A control apparatus for a hand-held wireless telephone having a housing and operating in a first operational state of a plurality of sequential operational states. The control apparatus changes the operational state of the wireless telephone from the first operational state to a second operational state. The control apparatus itself comprises a detector that produces a signal responsive to a user grasping the housing of the wireless telephone and a controller responsive to receiving the signal produced by the detector and configured to select another operational state following the first operational state in a predetermined sequence of operational states.
ONE-HANDED CONTROL FOR WIRELESS TELEPHONE

FIELD OF THE INVENTION

This invention relates to the field of wireless telephones, and, more specifically, to operational controls for wireless telephones.

BACKGROUND OF THE INVENTION

It is common knowledge that wireless telephones (also called mobile stations, cellular telephone and cell phones) do not operate in the same manner as conventional wireline telephones. Most wireline telephone operations, such as answering the telephone and disconnecting the telephone, can both be accomplished with one hand. In contrast, a wireless telephone usually requires two hands to operate. To answer or disconnect a wireless telephone, the user must hold the telephone in one hand and push a “send” or “end” button, respectively. Hunting for a specific button and then pushing it can be awkward, especially in comparison to wireline telephones. Answering a wireless call can be dangerous in an automobile if the driver must take his or her eyes off of the road to hunt for the “send” button. Some people try to use the thumb of the hand in which they are holding the wireless telephone to push buttons. The thumb is not the best pointing device, however, and many wireless telephones are too big for this maneuver. Further, as telephones become smaller while simultaneously performing more functions, the buttons are becoming smaller and harder to read and touch individually.

This problem is partially addressed by wireless telephones that have “flips” or panels that rotate out. Some of these flip phones answer a call when the flip is closed (and some disconnect when the flip is closed). However, many of the flip phones require two hands to open, and other functions cannot be accessed by use of the flip. The user must still use two hands to perform these functions. Therefore, there is a need in the art for wireless telephones that can be operated in as simple a manner as a wireline telephone.

SUMMARY OF THE INVENTION

In accordance with one aspect of this invention, a control apparatus for a hand-held wireless telephone is provided. The wireless telephone has a housing and operates in a first operational state comprising one of a plurality of sequential operational states. The control apparatus changes the operational state of the wireless telephone from the first operational state to a second operational state. The control apparatus itself comprises a grasp detector that produces a signal responsive to a user grasping the housing of the wireless telephone and a controller configured to select a next sequential operational state following the first operational state as the second operational state responsive to receiving the signal produced by the detector.

In accordance with another aspect of this invention, the detector comprises a thermal sensor embedded in the wireless telephone’s housing and generates the signal responsive to a rise in temperature around the housing, and, advantageously, generates the signal responsive to a decrease in temperature. According to a further aspect of this invention, the housing has at least one flexible side, wherein the grasp detector may be a pressure sensitive switch under the flexible side that generates the signal when the user squeezes the flexible side.

According to another aspect of this invention, the housing has a first and a second flexible location, wherein the detector further comprises a first pressure sensitive switch under the first flexible location and a second pressure sensitive switch under the second flexible location. The detector may generate the signal when the user squeezes either the first or the second location. According to another aspect of this invention, the housing has a first and a second flexible side, and the detector comprises a first pressure sensitive switch under the first flexible side and a second pressure sensitive switch under the second flexible side. The detector generates a first signal when the user squeezes the first flexible side, and generates a second signal when the user squeezes the second flexible side. According to a further aspect of this invention, the controller is configured to select a second operational state following a first operational state in a predetermined sequence of a plurality of operational states; and, in response to the second signal, is configured to select another operational state in the sequence. Usually, but not always, the “another” operational state will be a subsequent operational state following the second operational state in the sequence.

In accordance with another aspect of this invention, the housing includes a motion sensor, and the detector generates the signal when the housing is moved by the user. According to a further aspect of this invention, the detector further includes a timer, and wherein the detector generates the signal when the housing is stationary for a predetermined time. According to yet another aspect of this invention, the wireless telephone includes an OR gate receiving input from a microphone, a speaker, and the motion sensor. The detector is connected to the OR gate such that the detector does not send the signal to the controller when there is input from the microphone, speaker or motion detector for the predetermined period of time. According to a further aspect of this invention, the detector comprises a capacitance sensor enclosed in the housing, wherein the capacitance sensor generates the signal responsive to the user’s grasp completing a circuit through the capacitance sensor, and generates the signal responsive to the user letting go of the housing.

According to another aspect of this invention, the housing includes a light sensitive element, wherein the light sensitive element generates a signal when the user’s hand blocks the light sensor from the ambient light and generates a signal when the user’s hand moves away from and uncovers the sensor.

According to another aspect of this invention, when the wireless telephone is operating in an “alerting” state, the controller is configured to change the alerting state to a “send” (“off hook”) state responsive to the signal from the detector. According to another aspect of this invention, when the wireless telephone is operating in a “send” state, the controller is configured to change the “send” state to a “standby” (“on hook”) state responsive to the signal from the detector.

According to another aspect of this invention, when the wireless telephone is operating in a “standby” state, the controller is configured to change the “standby” state to a “redial” state responsive to the signal from the detector. In accordance with still yet another aspect of this invention, when the wireless telephone is operating in a “function” state, the controller is configured to change the “function” state to a “standby” state responsive to the signal from the detector. In accordance with another aspect of this invention, when the wireless telephone is operating in a “function” state, the controller is configured to change to a positive state responsive to a first signal and a negative state responsive to a second signal.

According to another aspect of this invention, a wireless telephone is provided that operates in a wireless telephone...
and 42, respectively, responsive to control messages and user input. A microphone 44 receives speech signal input, converts the input into analog electrical signals and delivers the analog electrical signals to the transmitter 18. The transmitter 18 converts the analog electrical signals into digital data, encodes the data with error detection and correction information and multiplexes this data with control messages from the controller 22. The transmitter 18 modulates this combined data stream and broadcasts the resultant radio signals to the wireless network through the duplexer filter 14 and the antenna 13.

A switch detector 46 is connected to a grasp-sensitive switch, as will be explained further below. The switch detector 46 provides a signal to the controller 22 when one of the grasp switches detects a user grasping or squeezing the housing of the wireless unit 10. In accordance with another aspect of this invention, the switch detector 46 may also provide a signal to the controller 22 when one of the grasp switches detects a user letting go of, or putting down the wireless telephone 10.

Advantageously, the switch detector 46 delivers its signal to an OR gate 48. The signal from the switch detector 46 is OR’ed with any signal from a microphone 44, with any signals on a line 50 to the speaker 20 and with any signals on a line 52 from the microphone 44. In this manner, a signal line 54 provides a signal to the controller 22 when the user is speaking or listening but not holding the housing.

Turning now to FIG. 2, a semi-cutaway front view of a wireless telephone 200 according to one aspect of this invention is shown. The wireless telephone 200 is configured with a flexible side 204 on one side of its housing 202. The flexible side 204 consists of an outer membrane 206, a first plate 208 and a second plate 210. When the user grasps and/or squeezes the housing 202, the first plate 208 is moved into contact with the second plate 210. This contact completes a circuit, which is detected by the switch detector 46. In response, the switch detector 246 sends a signal to the controller 22. The signal may be transitory or may be for the duration of the user’s grasp. If the signal is transitory, then when the user lets go of the housing 202, and hence flexible side 204, another signal can be generated. If the signal is not transitory, then the controller 22 may be configured to change the operational state to the next sequential operational state. Of course, other forms of pressure sensitive switches are known in the art that can perform the same function. Then signals which broadly may be considered indicative of the fact that a user has picked up or set down the wireless telephone, are employed for control sequencing purposes as well be discussed further, below.

Turning now to FIG. 3, a semi-cutaway front view of a wireless telephone 300 according to another aspect of this invention is shown. The wireless telephone 300 is configured with a capacitance switch 304 on or embedded in the sides of the housing 302. The capacitance switch 300 consists of a first plate 306 and a second plate 308. In this exemplary embodiment, when the user grasps the housing 302, the conductive nature of the human hand causes a current to flow between the first plate 306 and the second plate 308. This completes a circuit, which is detected by the switch detector 346. In response, the switch detector 346 sends a signal to the controller 22. Again, the signal may be transitory or, as mentioned above, to achieve the same function.

Fig. 4 illustrates a grasp detection switch that uses a thermal sensor according to another aspect of this invention. The thermal sensor includes a first thermal switch 406 and a second thermal switch 408. When the user grasps the housing 402, the heat from the user’s hand is detected by at least one of the thermal switches 406 and 408 completing a circuit, thus causing the switch detector 446 to send a signal to the controller 22. Again, the signal may be transitory or not, as mentioned above, to achieve the same functions.

Turning now to FIG. 5, a semi-cutaway front view of a wireless telephone 500 according to another aspect of this invention is shown. This wireless telephone 500 is configured with a motion sensitive switch 504 inside of the housing 502. The motion sensitive switch 504 senses signals to the switch detector 546 when it senses that the housing is being moved. The signal is “debounced” (that is, changed from an unsteady state to a steady state) either at the switch detector 546 or at the controller 22. When the user picks up the wireless telephone of FIG. 5, the motion sensitive switch 504 sends a signal to the switch detector 546, which sends a signal to the controller 22. According to a further aspect of this invention, the switch detector 546 further includes a timer, and the switch detector 546 generates a signal when the housing is stationary for a predetermined time.

The wireless telephone may include an OR gate 48 (FIG. 1) receiving inputs from a microphone 20, the speaker 44 and the motion sensor 504. The switch detector 46 is connected to the OR gate such that the signal from the switch detector 546 is not delivered to the controller 22 when there is input from the microphone 20, the speaker 44 or the motion sensor 504 for the predetermined period of time, to prevent, for example, a premature change in state from active to standby if the wireless telephone 10 is put down for a short period of time.

Turning now to FIG. 6, a semi-cutaway rear view of a wireless telephone 600 according to another aspect of this invention is shown. The wireless telephone 600 is configured with a light sensitive switch 604, comprising a photocell in this exemplary embodiment, on one side of the housing 602 and positioned to be covered by the user’s hand when the housing 602 is grasped. Thus, when the user grasps the housing 602, the ambient light is cut off from the photocell. This action breaks a circuit, which is detected by the switch detector 646. In response, the switch detector 646 sends a signal to the controller 22. When the user puts the wireless telephone 600 down, the photocell is uncovered and again completes a circuit, which is detected by the switch detector 646. Advantageously, the switch detector 646 may send a further signal to controller 22 responsive thereeto.

Turning now to FIG. 7, a semi-cutaway front view of a wireless telephone 700 according to one aspect of this invention is shown. The wireless telephone 700 is configured with two flexible sides 704, 706, on each side of the housing 702. The flexible sides 704, 706 each consists of an outer membrane 708, 710, a first plate 712, 714 and a second plate 716, 718. When the user grasps and/or squeezes the housing 702, either or both of the flexible sides 704 and 706 cause their respective first plate 712, 714 to contact the respective second plate 716, 718. This contact completes a circuit, which is detected by the switch detector 746. In response, the switch detector 746 sends a signal to the controller 22.

Alternatively, in accordance with another aspect of this invention, the switch detector 746 generates a first signal when the user squeezes the first flexible side 704 and second signal when the user squeezes the second flexible side 706.

According to a further aspect of this exemplary embodiment, in response to the first signal, the controller 22 is configured to select a second operational state following...