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(54) **ROTATIONAL MECHANISM FOR A WIRELESS COMMUNICATION DEVICE**

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(57) **ABSTRACT**

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This invention is a wireless communication device (100) including a first housing (220) with a housing support (250) and a second housing (120) positioned about the housing support, or a portion thereof, so that the second housing may rotate around the housing support. Also, the second housing (120) includes a circular portion (122) positioned about the housing support (250) and an extending portion (124) extending from the circular portion. When the device (100) is in a closed position (110), the circular and extending portions (122 & 124) of the second housing (120) are adjacent to the first housing (220). When the device (100) is in an opened position (210), the circular portion (122) is adjacent to the first housing (220) and the extending portion (124) is away from the first housing. In addition, the second housing (120) may have multiple position relative to the first housing (220) in which each position activates a particular function of the device (100).

(21) Appl. No.: **10/855,137**

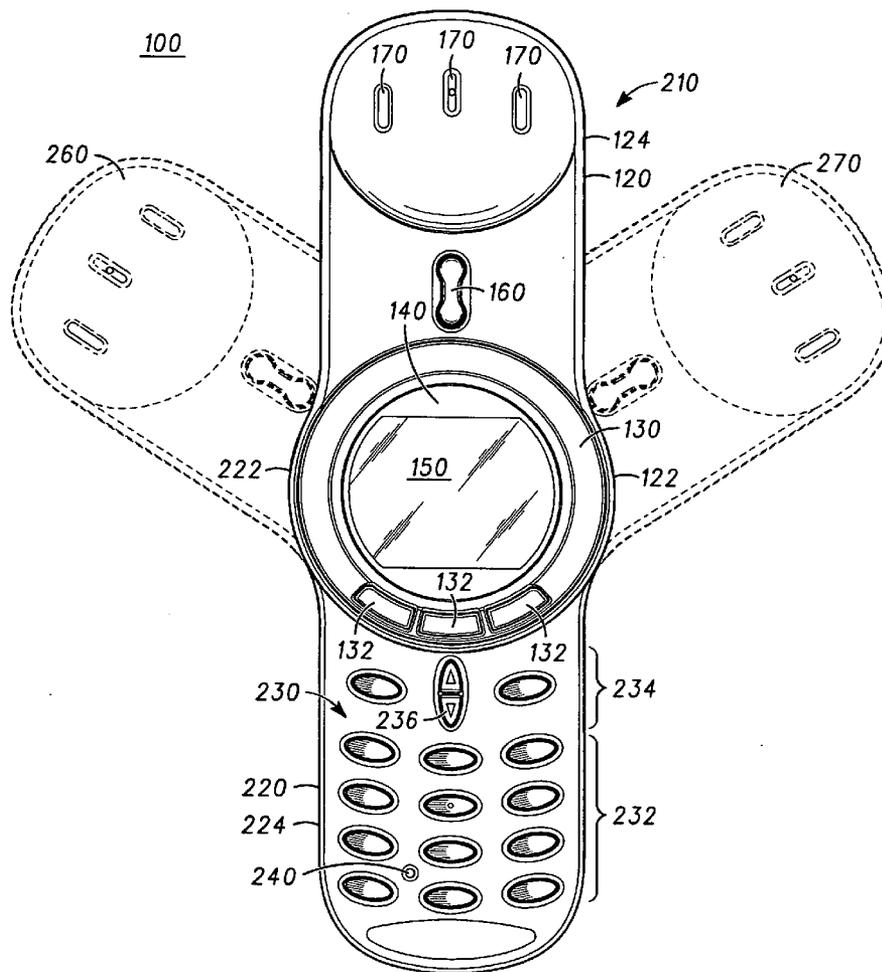
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Publication Classification

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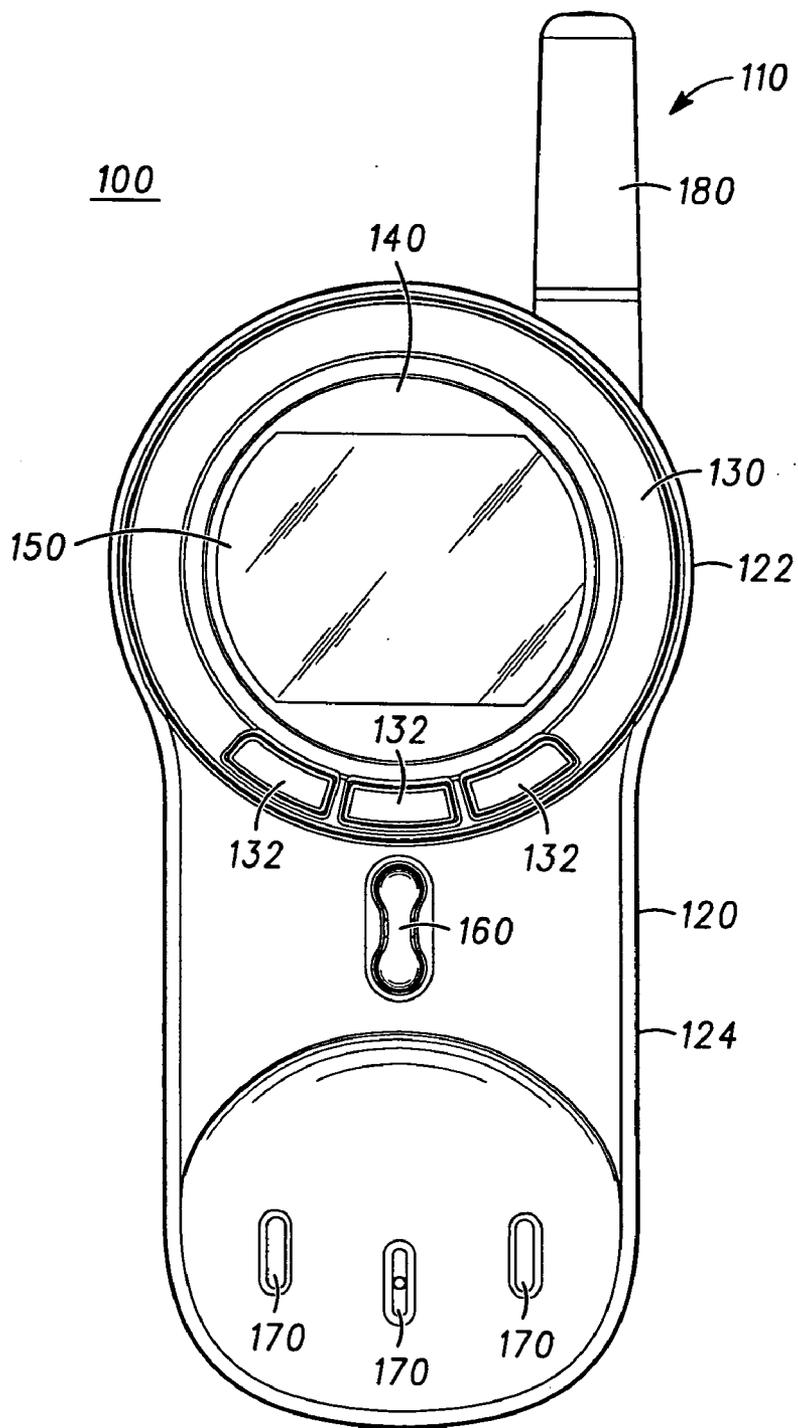


FIG. 1

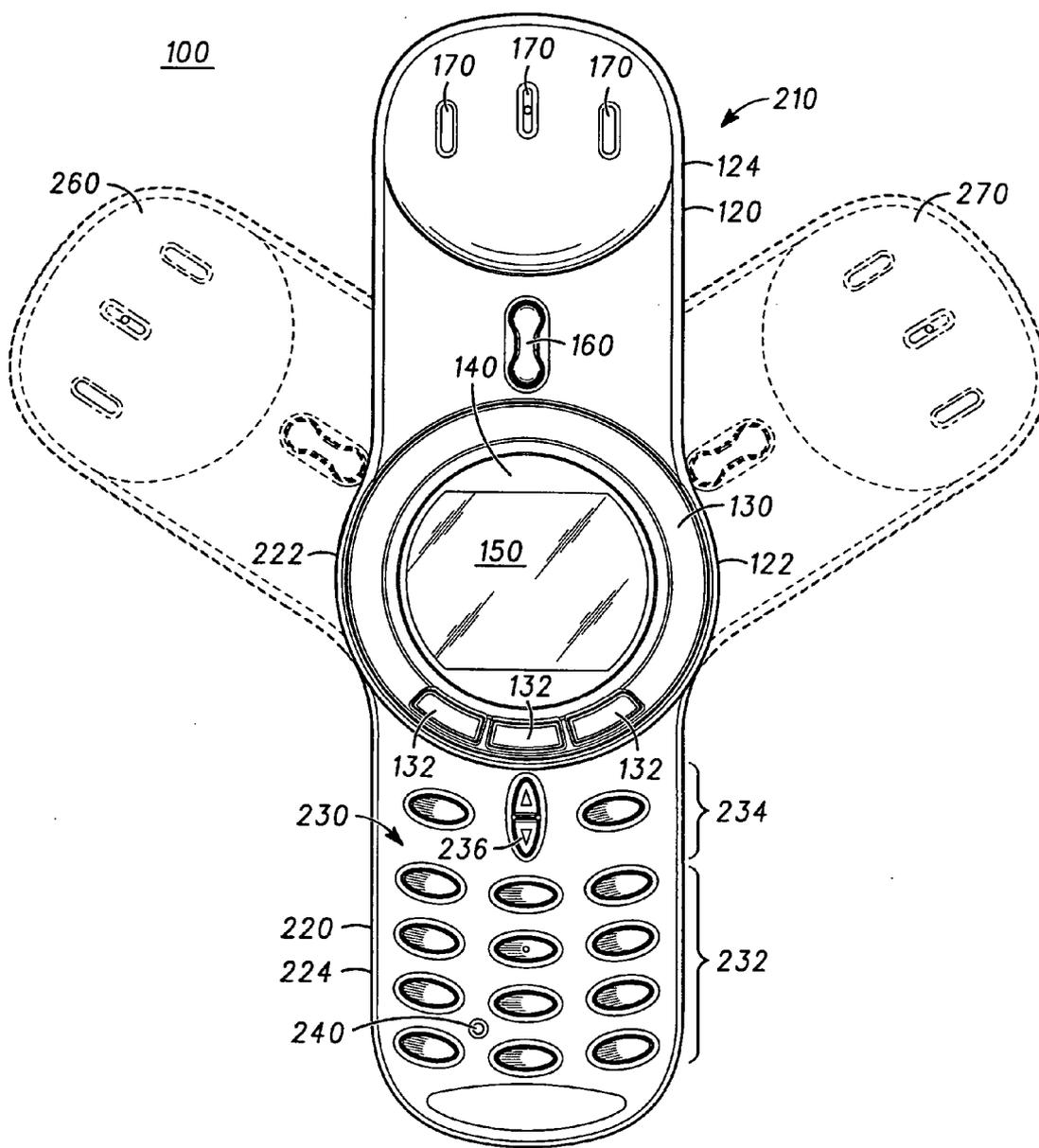


FIG. 2

FIG. 3

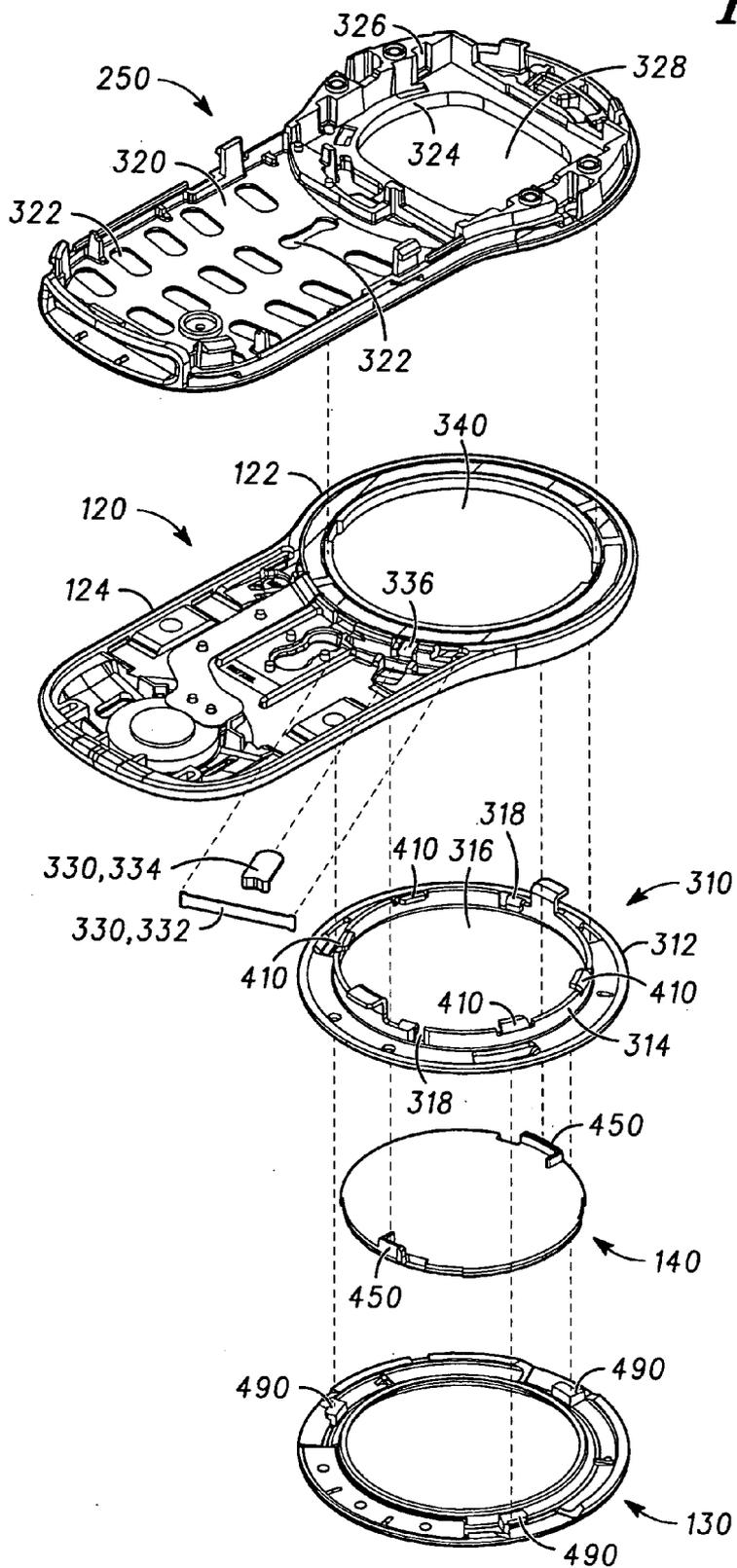
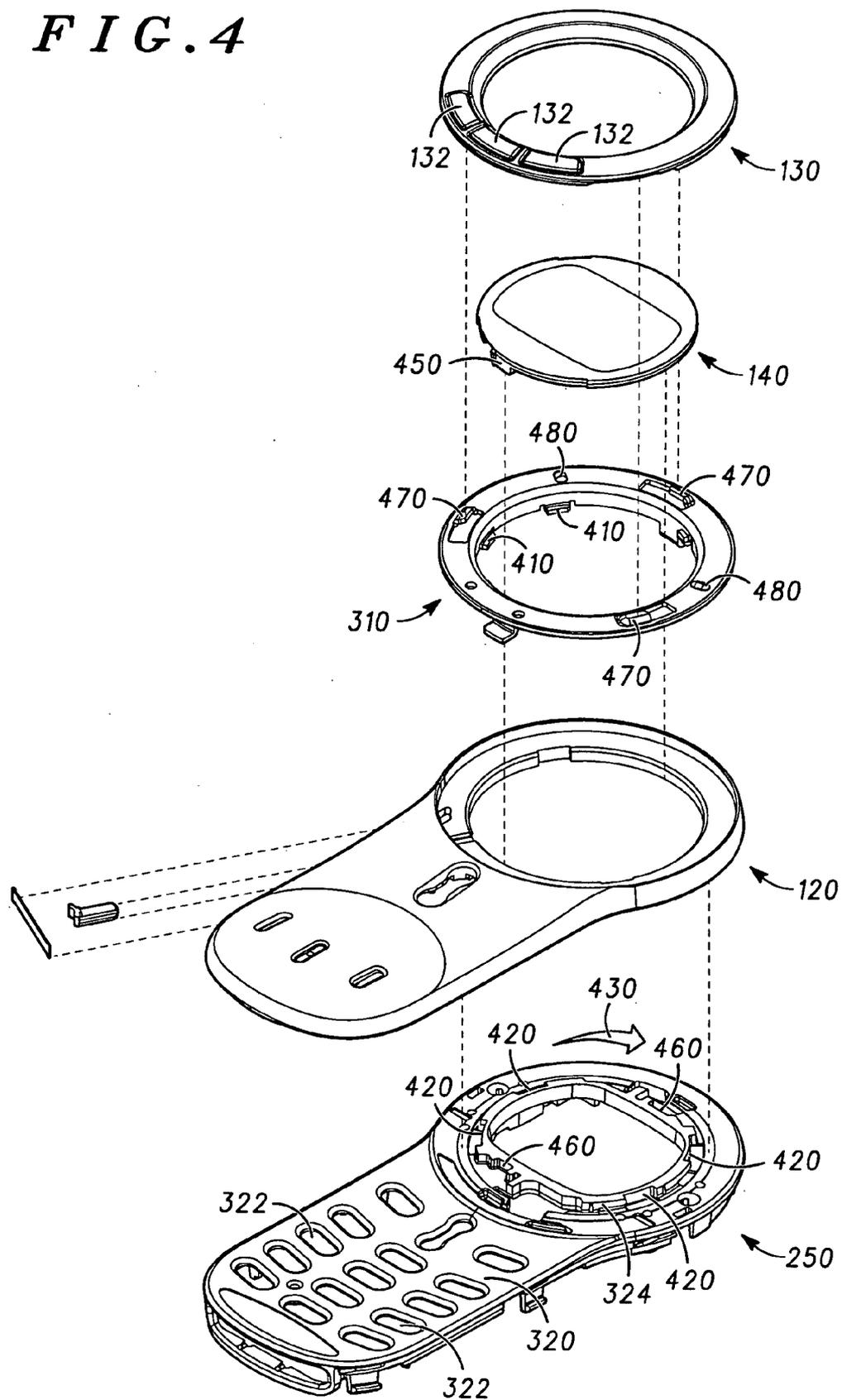


FIG. 4



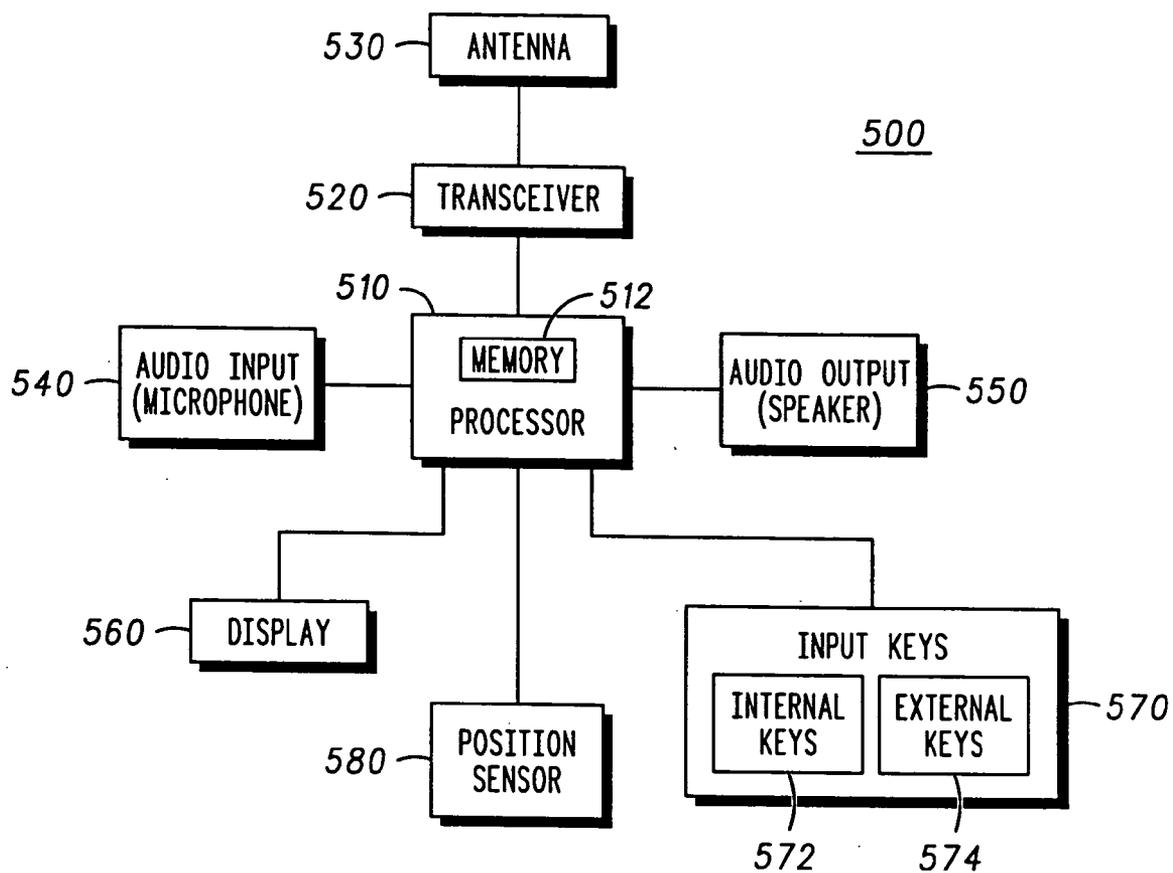


FIG. 5

ROTATIONAL MECHANISM FOR A WIRELESS COMMUNICATION DEVICE

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of portable electronic devices and, more particularly, to a wireless communication devices having a unique form factor to facilitate its portability and maximize its functionality.

BACKGROUND OF THE INVENTION

[0002] Portable electronic devices have many functions and come in a variety of different form factors. To increase their appeal, manufacturers of such devices focus on minimizing their form factor and while maximizing their functions. The flip-type device has a collapsible form factor that is particularly popular among manufacturers of wireless communication devices, such as radiotelephones, paging devices, personal digital assistant and the combination of these devices. The flip-type device includes two sections connected by a hinge that flip open for general operation of the device and flip closed for convenient transport of the device. Many wireless communication devices having the collapsible form factor provide a display an inner surface of the device so that it is exposed when the device is open and hidden when the device is closed.

[0003] Several wireless communication devices provide a viewable display when the devices are closed. As a result, a user may receive useful information, such as caller ID and time/date information, provided on the viewable display while the device is closed. One common type of wireless communication device provides a second display on the outer surface of the device. Another known type of wireless communication device provides an opening through one of the sections of the flip phone so that display on the inner surface of the device is exposed through the opening when the device is closed. Specifically, a first section of the device includes a display, and a second section of the device has two arms that attach to the first section with a large opening therebetween. Unfortunately, the arms of the open section tend to be unstable and fragile since the large opening between the two arms do not provide much support. Also, for both types of devices, the display is not conveniently viewable by the user when the device is transitioning from the closed position to the opened position and vice-versa.

[0004] Another type of wireless communication device with a collapsible form factor has two sections with inner surfaces that slide past each other to rotate open and slide together to rotate closed. For this configuration, the display is located on an outer surface of one section and is viewable by the user in both the opened and closed positions of the device. Unfortunately, if the display is considered to be right side up when the device is opened, the display is upside down when the device is closed due to the rotation of its corresponding section. Therefore, existing rotatable phones do not have conveniently viewable displays for both opened and closed positions.

[0005] There is a need for a wireless communication device with a collapsible form factor having a conveniently viewable display when the device is opened as well as closed. Also, the display should be conveniently viewable while the device is transitioning between the opened and closed positions. In addition, the desired device should not

compromise the stability and rigidity of the device in the opened and closed positions. The functionality of the desired device should be maximized, and it is further desirable to have a viewable display configuration that provides increased functionality to the device.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is a perspective view of a radiotelephone in a closed position;

[0007] FIG. 2 is a perspective view of the radiotelephone of FIG. 1 in an opened position as well as two alternative positions;

[0008] FIG. 3 is an exploded, perspective view of the radiotelephone of FIG. 1 viewed from the bottom down;

[0009] FIG. 4 is an exploded, perspective view of the radiotelephone of FIG. 1 viewed from the top down; and

[0010] FIG. 5 is a block diagram of the internal, electronic components of the radiotelephone of FIG. 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT(S)

[0011] The present invention is a wireless communication device including first and second housings. The first housing includes a housing support capable of retaining a display. The second housing includes a circular portion positioned about a portion of the housing support, namely the support rim, and an extending portion extending away from the circular portion. The second housing, particularly the circular portion, is capable of rotating around the portion of the support rim of the housing support. The first and second housings have a closed position and one or more opened positions. In the closed position, the circular and extending portions of the second housing are adjacent to the first housing. In one or more opened positions, the circular portion is adjacent to the first housing and at least a portion of the extending portion is positioned away from the first housing.

[0012] Referring to FIG. 1, there is provided a collapsible radiotelephone 100 in a closed position 110. The radiotelephone 100 has wireless communication capabilities and, thus, may be used to communicate with wireless infrastructure, such as cellular base stations, regional and local wireless transponders, and wireless local area networks. The radiotelephone 100 described herein is a representation of the type of wireless communication device that may benefit from the present invention. However, it is to be understood that the present invention may be applied to any type of portable electronic device and is not limited to the following devices: radiotelephones, cordless phones, paging devices, personal digital assistants, portable computers, pen-based or keyboard-based handheld devices, remote control units, an audio player (such as an MP3 player) and the like. Accordingly, any reference herein to the radiotelephone 100 should also be considered to apply equally to other portable electronic devices.

[0013] For the preferred embodiment shown in FIG. 1, the radiotelephone 100 includes an upper housing 120 having a generally elongated and planar shape. The upper housing 120 has an upper circular portion 122 at one end and an upper extending portion 124 extending away from the upper

circular portion. For this closed position **110**, the upper circular portion **122** and the upper extending portion **124** are adjacent to a lower housing (shown in **FIG. 2**). Also, an external antenna **180** may be provided to enhance the wireless communication capabilities of the radiotelephone **100**.

[0014] Components of the radiotelephone **100** are positioned near the upper circular portion **122** including an interchangeable cover **130**, a locking piece **140**, and a display **150**. The interchangeable cover **130** has a ring-like shape that may be attached to, and detached from, the radiotelephone **100**. Since the interchangeable cover **130** may be easily attached and detached by a user without the need of tools, the user may select among interchangeable covers of different colors to decorate the radiotelephone **100**. In addition, the interchangeable cover **130** may include cover selection buttons **132** and/or indicator lights (not shown) to provide additional functionality to the radiotelephone **100**. For example, the preferred embodiment provides three cover selection keys **132**: a left selection key, and right selection key and a menu key therebetween. The display **150** may be any type of output device that provides a convenient display of text and/or graphics to the user. Preferably, the display **150** is a liquid crystal display having a backlighting system to illuminate the display when lighting conditions are insufficient for proper viewing by the user. The locking piece **140** locks certain components of the radiotelephone **100** together, which is explained below. The locking piece **140** also functions as a display lens to protect the display **150** from undesirable, foreign matter.

[0015] The extended portion **124** of the upper housing **120** may include upper housing selection buttons **160** and speaker apertures **170**. Although many different selection buttons may be provided on the upper housing **120**, only one upper housing selection button **160** is shown in **FIG. 1** by way of example. Thus, the upper housing **120** of the present invention may include one or more selection buttons (such as selection buttons **132** and **160**) for various types of features including, but not limited to, volume control, menu control, call answering, call termination, caller identification, phone book control, voicemail control, e-mail/messaging control, network browsing, power on/off, and the like. The speaker apertures **170** direct sounds generated by an audio output device (shown in **FIG. 5**) to the user.

[0016] Referring to **FIG. 2**, the preferred embodiment of the radiotelephone **100** is shown in an opened position **210**. The portions the radiotelephone **100** that become visible in the opened position **210** include a lower housing **220**, a keypad **230** and a microphone aperture **240**. When viewed from above, the lower housing of the preferred embodiment has a substantially similar profile to the upper housing **120**. Similar to the upper housing **120**, the lower housing includes a lower circular portion **222** and a lower extending portion **224**. For this opened position **210**, the upper circular portion **122** of the upper housing **120** is adjacent to, and positioned above, the lower circular portion of the lower housing **220**. On the other hand, the upper extending portion **124** is positioned away from the lower housing. For example, as shown in **FIG. 2**, the upper extending portion **124** is positioned the opposite the lower extending portion **124** on opposite sides of the upper and lower circular portions **122** & **222**. The keypad **230** may include any layout of keys that provide convenient operation of the radiotelephone **100** by

the user. The microphone aperture **240** directs sounds received from the user or other local sounds to an audio input device (shown in **FIG. 5**).

[0017] The preferred embodiment includes a standard layout of alphanumeric and menu control for operation of the radiotelephone **100**. As shown in **FIG. 2**, the keypad **230** includes twelve standard keys **232** (namely, 0 through 9, # and *) as well as three lower housing selection buttons **234**. However, the radiotelephone **100** may include a larger grouping of keys, such as a QWERTY keyboard, if a device having a larger form factor or smaller individual keys is desired. Although not shown in **FIG. 2**, the keypad **230** may also include a cursor or graphical pointing device such as a joystick, touch pad or track ball. Also, similar to selection buttons **132** and **160** described, above, the lower housing selection buttons **234** may be used for various features including, but not limited to, volume control, menu control, call answering, call termination, caller identification, phone book control, voicemail control, e-mail/messaging control, network browsing, power on/off, and the like.

[0018] The position of the upper housing **120** is not restricted the opened position **210** and the closed position **110** described above. The upper extending portion **124** of the upper housing **120** has at least three functional positions about a housing support or bottom support (described below) of the lower housing **220**. The preferred embodiment shown in **FIG. 2** includes four functional positions, namely opened position **210**, closed position **110**, and auxiliary positions **260** & **270**. Generally, the opened position **210** and the closed position **110** may activate functions of the radiotelephone **100** such as answering an incoming call and terminating an existing call. Each of the auxiliary positions **260** & **270** may also be set to activate a particular function of the radiotelephone **100**. For example, auxiliary position **260** may operate to illuminate the display **150** (without answering an incoming call, if one exists), and auxiliary position **270** may operate to provide caller identification information about an incoming call that is not provided in the closed position **110**.

[0019] Another function that may be activated by the functional positions of the upper extending portion **124** includes changing between different modes of operation for a multimode device. For example, the position of the upper extending portion **124** may determine whether the wireless communication device operates as a radiotelephone, a pager, a network browser, an e-mail device, a personal digital assistant, or an audio player.

[0020] Still another function that may be activated by the functional positions of the upper extending portion **124** includes scrolling through a predetermined selection of data shown on the display **150**. For example, the upper extending portion **124** may be rotated to conveniently move up and down a list of contacts and/or phone numbers, or a listing of alphanumeric characters (i.e. "A" through "Z", "a" through "z", "0" through "9", and any special characters). This feature may also be used to operate functions that are not necessarily shown on the display **150**, such as volume control.

[0021] Regardless of the position of the upper housing **120** relative to the lower housing **220**, the cover selection buttons **132**, upper housing selection button **160**, and lower housing selection buttons **234** may operate independently or in

cooperation. For example, the each of these selection buttons **132**, **160** & **234** may activate a different function of the radiotelephone **100**. Regarding the upper housing selection button **160**, its function may change depending upon the position of the upper housing **120** relative to the lower housing **220**. For the preferred embodiment, the upper housing selection button **160** and the middle button **236** of the lower housing selection buttons **234** operate cooperatively. In the closed position **110** shown in **FIG. 1**, the upper housing selection button **160** is a mechanical lever that physically contacts the surface of the middle button **236** when a user adjusts the upper housing selection button. In the opened position **210** (and the alternative positions **260** & **270**), the upper housing selection button **160** does not have any function.

[0022] Referring to **FIG. 3**, the radiotelephone **100** of the preferred embodiment includes a top support **310** in addition to the lower housing **220**, the upper housing **120**, the locking piece **140** and the interchangeable cover **130** described above in reference to **FIGS. 1 and 2**. In contrast to **FIGS. 1 & 2**, certain sections of the radiotelephone **100**, such as an inner surface of the upper housing **120**, an outer surface of the lower housing **220**, the display **150** and other components within the upper and lower housings, are not shown in **FIG. 3** to more easily view the relationship among the top support **310**, the lower housing, the upper housing, the locking piece **140** and the interchangeable cover **130**. The lower housing **220** includes the lower circular portion **222** and the lower extending portion **224** (shown in **FIG. 2**). The lower circular portion **222** includes the housing support or bottom support **250** and the display **150** (shown in **FIGS. 1 & 2**).

[0023] The bottom support **250** includes a bottom support rim **324** having a circular shape and a bottom support base **326** to receive and support the display **150** (shown in **FIGS. 1 & 2**) such as a backlit liquid crystal display. The bottom support rim **324** defines a bottom support opening **328** to provide a viewing area of the display **150** to the user. The housing support or bottom support **250** may be an integrated component that is part of the lower housing **220** or a separable component that is positioned within the lower housing. As shown in **FIG. 3**, the bottom support **250** of the preferred embodiment is an integrated component that is part of an inside wall **320** of the lower housing **220**. The bottom support **250** is integrated with one part of the lower housing **220** to retain the display **150** in that area of the lower housing. The other part of the lower housing **220** includes keypad apertures **322** to reveal user-accessible portions of the keypad **230**.

[0024] The top support **310** mates with the bottom support **250** and maintains the upper housing **120** between the top and bottom supports. The top and bottom supports **310** & **250** are made of a rigid material, preferably a metallic material, to form a strong, inflexible coupling between the top and bottom supports. The top support **310** includes a top support base **312** and a top support rim **314** having a circular shape. The top support **310** is positioned over the upper housing **120** so that a lower surface of the top support base **312** is adjacent to an upper surface of the upper circular portion **122**. Similarly, the bottom support **250** is positioned under the upper housing **120** so that an upper surface of the bottom support base **326** is adjacent to a lower surface of the upper circular portion **122**. Also, the top support rim **314** is

positioned around the bottom support rim **324** so that an inner surface of the top support rim is adjacent to an outer surface of the bottom support rim. The upper housing **120** is situated between the top support **310** and the bottom support **250** so that the inner surface of the upper circular portion **122** is adjacent to the outer surface of the top support rim **314**. Accordingly, the upper circular portion **122** is capable of rotating about the top support rim **314** and the bottom support rim **324**.

[0025] The top support rim **314** of the top support **310** defines a top support opening **316** to permit the user to see a viewing area of the display **150**. The shape of the top support **310** may vary, but the top support rim **314** is preferably circular to provide a rotatable surface for the upper housing **120**. Also, the top support opening **316** of the top support **310** preferably has a shape that does not obstruct the user's view of the display **150**. Similarly, the upper housing **120** includes an upper housing opening **340** to permit the user to see a viewing area of the display **150** and, preferably, does not obstruct the user's view of the display.

[0026] As shown in **FIG. 3**, the locking piece **140** is positioned through the top support **310** and coupled to the bottom support **250** to prevent the top support from detaching from the bottom support. A more detailed explanation is provided below in reference to **FIG. 4**. Of course, as stated above, the locking piece **140** of the preferred embodiment also serves as the display lens to protect the display **150** from undesirable, foreign matter

[0027] The upper housing **120** may also include a detent assembly **330** to position the upper housing at various positions about the top and bottom supports **310** & **250**. More specifically, the detent assembly **330** permits the upper extending portion **124** of the upper housing **120** to be positioned at various positions about the top support rim **314** and the bottom support rim **324**. For the preferred embodiment, the detent assembly **330** includes a spring **332** and a follower **334** that are supported by the upper circular portion **122**. The follower **334** is positioned in an aperture **336** through a sidewall of the upper circular portion **122** so that it protrudes passed the inner surface of the upper circular portion. The spring **332** flexibly supports the follower **334** at this position, so that the follower may mate with a slot **318** provided on the outer surface of the top support rim **314**. In the alternative, the detent assembly **330** may include a one-piece spring having a projecting form that provides the functions of the spring **332** and the follower **334** of the preferred embodiment.

[0028] As shown in **FIG. 3**, the top support **310** may have a plurality of slots **318** and, likewise, the upper housing **120** may have a plurality of detent assemblies **330**. This structure permits the radiotelephone **100**, particularly, the upper extending portion **124** of the upper housing **120**, to have at least three positions about the bottom support rim **324** of the lower housing **220**, as explained above in reference to **FIG. 2**.

[0029] Referring to **FIG. 4**, the interlocking connection among the locking piece **140**, the top support **310**, and the bottom support **250** are represented. To assemble these components, the top support **310** is dropped onto the bottom support **250**. The top support **310** includes one or more top support inner and outer anchors **410** & **412** (also shown in **FIG. 3**), and the bottom support **320** includes corresponding

bottom support inner and outer grooves **420** & **422**. Top support inner anchors **410** of the top support **310** are aligned with corresponding bottom support inner grooves **420** of the bottom support **250** and, similarly, top support outer anchors **412** of the top support are aligned with corresponding bottom support outer grooves **422** of the bottom support. Then, the top support **310** is rotated, as shown by direction **430**, to lock the top support inner and outer anchors **410** & **412** into the bottom support inner & outer grooves **420** & **422**. Finally, the locking piece **140** is dropped down to prevent the top support **310** from rotating back in a direction opposite the original direction **430**. The locking piece **140** includes one or more locking piece feet **450** (also shown in **FIG. 3**) for mating with corresponding bottom support retaining areas **460** of the bottom support **250**.

[0030] Referring again to **FIG. 1** in conjunction with **FIG. 4**, the interchangeable cover **130** may be attached to, and detached from, the radiotelephone **100** by a user without the need for tools. The interchangeable cover **130** would have a ring-like shape that may enhance but, preferably, does not obstruct the user's view of the display **150**. The interchangeable cover **130** includes cover anchors **490** that mate with corresponding top support grooves **470** of the top support **310**. The top support **310** also includes projections **480** to provide tension against the inner surface of the interchangeable cover **130** in order to retain the cover anchors **490** in the top support grooves **470**.

[0031] Although not shown in **FIG. 4**, the cover selection buttons **132** of the preferred embodiment has electrical contacts that couple to corresponding electrical contacts of the top support **310**. These corresponding electrical contacts of the top support **310** are coupled to electronic components, discussed below in reference to **FIG. 5**, supported in the lower housing **250** by a flex cable.

[0032] Referring to **FIG. 5**, the electronic components **500** of the radiotelephone **100** are housed within the upper and lower housings **120** & **220**. The electronic components **500** include a processor **510**, a transceiver **520** and an antenna **530**. For the preferred embodiment, the antenna **530** transmits radio frequency ("RF") signals received from the transceiver **520** and provides RF signals to the transceiver that it receives. Likewise, the transceiver **520** converts controls signals received from the processor **510** for transmission by the antenna **530**, and converts RF signal received by the antenna for processing by the processor. The processor **510** acts as a central processing unit for the radiotelephone **100** and coordinates the operations of the electronic components **500**. The processor **510** also includes a memory portion **512** to store and retrieve data as well as perform various operations of the radiotelephone **100**. However, it is to be understood that various functions described herein for the electronic components **500** may be integrated or segregated and, thus, the present invention is not limited to particular discrete components shown in **FIG. 5**. For example, the processor **510** and the transceiver **520** may be combined in a single integrated circuit, or the processor and the memory portion **512** may be separated to different components.

[0033] The electronic components **500** may also include an audio input **540**, an audio output **550**, a display **560** and input keys **570**. For the preferred embodiment, the audio input **540** is a microphone that receives sounds through the

microphone aperture **240** (shown in **FIG. 2**) and the audio output **550** is an earpiece that emits sounds through the speaker apertures **170** (shown in **FIGS. 1** & **2**). Also, for the preferred embodiment, the display **560** is a backlit, liquid crystal display that is shown in **FIGS. 1** & **2** as display **150**. The input keys **570** include internal keys **572** such as the keypad **230** (shown in **FIG. 2**) and external keys **574** such as the upper housing selection button **160** and the cover selection buttons **132** (shown in **FIGS. 1** & **2**). The display **560** and the input keys **570** may also include connections to any indicator lights or selection buttons provided on the interchangeable cover **140**, as described above.

[0034] The electronic components **500** of the present invention further include at least one position sensor **580**. For example, the position sensor **580** of the preferred embodiment is a Hall effect detector that includes a magnet mounted on the upper circular portion **122** of the upper housing **120** and a Hall effect switch mounted to the lower circular portion **222** of the lower housing **220**. A single position sensor **580** is capable of detecting a particular position of the upper housing **120** relative to the lower housing **220**. Therefore, a plurality of position sensors **580** may be positioned throughout the circular portions **122** & **222** of the upper and lower housings **120** & **220** to detect various positions of the upper housing relative to the lower housing, such as the closed position **110**, an opened position **210**, and additional positions (such as **260** & **270**) about the housing support **250**. The position sensor **580** is capable of determining a particular position of the upper housing **120** relative to the lower housing **220** and generating a response signal corresponding to the particular position. The processor **510** is then effective to activate a particular function of the radiotelephone **100** in response to the response signal when the upper housing **120** is positioned at one of the additional positions.

[0035] While the preferred embodiments of the invention have been illustrated and described, it is to be understood that the invention is not so limited. Numerous modifications, changes, variations, substitutions and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.

1-25. (canceled)

26. A wireless communication device comprising:

a first housing having an elongated shape; and

a second housing rotatably coupled to the first housing and including a display, the second housing being capable of rotating in a plane parallel to the display,

wherein the first housing is capable of rotating relative to one end of the first housing, and the second housing is capable of rotating relative to a central portion of the display.

27. The wireless communication device of claim 26, wherein the first housing has a circular portion and an extending portion extending away from the circular portion.

28. The wireless communication device of claim 26, wherein the first housing includes at least one selection button.

29. The wireless communication device of claim 26, wherein the first housing includes at least one audio aperture.

30. The wireless communication device of claim 29, wherein the at least one audio aperture is located at a distal position from the one end of the first housing.

31. The wireless communication device of claim 26, wherein the first housing includes one of a microphone aperture and a speaker aperture and the second housing includes the other of the microphone aperture and the speaker aperture

32. The wireless communication device of claim 26, wherein the first housing has a profile similar to a profile of the second housing.

33. The wireless communication device of claim 26, wherein the second housing includes a top support positioned in front of the first housing relative to a viewing area of the display.

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