US006292674B1

(12) **United States Patent**
Davis

(10) **Patent No.: US 6,292,674 B1**
(45) **Date of Patent: Sep. 18, 2001**

(54) **ONE-HANDED CONTROL FOR WIRELESS TELEPHONE**

(75) Inventor: **Gerald C. Davis**, Hillsborough, NC (US)

(73) Assignee: **Ericsson, Inc.**, Research Triangle Park, NC (US)

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

(21) Appl. No.: **09/135,315**

(22) Filed: **Aug. 5, 1998**

(51) **Int. Cl.**[7] **H04B 1/38**
(52) **U.S. Cl.** **455/550**; 455/90; 455/575
(58) **Field of Search** 455/90, 575, 569, 455/550; 379/433, 430, 428; 236/51; 89/1.11

(56) **References Cited**

U.S. PATENT DOCUMENTS

4,930,392	*	6/1990	Wilson	89/4.11
5,006,836		4/1991	Cooper	340/710
5,112,785		5/1992	Cooper	240/710
5,329,577	*	7/1994	Norimatsu	455/550
5,493,690	*	2/1996	Shimazaki	455/575
5,504,813		4/1996	Takasaki .	
5,538,181	*	7/1996	Simmons et al.	236/51
5,579,443	*	11/1996	Tatematsu et al.	455/521
5,588,041	*	12/1996	Meyer, Jr. et al.	455/569
5,696,821	*	12/1997	Urbansi	455/570
5,758,267	*	5/1998	Pinder et al.	455/90
5,802,476	*	9/1998	Nakajima et al.	455/550
5,924,046	*	7/1999	Martensson	455/567
6,026,283	*	2/2000	Stephenson	455/575
6,032,058	*	2/2000	Higuchi et al.	455/550
6,055,439	*	4/2000	Helin et al.	455/550

FOREIGN PATENT DOCUMENTS

0346859	12/1989	(EP) .
2316574	2/1998	(GB) .
WO 9716932	5/1997	(WO) .

OTHER PUBLICATIONS

Patent Abstracts of Japan, vol. 1996, No. 09, published Sep. 30, 1996.
Patent Abstracts of Japan, vol. 011, No. 171, published Jun. 2, 1987.

* cited by examiner

Primary Examiner—Vivian Chang
Assistant Examiner—Charles N. Appiah
(74) *Attorney, Agent, or Firm*—Wood, Phillips, VanSanten, Clark & Mortimer

(57) **ABSTRACT**

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.

20 Claims, 7 Drawing Sheets

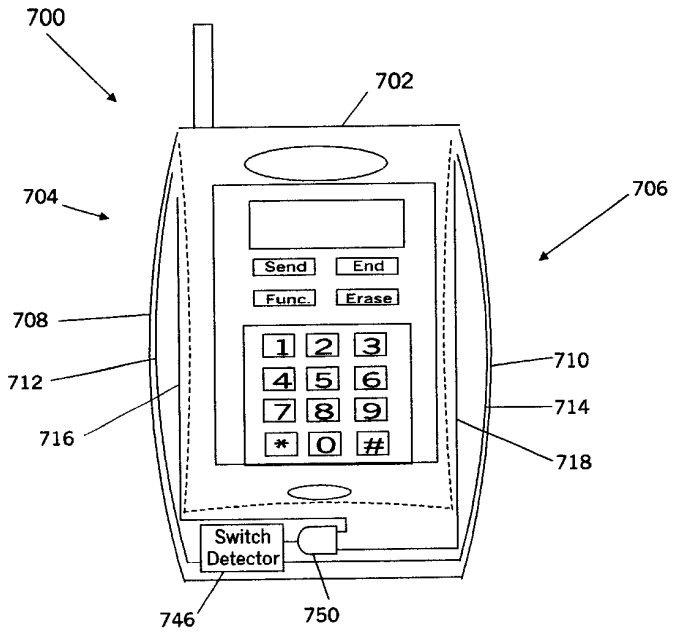


FIG. 2

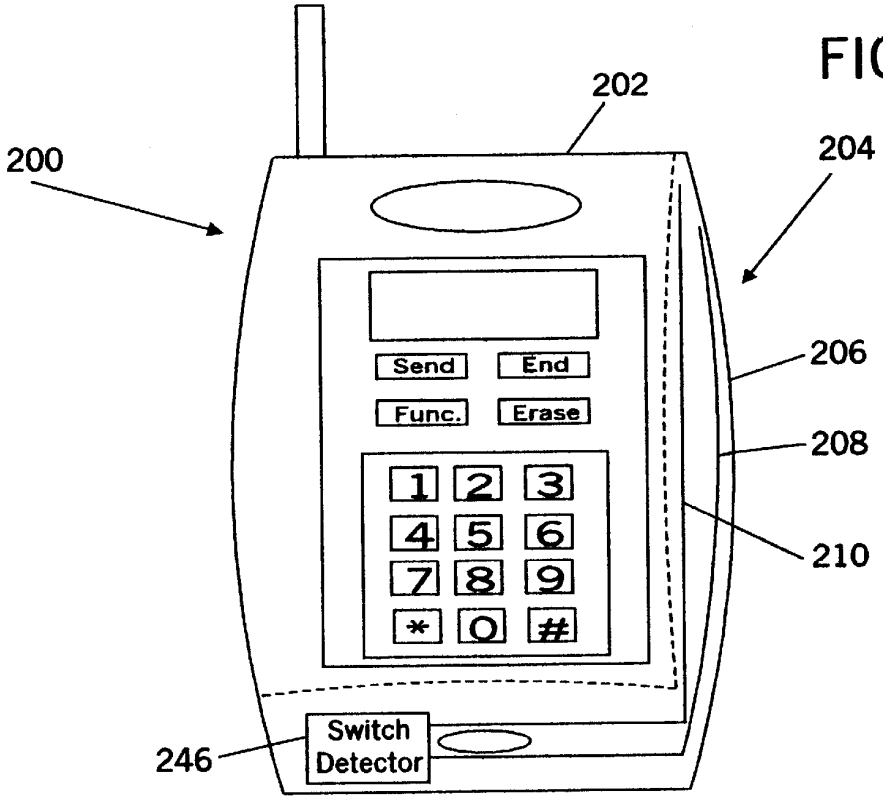
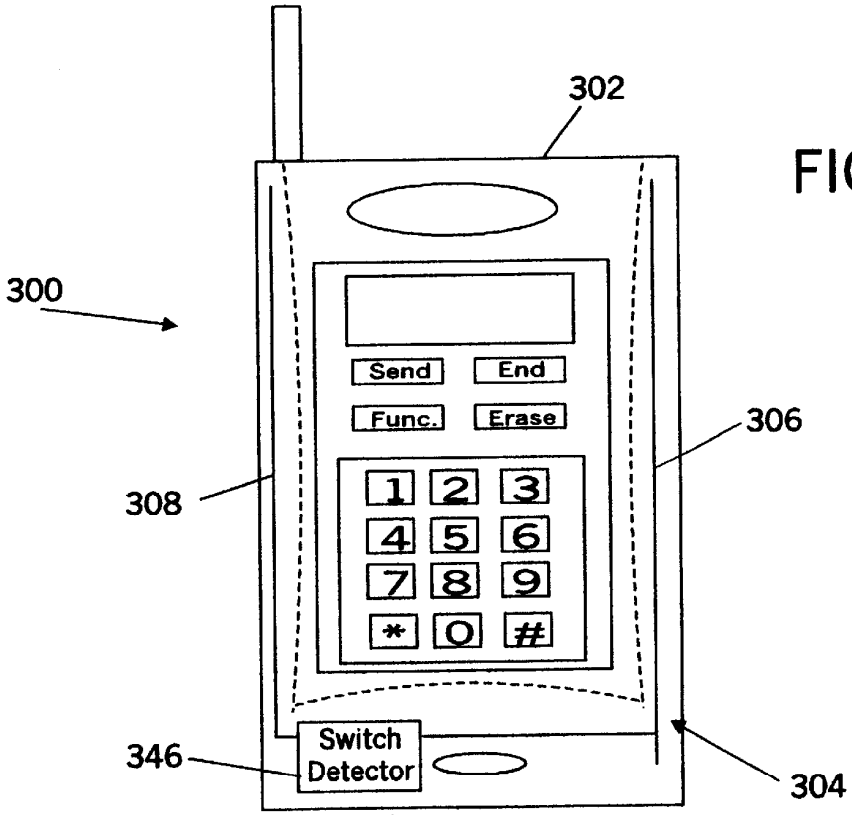

202
200
204
206
208
210
Send
End
Func.
Erase
1 2 3
4 5 6
7 8 9
* 0 #
246
Switch Detector

FIG. 3


302
300
306
308
Send
End
Func.
Erase
1 2 3
4 5 6
7 8 9
* 0 #
346
Switch Detector
304

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 opened (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. In accordance with yet 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 this aspect of the invention, in response to the first signal, 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 a further 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 sends 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 an 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 a further 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 an 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 duplex 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 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 not, as mentioned above, to achieve the same functions.

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 semicutaway front view of a wireless telephone **500** according to still 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** sends a signal 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 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 the 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 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 thereto.

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