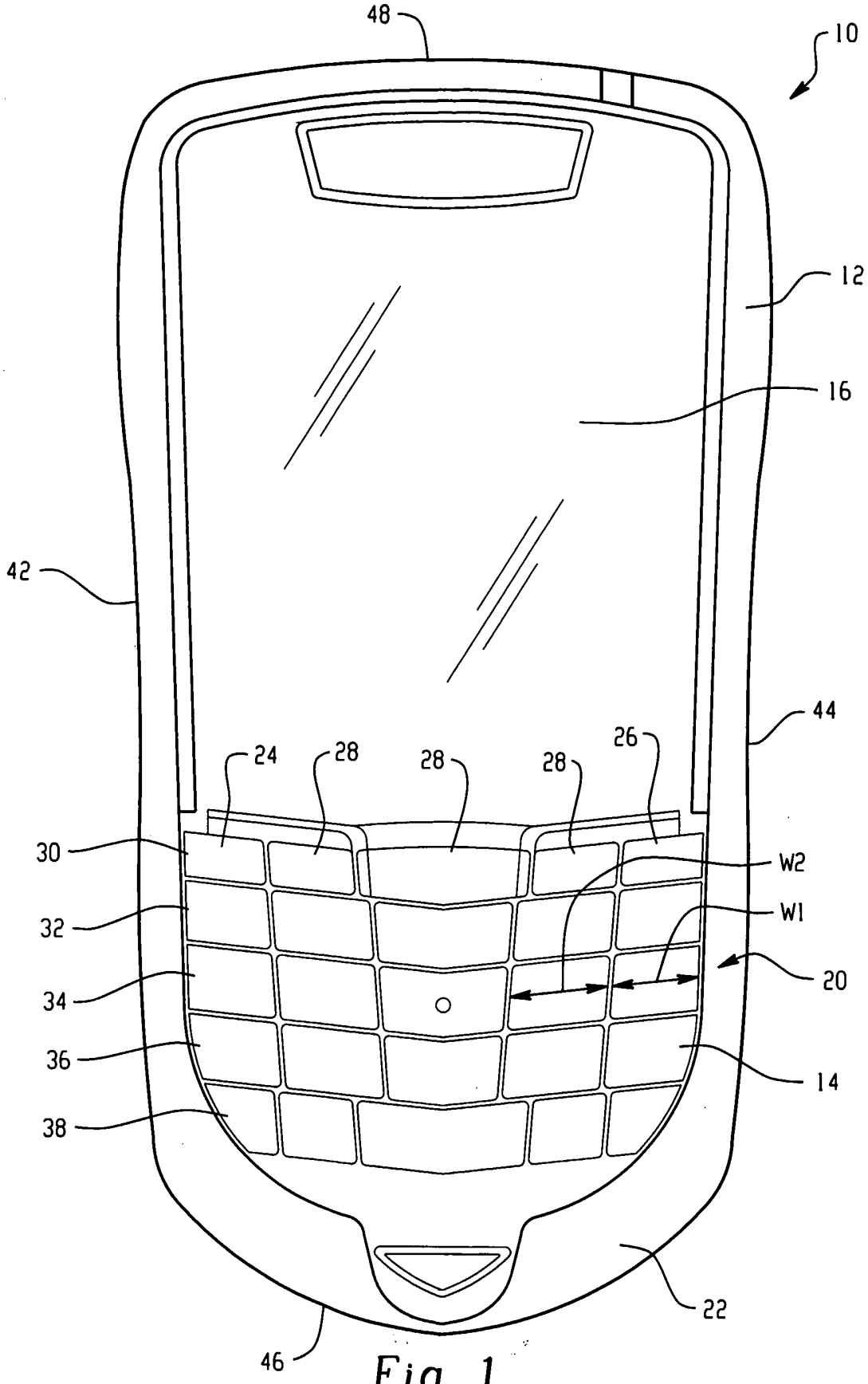


Fig. 1

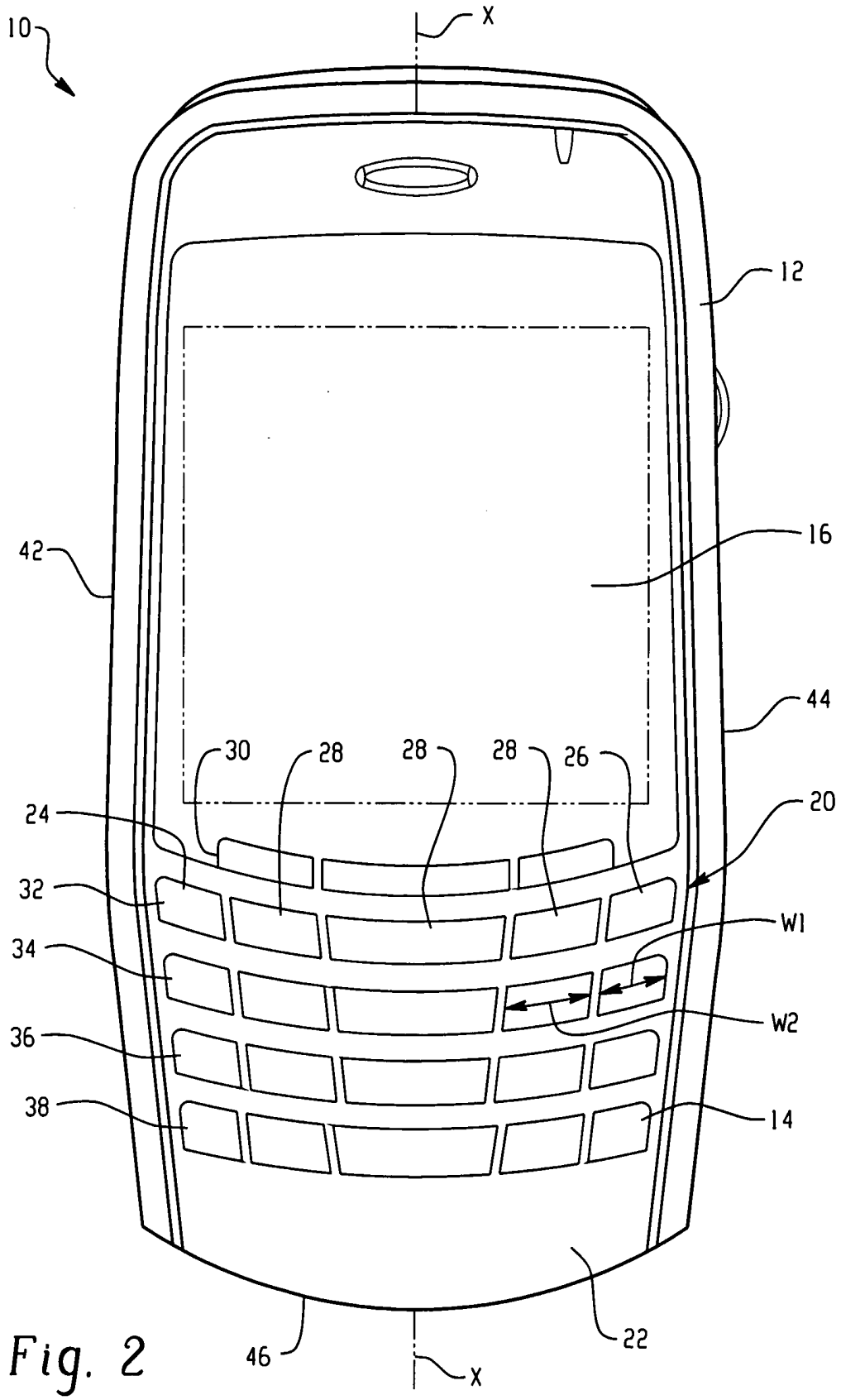


Fig. 2

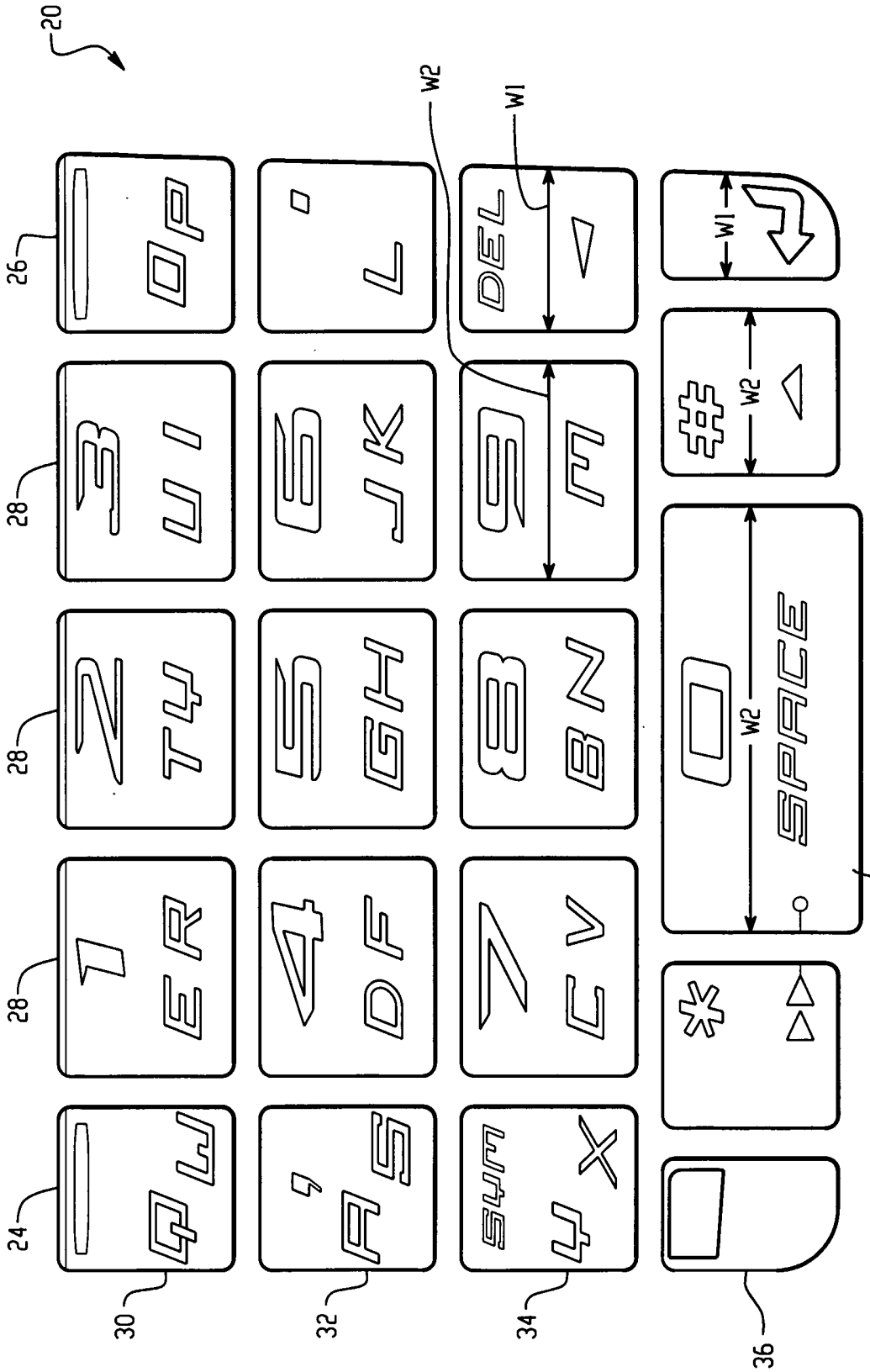


Fig. 3

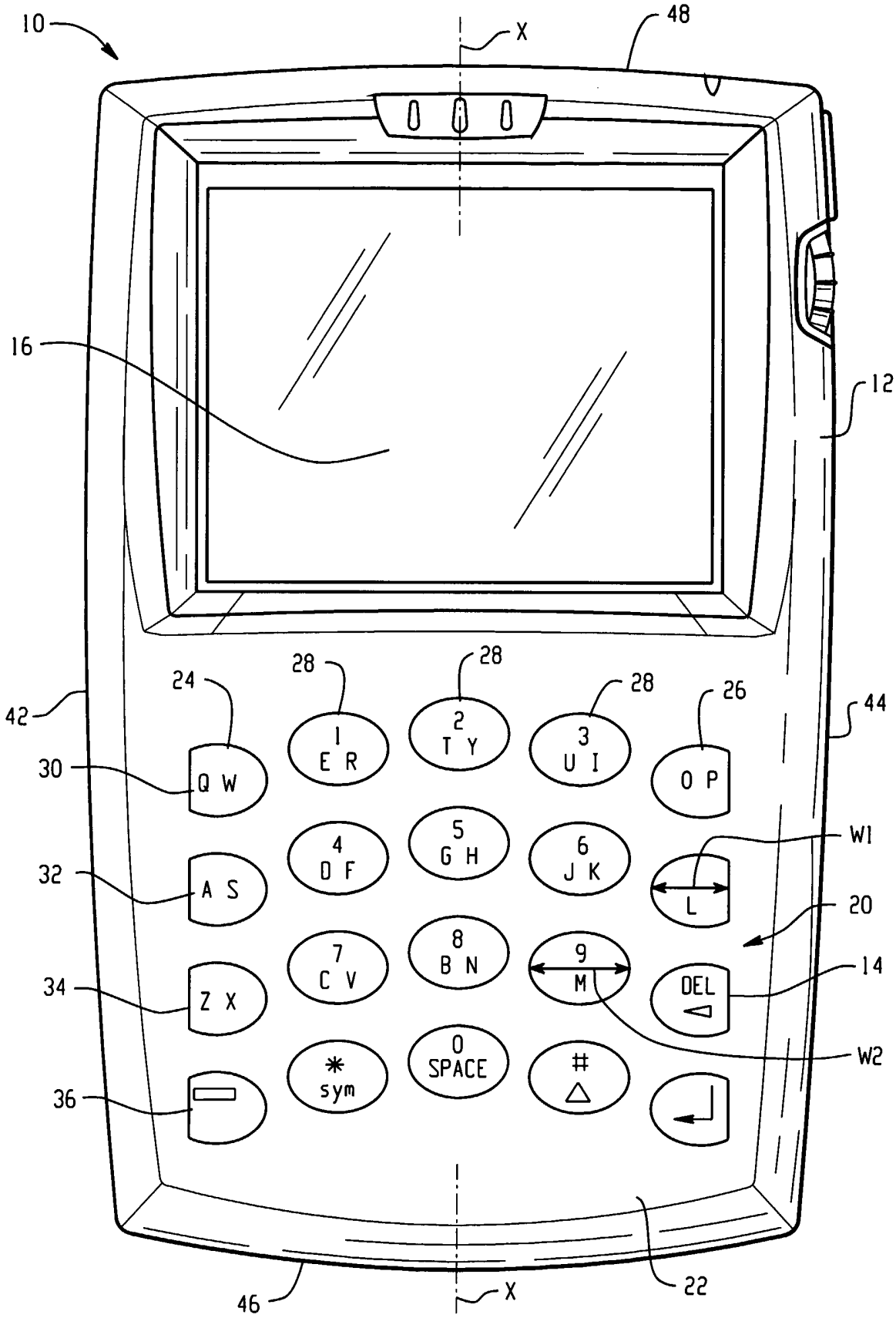

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44
30
Q W
1 E R
2 T Y
3 U I
O P
4 D F
5 G H
6 J K
W1
32
A S
L
20
7 C V
8 B N
9 M
14
34
Z X
DEL
W2
0 SPACE
* sym
#
36
46
X
22

Fig. 4

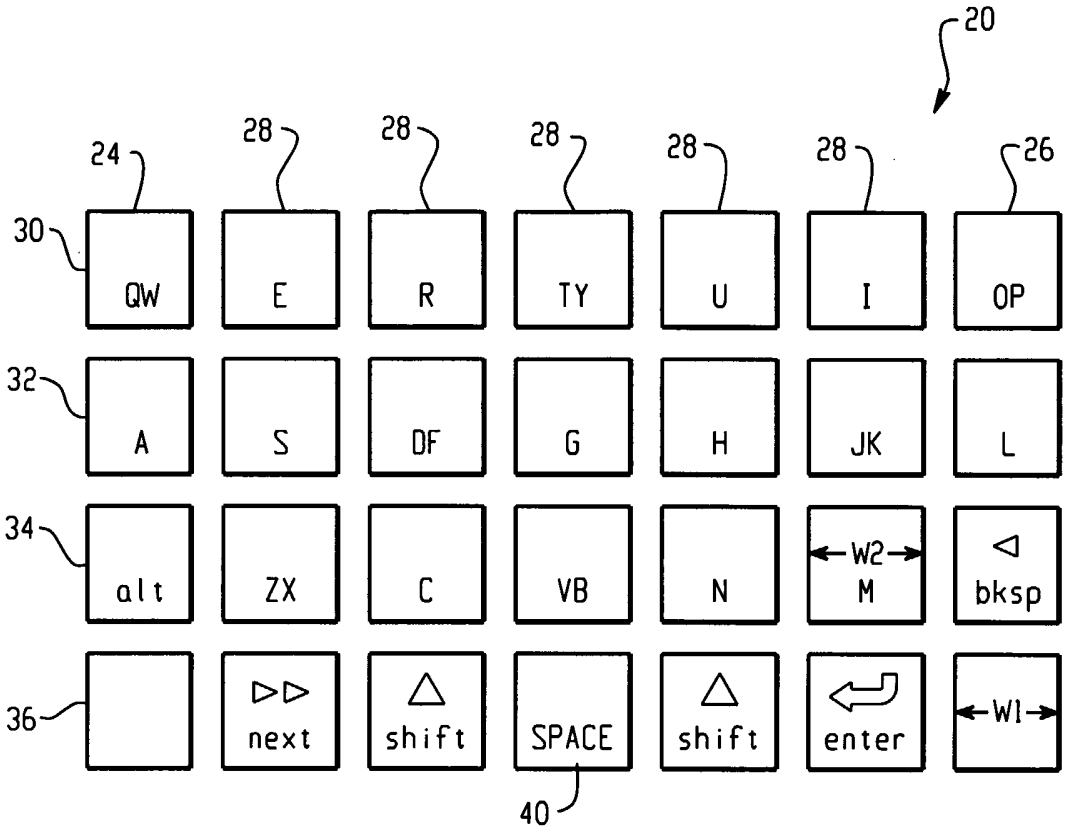

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QW
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TY
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G
H
JK
L
34
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ZX
C
VB
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next
shift
SPACE
shift
enter
W1
40

Fig. 5

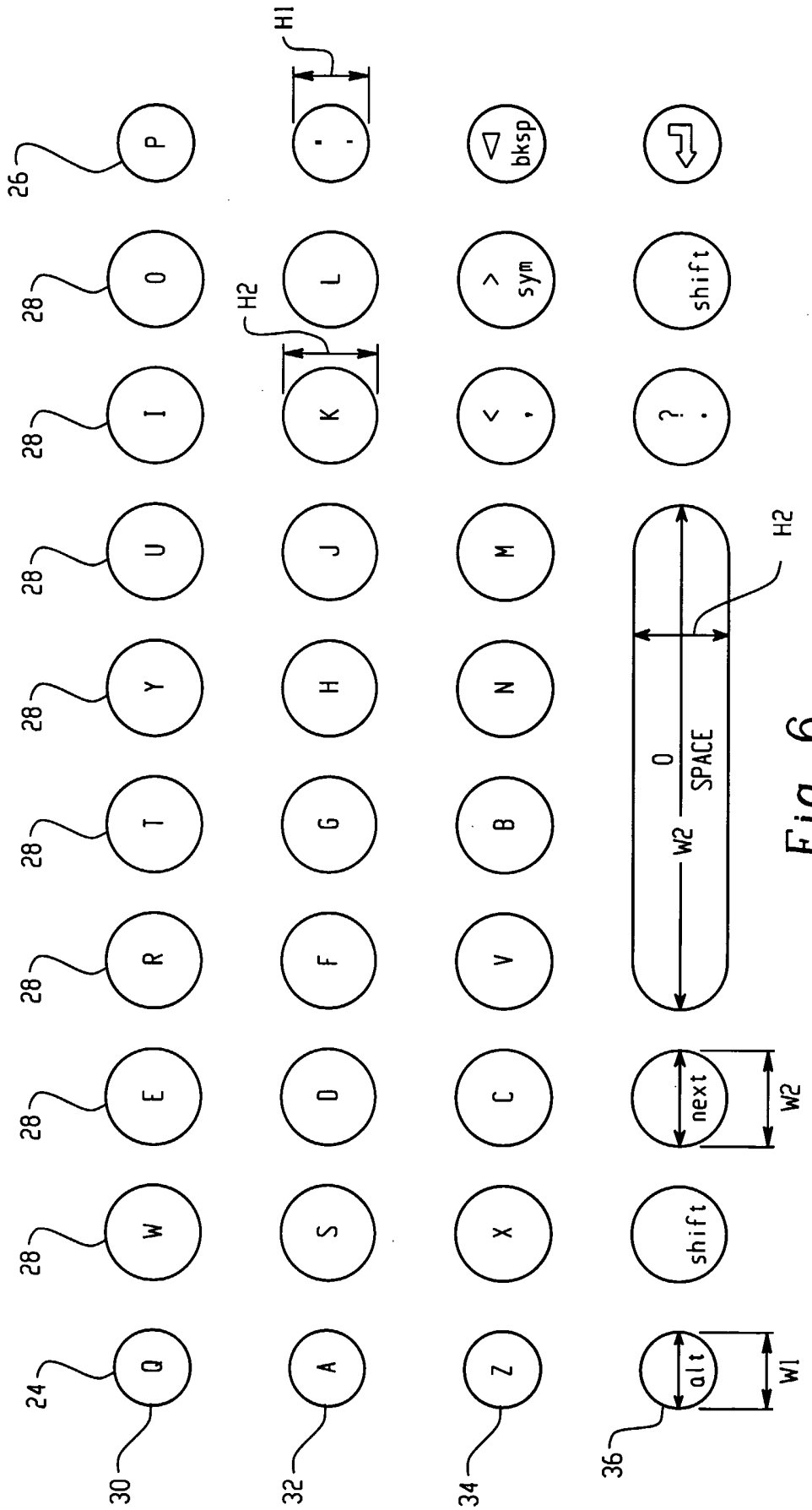

H1
H2
H2
W1
W2
W2
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26
28
30
32
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36
Q
W
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R
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U
I
O
P
A
S
D
F
G
H
J
K
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C
V
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N
M
alt
shift
next
0
SPACE
bksp
sym
shift

Fig. 6

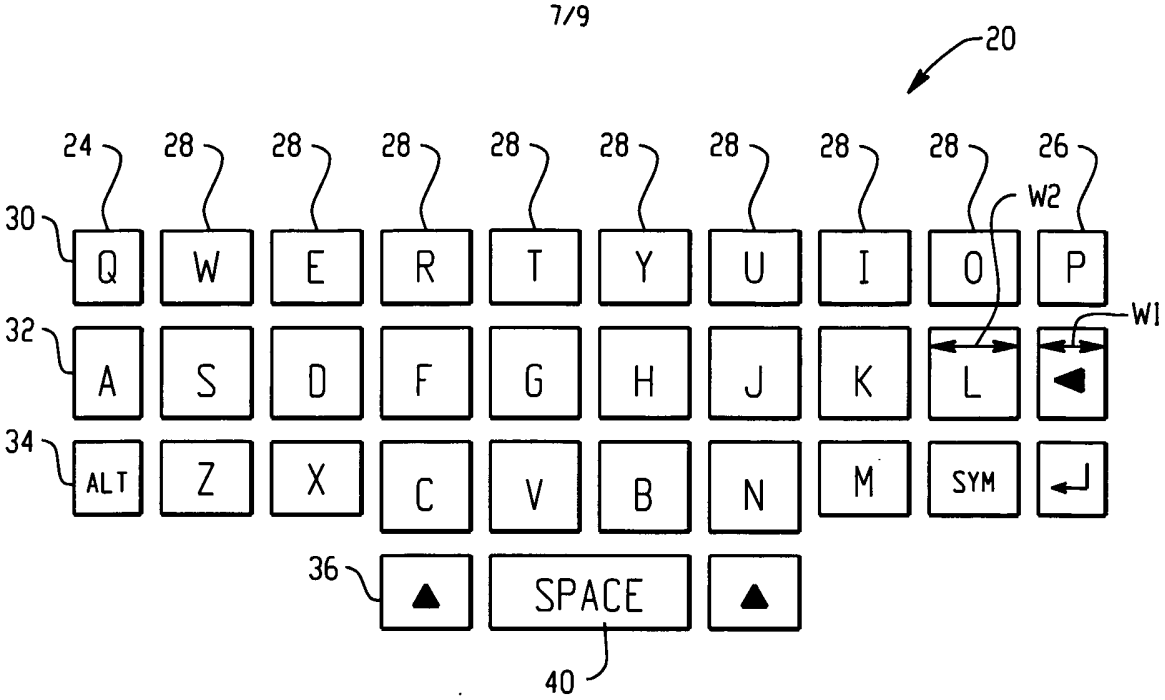


Fig. 7

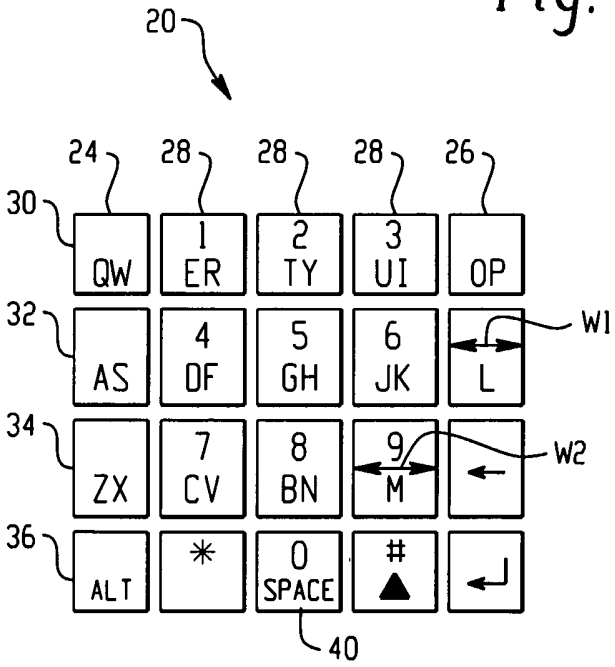


Fig. 8

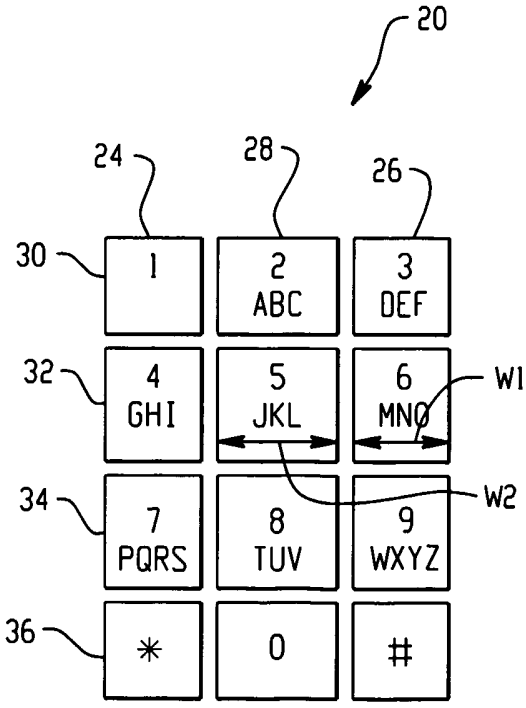


Fig. 9

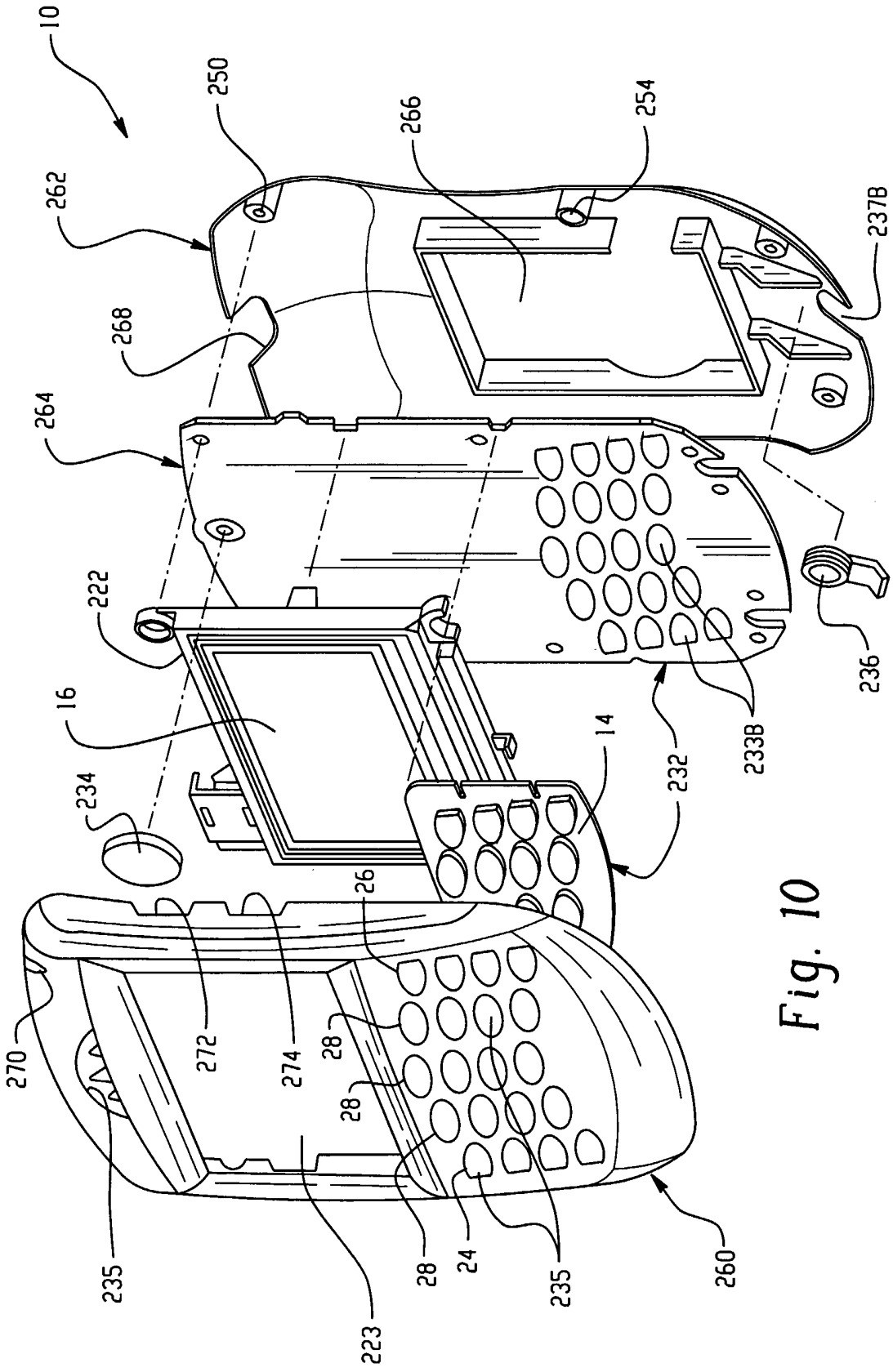

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Fig. 10

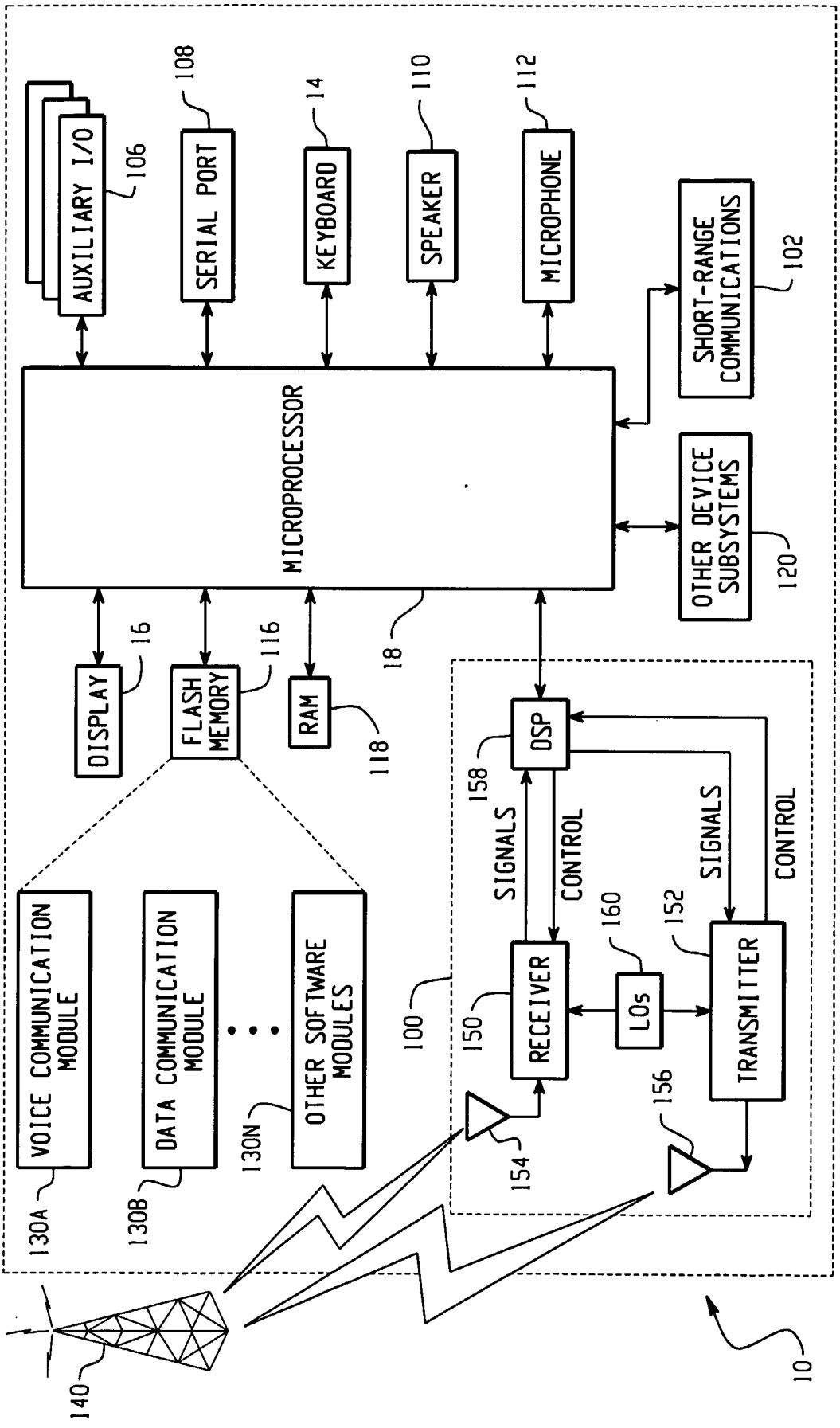

AUXILIARY I/O
106
SERIAL PORT
108
KEYBOARD
14
SPEAKER
110
MICROPHONE
112
SHORT-RANGE COMMUNICATIONS
102
MICROPROCESSOR
OTHER DEVICE SUBSYSTEMS
120
DISPLAY
16
FLASH MEMORY
116
RAM
118
18
DSP
158
SIGNALS
CONTROL
SIGNALS
CONTROL
160
152
LOs
RECEIVER
150
TRANSMITTER
100
154
156
VOICE COMMUNICATION MODULE
130A
DATA COMMUNICATION MODULE
130B
130N
OTHER SOFTWARE MODULES
140
10

Fig. 11