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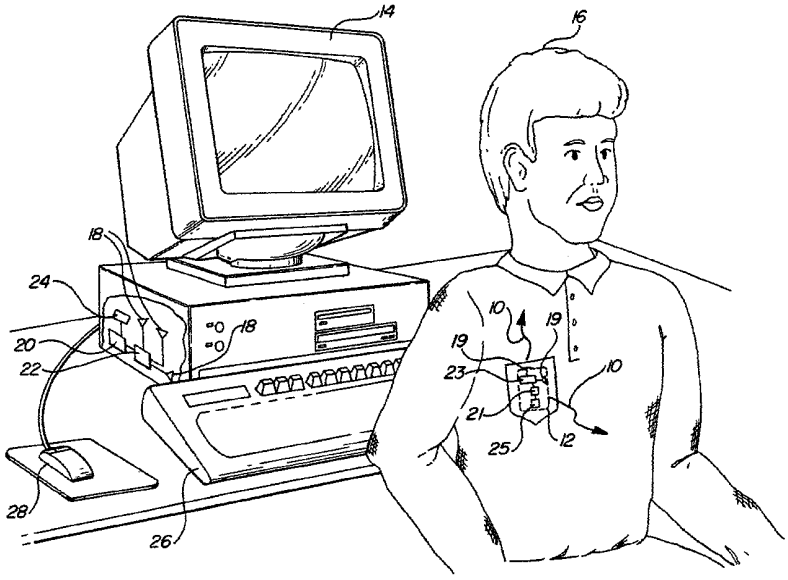
(54) Title: RADIO BASED PROXIMITY TOKEN WITH MULTIPLE ANTENNAS




(57) Abstract: A method of detecting a signal (10, 10') between a token (12) and an electronic device (14) for authorizing a user (16) to access the electronic device (14). The method comprises the steps of emitting a signal (10, 10') containing data, detecting the signal (10, 10') with a plurality of antennas (18, 18'), and measuring the strength of the signal (10, 10') detected at each of the antennas (18, 18'). If the maximum signal strength detected by any of the antennas (18, 18') is above an operational threshold, the electronic device (14) will be enabled. If the signal (10, 10') is above the operational threshold, the signal (10, 10') is compared to a user code database for authorizing the user (16) to access the electronic device (14). The operational threshold may be lowered to account for any signal variances that may occur after the user (16) has been authorized to access or when accessing the electronic device (14).

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# RADIO BASED PROXIMITY TOKEN WITH MULTIPLE ANTENNAS

## 1. Field of the Invention

A method of detecting a signal transmitted between a token and an electronic device for authorizing a user to access the electronic device

## 2. Description of the Prior Art

One method for providing security for accessing an electronic device includes detecting a signal between a token and an electronic device for authorizing a user to access the electronic device. The method comprises the steps of emitting a signal, detecting the signal with an antenna, and measuring the strength of the signal detected at the antenna. The signal is then compared to a predetermined threshold to determine if the user is within a predetermined range. If the user is determined to be within the predetermined range, the user is authorized to access the electronic device. If the strength of the signal is below the predetermined threshold, the user is not allowed to access the electronic device.

One such method is shown in United States Patent No. 5,821,854 for providing security to a personal computer. However, the software used for this method frequently locks the computer in response to signal strength dropping below the predetermined threshold due to the user moving and working near the computer. If the predetermined threshold is lowered to allow the user more mobility, the computer is less secure because the signal strength may still be above the predetermined threshold to allow an unauthorized user to access the computer when the user is not in proximity to the computer.

## SUMMARY OF THE INVENTION AND ADVANTAGES

The subject invention provides a method of detecting a signal between a token, i.e. a badge, and an electronic device for authorizing a user to access the electronic

device. The method comprises the steps of emitting a signal containing data, detecting the signal with a plurality of antennas, and measuring the strength of the signal detected at each of the plurality of antennas. The method is characterized by sensing the maximum signal strength detected at any of the plurality of antennas and enabling the electronic device in response to the maximum signal strength being above an operational threshold.

Accordingly, the subject invention provides additional security when detecting a signal between a token and an electronic device for providing access to a user. The plurality of antennas allows for detection of the maximum signal strength to overcome any variance that may be detected by the user moving or working near the electronic device. Additionally, the detection of the multiple signals allows the electronic device to log all detected signals and to determine the location of the user relative to the electronic device. The method further provides additional security to prevent the electronic device from being accessed by an unauthorized user when the user is not in proximity to the electronic device.

## BRIEF DESCRIPTION OF THE DRAWINGS

Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

Figure 1 is a flowchart showing a method of detecting a signal to authorize a user to access an electronic device;

Figure 2 is a perspective view of a first embodiment of a user wearing a token facing away from an electronic device such that the strength of the signal is below a predetermined threshold; and

Figure 3 is a perspective view of a second embodiment of the user wearing the token and operating the electronic device whereby the signal is being detected and the user is authorized to access the electronic device.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, a flowchart illustrating a method of detecting a signal **10, 10'** between a token **12**, i.e. a badge having a transceiver disposed therein, and an electronic device **14** for authorizing a user **16** to access the electronic device **14** is shown in Figure 1.

The method comprises the steps of emitting the signal **10, 10'** containing data, detecting the signal **10, 10'** with a first plurality of antennas **18, 18'**, and measuring the strength of the signal **10, 10'** detected at each of the first plurality of antennas **18, 18'**. The signal **10, 10'** is preferably emitted as a radio frequency (RF) or an equivalent signal that allows for wireless communication as is known in the art. A first embodiment, as shown in Figures 2, emits the signal **10** from the token **12**. The second embodiment, shown in Figure 3, emits the signal **10'** from the electronic device **14**. The signal **10, 10'** may be emitted continuously or periodically as is required to provide adequate security and to authorize the user **16** for continued access to the electronic device **14**. The token **12** may be programmed to transmit for a specified period of time and then terminate transmission for a predetermined period of time. The token **12** may be a badge, a pager, or any other portable unit carried or worn by the user **16**.

In Figure 2, the token **12** has a second plurality of antennas **19** positioned parallel to each other for subsequently emitting the signal **10** from one of the antennas **19** and then from the other of the antennas **19**. In Figure 3, the electronic device **14** has the second plurality of antennas **19'** positioned parallel to each other for subsequently emitting the signal **10'** from one of the antennas **19'** and then from the other of the antennas **19'**.

In both embodiments, the first plurality of antennas **18, 18'** are aimed transversely to each other such that one of the antennas **18, 18'** is aimed in a first direction and the other of the antennas **18, 18'** is aimed in a second direction so that one

of the directions is always more sensitive for detecting the signal **10, 10'**, that is, except when the signal the signal direction bisects the antennas **18, 18'**. The electronic device **14** is preferably a computer but may further include printers, cellular phones, scanners, or any other electronic equipment. The emitted signal **10, 10'** is detected by the plurality of antennas **18, 18'**. The antennas **18, 18'** may be any type of antenna as is known in the art of RF signal detection. In addition, the antennas **18, 18'** may be circularly polarized for increasing the probability of detecting the signal **10, 10'**.

In the first embodiment, shown in Figure 2, the electronic device **14** has a first measurement device **20**, an first antenna switch **22** and a first processor **24** and the token **12** has an second antenna switch **23**, a second measurement device **21** and a second processor **25** to perform the method as described below. In the second embodiment, shown in Figure 3, the token **12** has the first measurement device **20'**, the first antenna switch **22'**, and the first processor **24'** and the electronic device **14** has the second measurement device **21',** the second antenna switch **23'**, and the second processor **25'** to perform the method as described below. It is to be understood that the method may be practiced with one way or two way communication between the token **12** and the electronic device **14**.

After the signal **10, 10'** has been detected by the antennas **18, 18'**, the signal **10, 10'** is sent to a measurement device **20, 20'** for measuring the strength of the signal **10, 10'** detected. Most likely, each of the antennas **18, 18'** will detect a different signal strength. An antenna switch **22, 22'** alternates which of the antennas **18, 18'** are being measured for detecting the strength of the signal **10, 10'** to verify that at least one of the antennas **18, 18'** are receiving a signal strength above an operational threshold.

The method is characterized by sensing the maximum signal strength of the signal **10, 10'** detected by any of the plurality of antennas **18, 18'** and disabling the electronic device **14** in response to the maximum signal strength falling below the operational threshold. One of the antennas **18, 18'** that senses the maximum signal strength is designated as a default antenna. The antenna switch **22, 22'** is initially

positioned at the default antenna. The antennas **18, 18'** are continuously scanned by the antenna switch **22, 22'** for detection of the signal **10, 10'** for measuring the strength of the signal **10, 10'** and to verify that at least one of the antennas **18, 18'** are sensing a signal strength above the operational threshold. As the maximum signal strength is detected at a different antenna than the default antenna, the antenna switch selects the antenna as the new default antenna.

After the maximum signal strength has been sensed, the strength is compared to the operational threshold. If the signal **10, 10'** detected at any of antennas 18, 18' are above the operational threshold, the signal **10, 10'** detected at the default antenna is transmitted to a processor **24, 24'**. For example, a signal is detected at a first, default antenna and a second antenna. The signal strength is measured at the first antenna and the second antenna and the signal strength at the first antenna is compared to the operational threshold. If the signal strength at the first antenna is above the threshold, then the signal detected at the first antenna is transmitted to the processor **24, 24'** and the first antenna remains the default antenna. If the signal strength at the first antenna is below the operational threshold, then the signal strength at the second antenna is compared to the operational threshold. If the signal strength at the second antenna is above the operational threshold, the signal detected at the first antenna is sent to the processor **24, 24'** and the second antenna becomes the default antenna. Even if the signal strength at the first antenna is above the operational threshold, the signal strength at the second antenna will be transmitted to the processor **24, 24'** for establishing the default antenna for subsequent detection. If the signal strength at the second antenna is stronger than that detected at the first antenna, then the second antenna becomes the default antenna. When the signal strength measured at every antennas **18, 18'** falls below the operational threshold, the electronic device **14** is disabled.

The processor **24, 24'** compares data of the signal **10, 10'** to a user code database. If the data of the signal **10, 10'** matches a user code in the user code database, the electronic device **14** is enabled and the user **16** is authorized to access the electronic

device **14**. If the signal **10, 10'** fails to match the user code, the electronic device **14** is disabled and the user **16** is unable to access the electronic device **14**. If the maximum signal strength detected at one of the antennas **18, 18'** are below the operational threshold, the electronic device **14** remains disabled and the user **16** is unable to access the electronic device **14**. The antennas **18, 18'** continuously detects signals from a plurality of tokens that are within range of the electronic device **14**.

The processor **24, 24'** receives signal information for each of the tokens **12** which includes the one of the first plurality of antennas **18, 18'** which detected the signal **10, 10'**, the one of the second plurality of antennas **19, 19'** which emitted the signal **10, 10'**, the signal strength detected at the first antenna **18, 18'**, and the signal strength detected at the second antenna **18, 18'**. For example, if the signal strength detected by any of the antennas **18, 18'** are above the operational threshold for a plurality of users **16** each having the token **12**, each of the users will be authorized to access the electronic device **14**. If more than one user **16** is authorized to operate the electronic device **14**, the electronic device **14** can only be operated by the first user **16** who identified himself by way of logging into the computer. This is accomplished by password entry, biometrics, or any other method as is known in the art of verifying a users identity. If only one user **16** is authorized to use the electronic device **14** and that user **16** then identifies himself to the electronic device **14**, the electronic device **14** can only be accessed by that user **16**. Meanwhile, the plurality of antennas **18, 18'** are still detecting each of the user signals, but the processor **24, 24'**, will not respond to the signals. Once the user **16** logs out of the electronic device **14** or his signal strength falls below the operational threshold, the processor **24, 24'** will then respond to the detection of the other users signals. The processor **24, 24'** examines the signal information and determines if any of the users signals are not detected. The processor **24, 24'** also maintains a log of the signal information for determining what tokens **12** are in the operating space and when the signal **10, 10'** is not detected.

As the user **16** moves about the electronic device **14**, the strength of the signal **10, 10'** can vary with the position and direction the user **16** is facing. The strength of the signal **10, 10'** is lower when the user **16** faces away from the electronic device **14**, as shown in Figure 2, or when the signal **10, 10'** is being blocked by the user **16** or any other object. Therefore, the operational threshold may be changed to account for such variances in the signal strength after the user **16** has been authorized or when accessing the electronic device **14**. The changes to the operational threshold are determined by the level of security and are preprogrammed into the processor **24, 24'**. For instance, the operational threshold may be lowered in response to the signal **10, 10'** matching a user code in the user code database when the maximum signal strength detected is above the operational threshold. The operational threshold may also be changed when the user **16** operates a peripheral component connected to the electronic device **14**. In one embodiment, the operational threshold may be lowered for a computer when the user **16** manipulates a keyboard **26** or a mouse **28**.

Obviously, many modifications and variations of the present invention are possible in light of the above teachings. The invention may be practiced otherwise than as specifically described within the scope of the appended claims, wherein that which is prior art is antecedent to the novelty set forth in the "characterized by" clause. The novelty is meant to be particularly and distinctly recited in the "characterized by" clause whereas the antecedent recitations merely set forth the old and well-known combination in which the invention resides. These antecedent recitations should be interpreted to cover any combination in which the incentive novelty exercises its utility. In addition, the reference numerals in the claims are merely for convenience and are not to be read in any way as limiting.

# CLAIMS

What is claimed is:

1. A method of detecting a signal between a token and an electronic device for authorizing a user to access the electronic device, said method comprising the steps of;

emitting a signal **(10, 10')** containing data from at least one of a token **(12)** and an electronic device **(14)**,

detecting the signal **(10, 10')** with a first plurality of antennas **(18, 18')** disposed within the other of the token **(12)** and the electronic device **(14)**,

measuring the strength of the signal **(10, 10')** detected at each of the first plurality of antennas **(18, 18')** with a measurement device **(20, 20')**,

said method characterized by sensing the maximum signal strength detected by any of the first plurality of antennas **(18, 18')** and enabling the electronic device **(14)** in response to the maximum signal strength being above an operational threshold.

2. A method as set forth in claim 1 wherein the measuring is further characterized by scanning the first plurality of antennas **(18, 18')** for sequentially measuring the strength of the signal **(10, 10')** at each antenna and isolating the antenna receiving the maximum signal strength as the default antenna.

3. A method as set forth in claim 2 further characterized by comparing the data of the signal **(10, 10')** detected at the default antenna to a user code database and enabling the electronic device **(14)** for authorizing a user **(16)** to access the electronic device **(14)**.

4. A method as set forth in claim 3 further characterized by changing the operational threshold in response to the data of the signal **(10, 10')** matching a user code in the user code database.

5. A method as set forth in claim 4 further characterized by changing the operational threshold in response to operation of the electronic device **(14)** by the user **(16)**.

6. A method as set forth in claim 4 wherein the changing of the operational threshold is further defined by lowering the operational threshold.

7. A method as set forth in claim 6 wherein the changing of the operational threshold is further defined as lowering the threshold in response to input to the computer from one of a keyboard **(26)** and a mouse **(28)**.

8. A method as set forth in claim 2 further defined as emitting the signal **(10, 10')** from the electronic device **(14)** and measuring the strength of the signal and sensing the maximum signal strength by a token **(12)**.

9. A method as set forth in claim 2 further defined as emitting the signal **(10, 10')** from the token **(12)** and measuring the strength of the signal and sensing the maximum signal strength by the electronic device **(14)**.

10. A method as set forth in claim 2 further characterized by aiming one of the first plurality of antennas **(18, 18')** in a first direction and an other of the first plurality of antennas **(18, 18')** in a second direction, the first direction being transverse to the second direction and such that one of either the first direction and the second direction is more sensitive for detecting the signal **(10, 10')** than the other direction.

11. A method as set forth in claim 2 wherein the emitting of the signal **(10, 10')** is further defined as emitting the signal **(10, 10')** from a second plurality of antennas **(19, 19')**.

12. A method as set forth in claim 11 wherein the emitting of the signal **(10, 10')** from the second plurality of antennas **(19, 19')** is further defined as alternating the emission of the signal **(10, 10')** from one of the second plurality of antennas **(19, 19')** and then from the other of the second plurality of antennas **(19, 19')**.

13. A method as set forth in claim 12 including sequentially detecting each of the signals **(10, 10')** emitted from the second plurality of antennas **(19, 19')** and measuring the strength of the sequential signals **(10, 10')** with the first plurality of antennas **(18, 18').**

14. A method of detecting a signal between a token and an electronic device for authorizing a user to access the electronic device, said method comprising the steps of;

emitting a signal **(10, 10')**,

detecting the signal **(10, 10')** with at least one antenna,

measuring the strength of the signal **(10, 10')** detected by the antenna,

comparing the strength of the signal **(10, 10')** to an operational threshold,

enabling the electronic device **(14)** in response to the signal strength being above the operational threshold,

said method characterized by changing the operational threshold in response to the user **(16)** operating the electronic device **(14)**.

15. A method as set forth in claim 14 wherein the changing of the operational threshold is further defined by lowering the operational threshold.

16. A method as set forth in claim 15 wherein the enabling of the electronic device **(14)** is further defined as enabling a computer.

17. A method as set forth in claim 16 wherein the changing of the operational threshold is further defined as lowering the threshold in response to input to the computer from one of a keyboard **(26)** and a mouse **(28)**.

18. A method as set forth in claim 14 wherein the detecting of the signal **(10, 10')** includes detecting the signal **(10, 10')** with a plurality of antennas **(18, 18')**.

FIG - 1

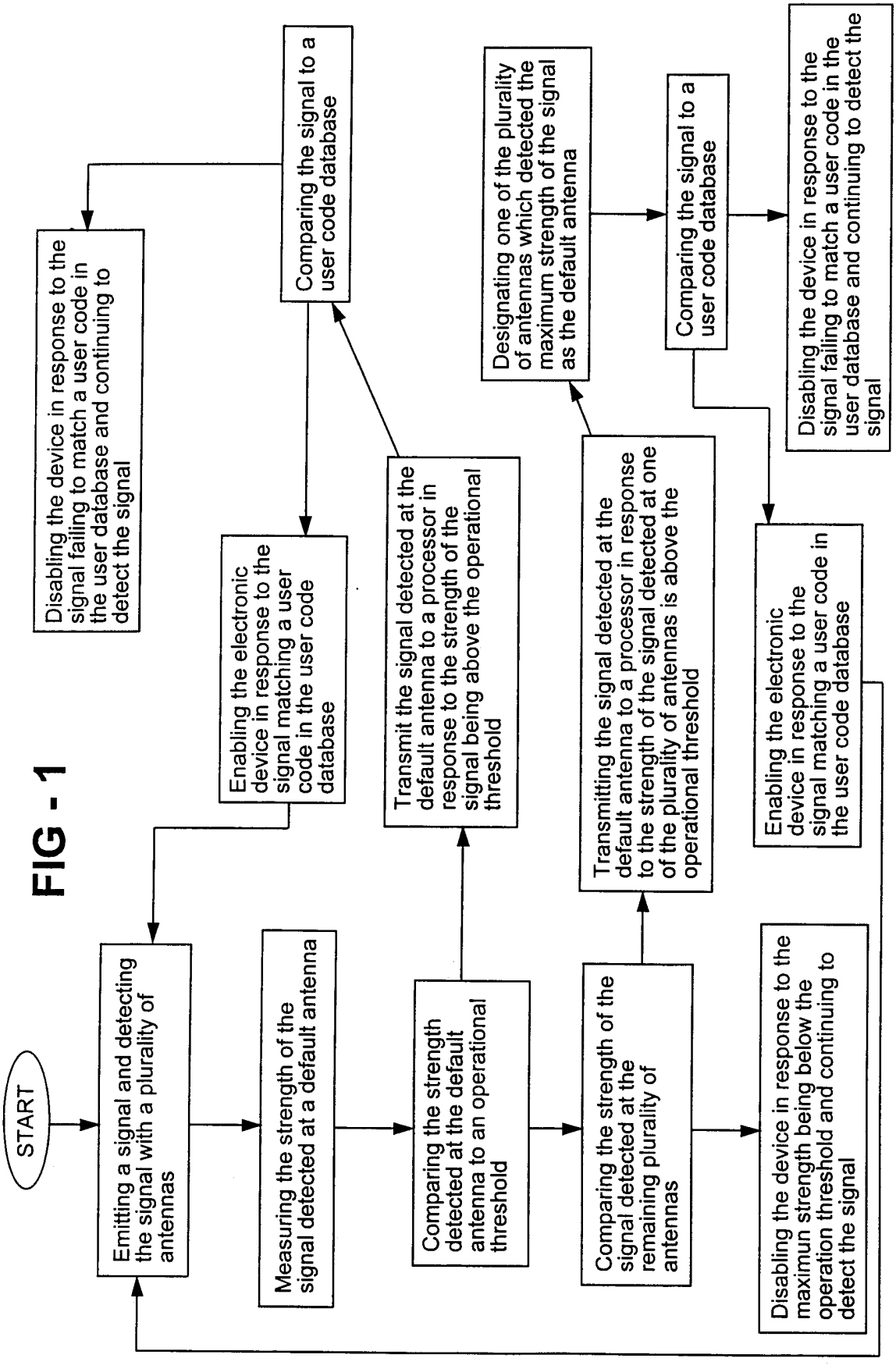

START
Emitting a signal and detecting the signal with a plurality of antennas
Measuring the strength of the signal detected at a default antenna
Comparing the strength detected at the default antenna to an operational threshold
Comparing the strength of the signal detected at the remaining plurality of antennas
Disabling the device in response to the maximun strength being below the operation threshold and continuing to detect the signal
Transmitting the signal detected at the default antenna to a processor in response to the strength of the signal detected at one of the plurality of antennas is above the operational threshold
Designating one of the plurality of antennas which detected the maximum strength of the signal as the default antenna
Comparing the signal to a user code database
Disabling the device in response to the signal failing to match a user code in the user database and continuing to detect the signal
Enabling the electronic device in response to the signal matching a user code in the user code database
Transmit the signal detected at the default antenna to a processor in response to the strength of the signal being above the operational threshold
Comparing the signal to a user code database
Disabling the device in response to the signal failing to match a user code in the user database and continuing to detect the signal
Enabling the electronic device in response to the signal matching a user code in the user code database

FIG-2

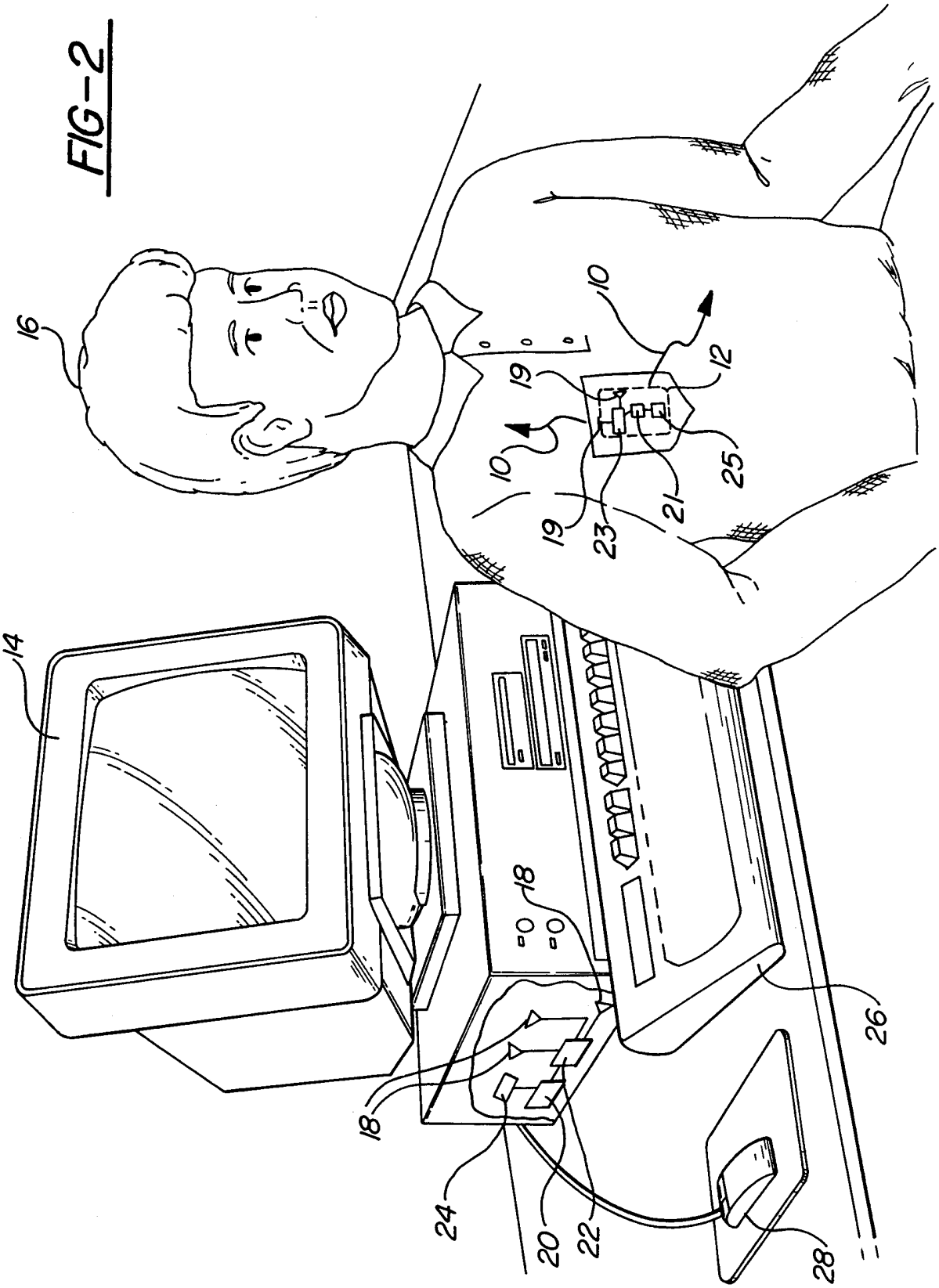
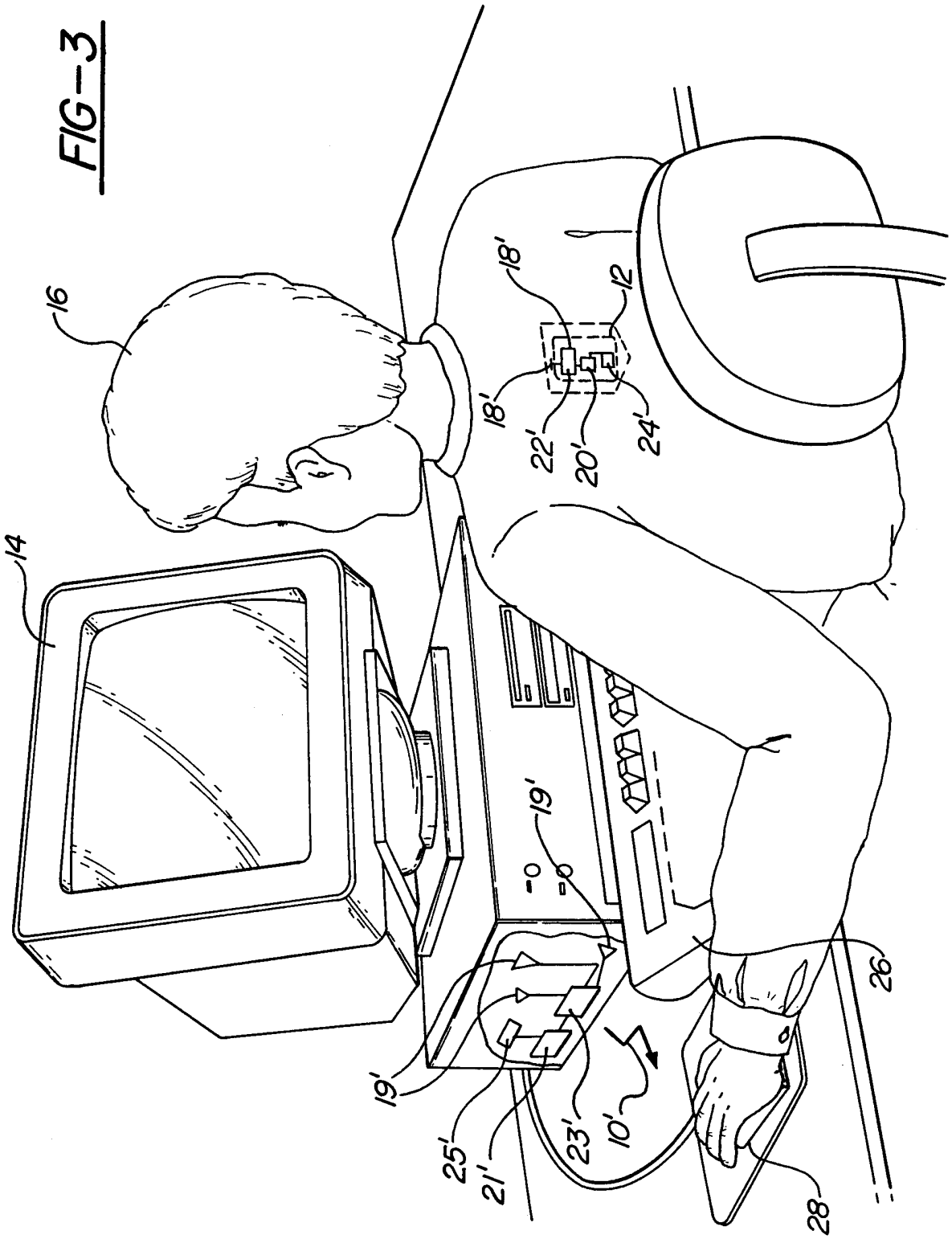


FIG-3



# INTERNATIONAL SEARCH REPORT

International application No.

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**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) : G06F 7/00

US CL : 340/5.1,825.49;455/271-279.1

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 340/5.1,825.49;455/271-279.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 3,891,980 A (LEWIS et al.) 24 June 1975 (24.06.1975), column 2, lines 45-68 to column 6, lines 1-30, | 1-18 |
| Y | US 5,914,671 A (TUTTLE) 22 June 1999 (22.06.1999), column 4, lines 43-55, | 1-18 |
| Y | US 5,821,854 A (DORINSKI et al.) 13 October 1998, FIGURES 2-4, | 1-18 |

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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| Date of the actual completion of the international search | Date of mailing of the international search report |
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