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(12) **United States Patent**
de la Huerga

(10) **Patent No.: US 7,941,534 B2**
(45) **Date of Patent: May 10, 2011**

(54) **SYSTEM AND METHOD TO AUTHENTICATE USERS TO COMPUTER SYSTEMS**

(76) Inventor: **Carlos de la Huerga**, Milwaukee, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1604 days.

(21) Appl. No.: **10/899,520**

(22) Filed: **Jul. 26, 2004**

(65) **Prior Publication Data**

US 2005/0091338 A1 Apr. 28, 2005

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/127,734, filed on Apr. 22, 2002, now Pat. No. 6,779,024, which is a continuation-in-part of application No. 09/170,169, filed on Oct. 13, 1998, now Pat. No. 6,408,330, which is a continuation-in-part of application No. 08/834,634, filed on Apr. 14, 1997, now Pat. No. 5,960,085.

(51) **Int. Cl.**
G06F 13/00 (2006.01)

(52) **U.S. Cl.** **709/225**; 709/219; 709/227; 709/250

(58) **Field of Classification Search** 709/217, 709/219, 223, 224, 225, 227, 228, 250
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,878,142 A * 3/1999 Caputo et al. 713/159
6,088,450 A * 7/2000 Davis et al. 713/182
6,181,803 B1 * 1/2001 Davis 382/115
6,381,631 B1 * 4/2002 van Hoff 709/202
6,910,136 B1 * 6/2005 Wasserman et al. 726/4
7,028,897 B2 * 4/2006 Fernandes et al. 235/449
7,324,972 B1 * 1/2008 Oliver et al. 705/40

OTHER PUBLICATIONS

Contextual Digital Assistant Model 1000, Product Data Sheet CN-PDCDA 1000 R1; Copyright Jan. 2002 CartaNova, Inc. ; 2 pages.
Contextual Digital Assistant Model 1000, Product Data Sheet CN-PDCDA 1000 R1; Copyright Feb. 2002 CartaNova, Inc. ; 4 pages.

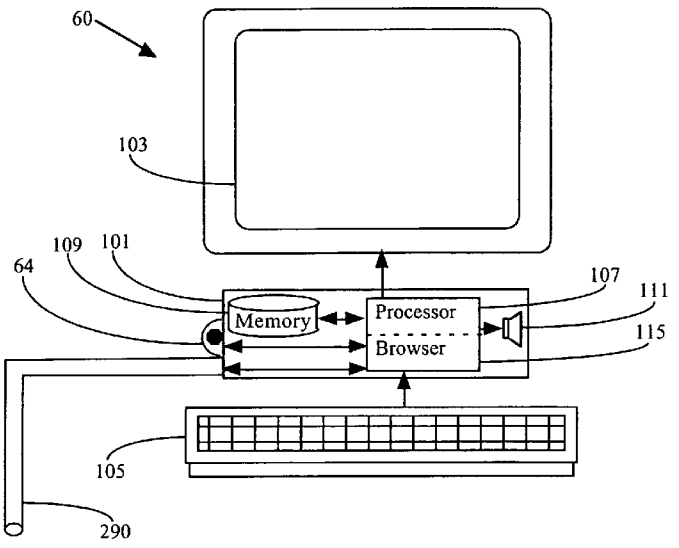
* cited by examiner

Primary Examiner — Viet Vu
(74) *Attorney, Agent, or Firm* — Quarles & Brady

(57) **ABSTRACT**

A system utilizing a personal security device to provide access to a computer terminal where the personal security device includes circuitry and transceiver components for transmitting identification information and exchanging other digital information with a computer terminal and other compatible devices and the personal security device establishes a communication link with a computer terminal to allow a user to logon to the terminal so that when a user leaves the computer terminal, the communication link is terminated, causing the computer terminal to lock the keyboard, blank the monitor, and/or logoff the user if the communication link is not restored within a sufficient time period and also allowing the personal security device to facilitate subsequent computer access within a time range by providing time related access codes to the terminal that can be used to reestablish computer terminal access.

47 Claims, 54 Drawing Sheets



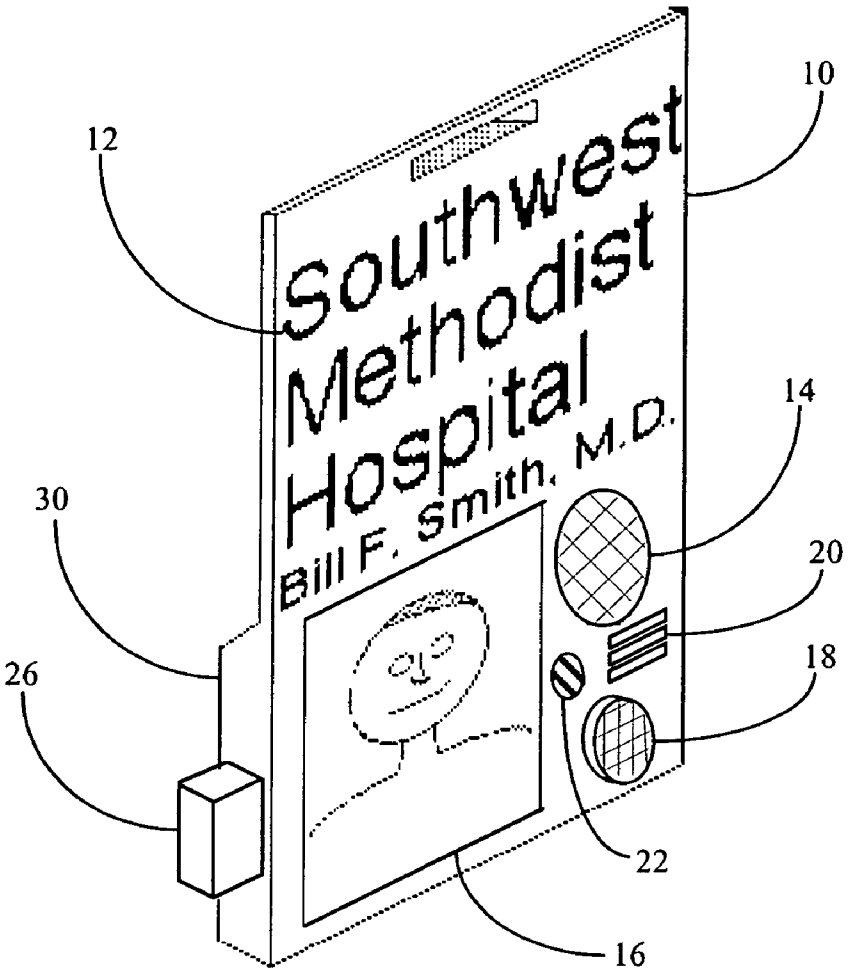


Figure 1

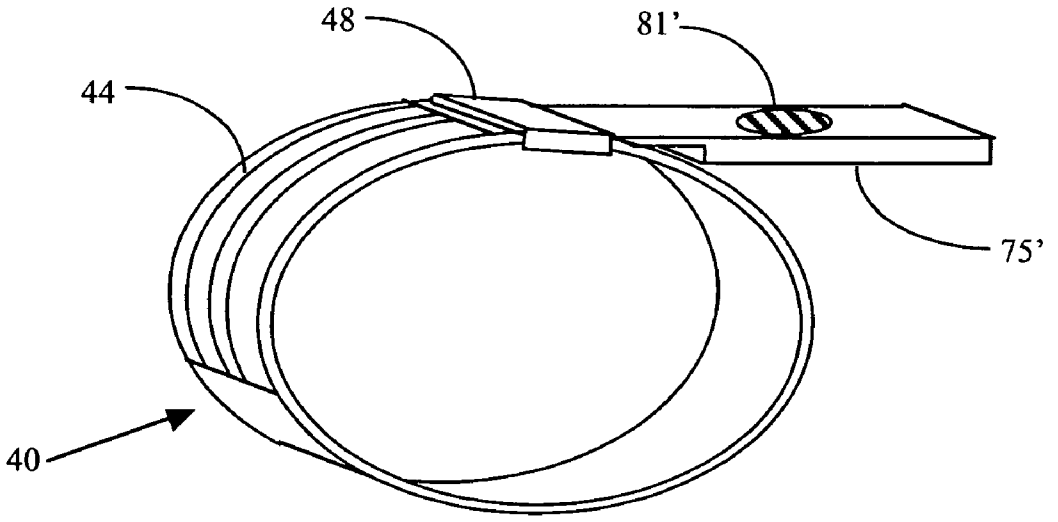


Figure 2

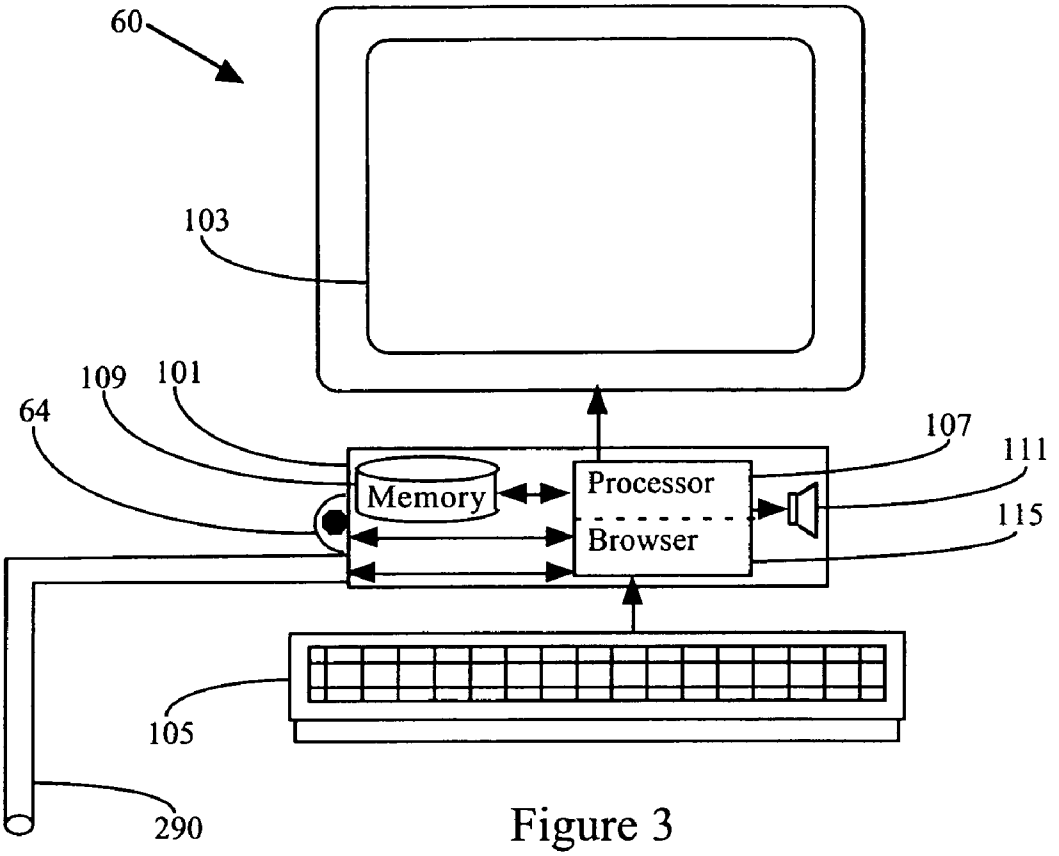


Figure 3

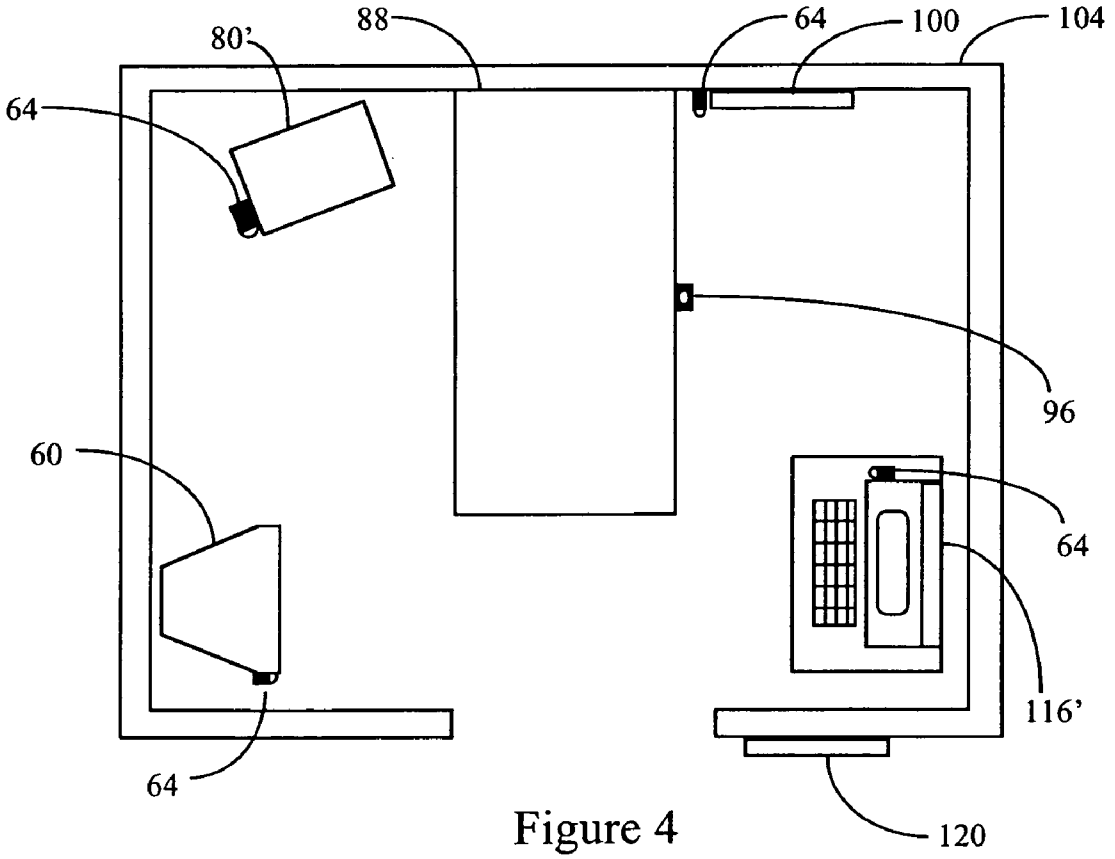


Figure 4

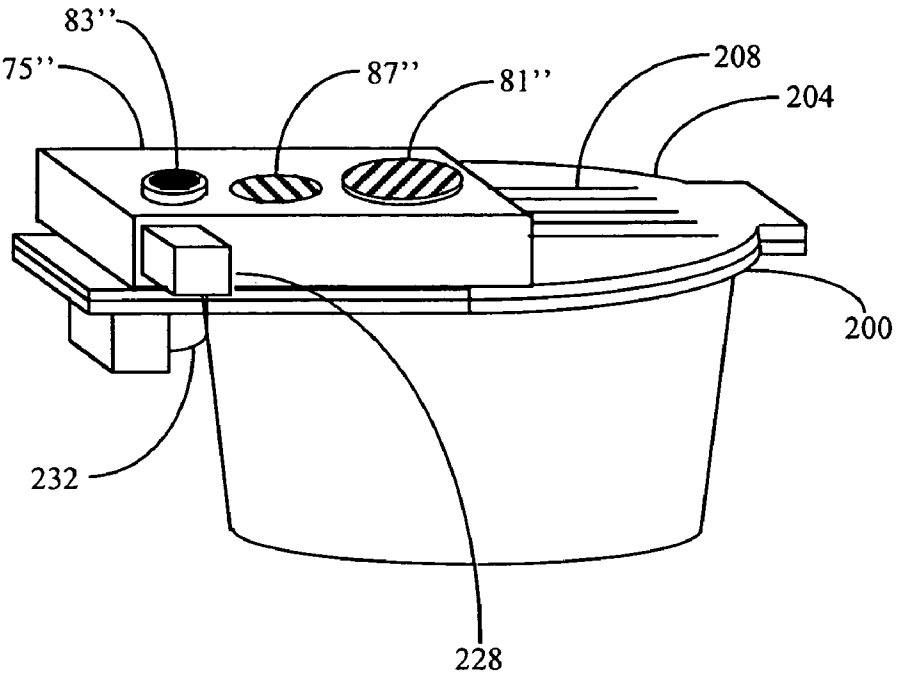


Figure 5

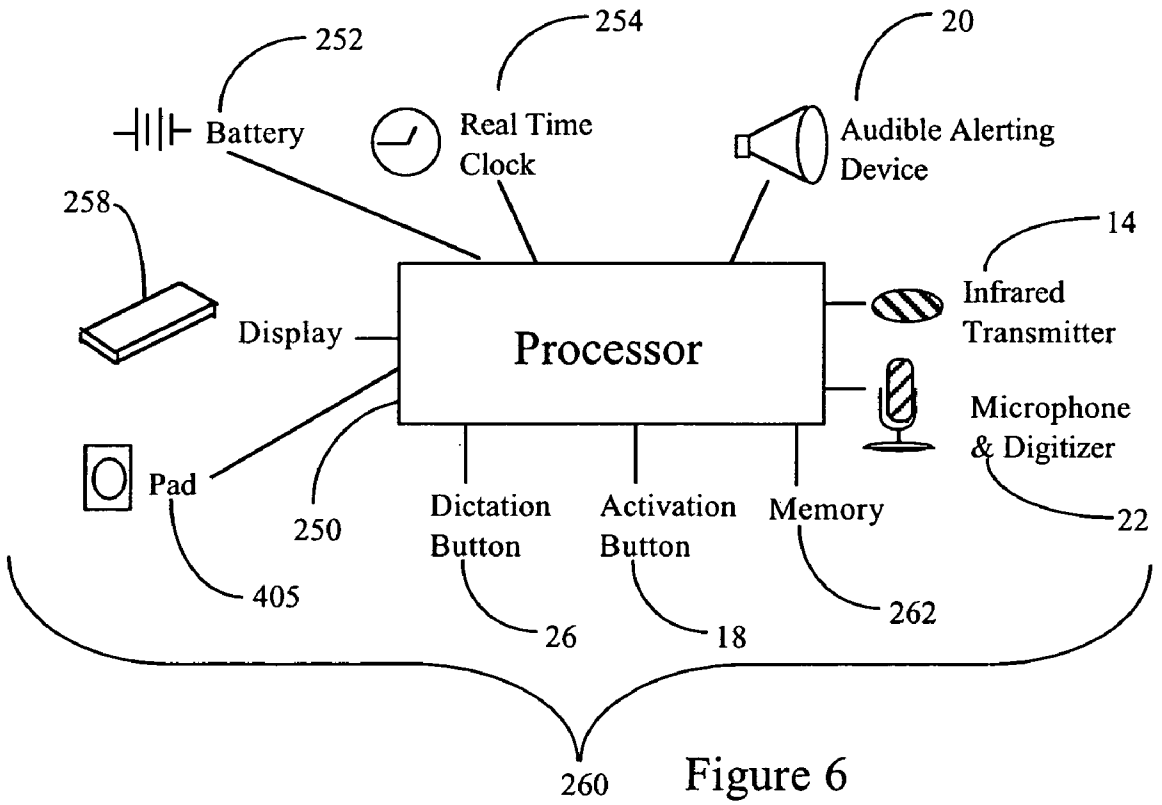


Figure 6

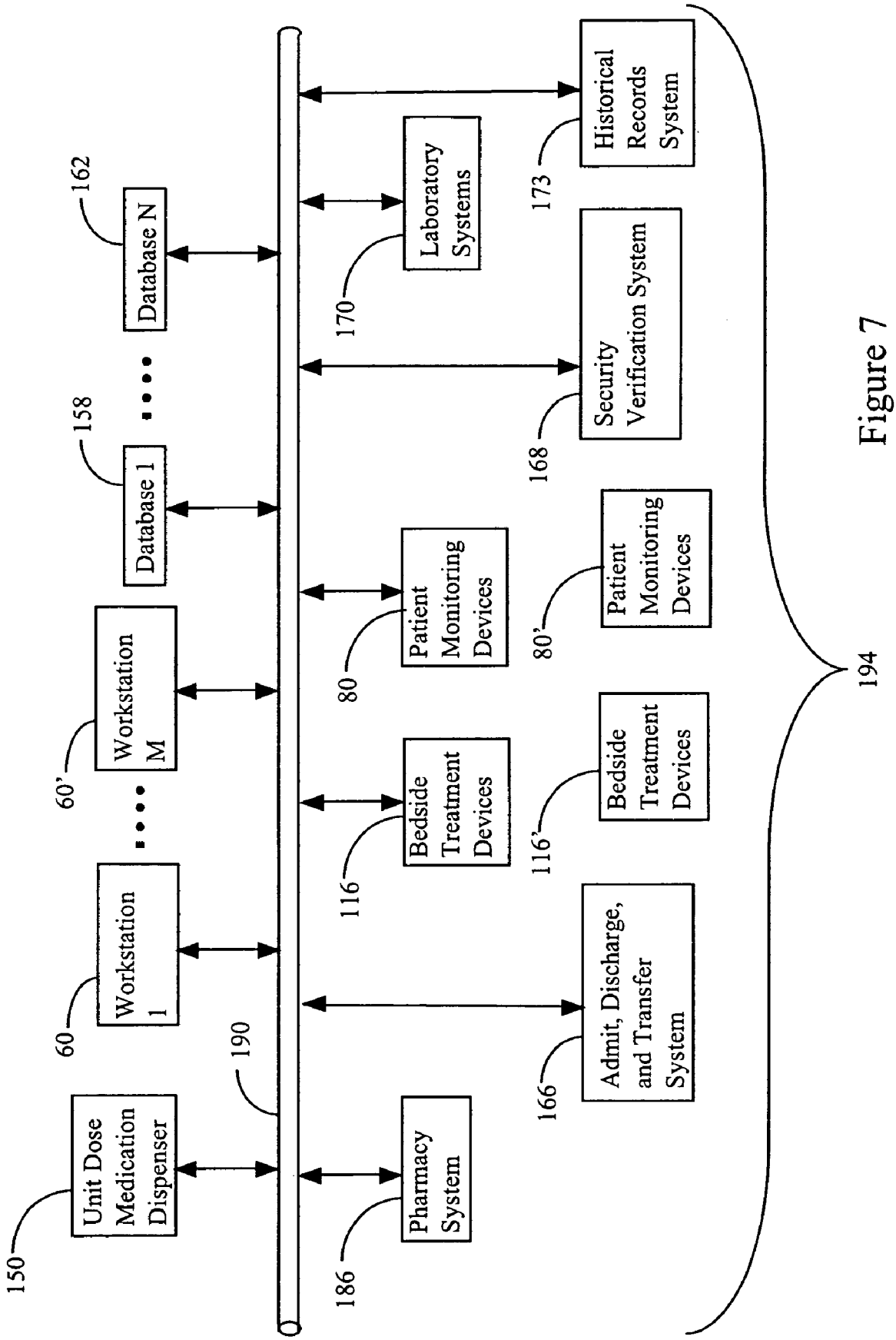

Unit Dose Medication Dispenser
150
Workstation 1
60
Workstation M
60'
Database 1
158
Database N
162
Pharmacy System
186
Bedside Treatment Devices
116
Patient Monitoring Devices
80
Admit, Discharge, and Transfer System
166
Bedside Treatment Devices
116'
Patient Monitoring Devices
80'
Security Verification System
168
Laboratory Systems
170
Historical Records System
173
190
194

Figure 7

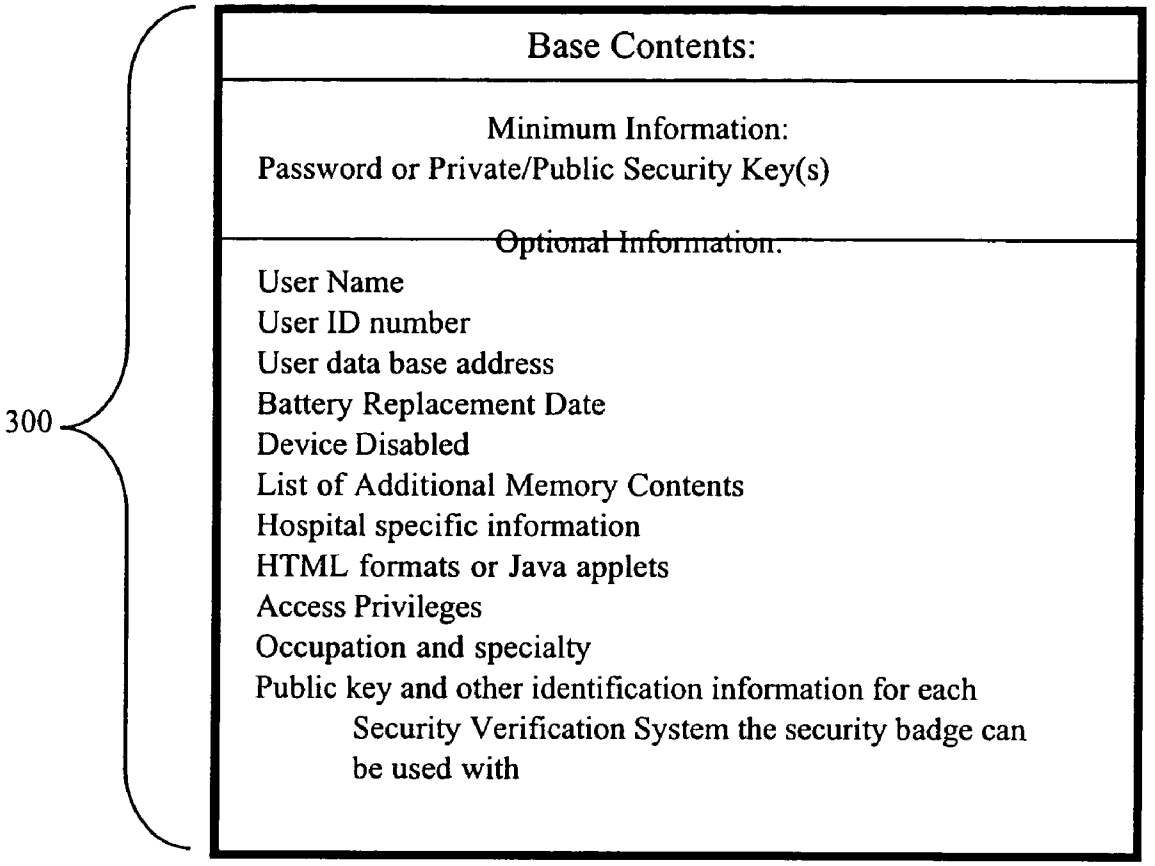


Figure 8

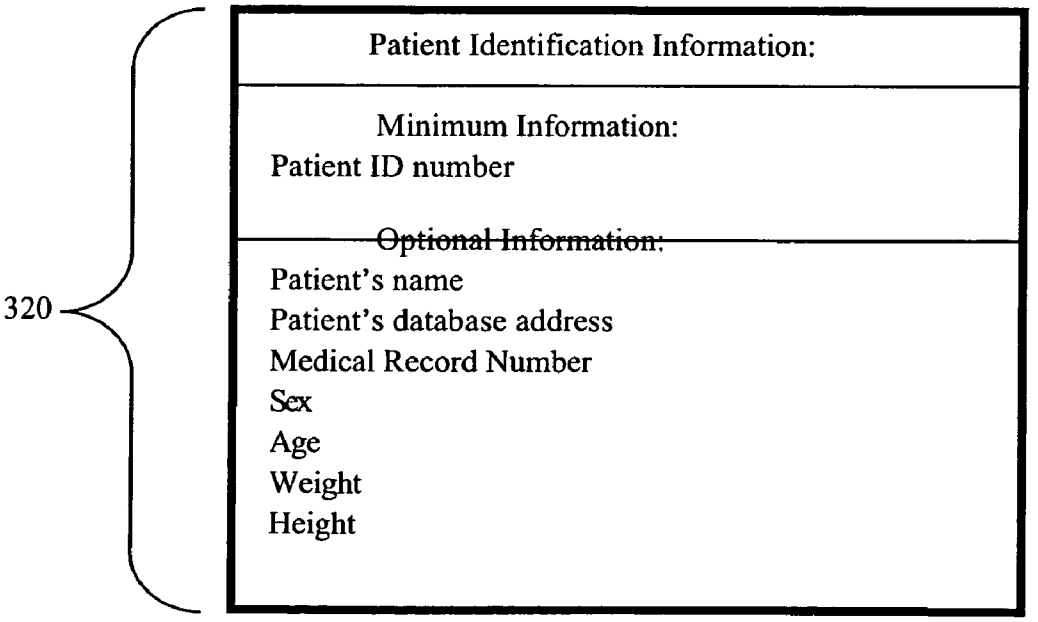


Figure 9

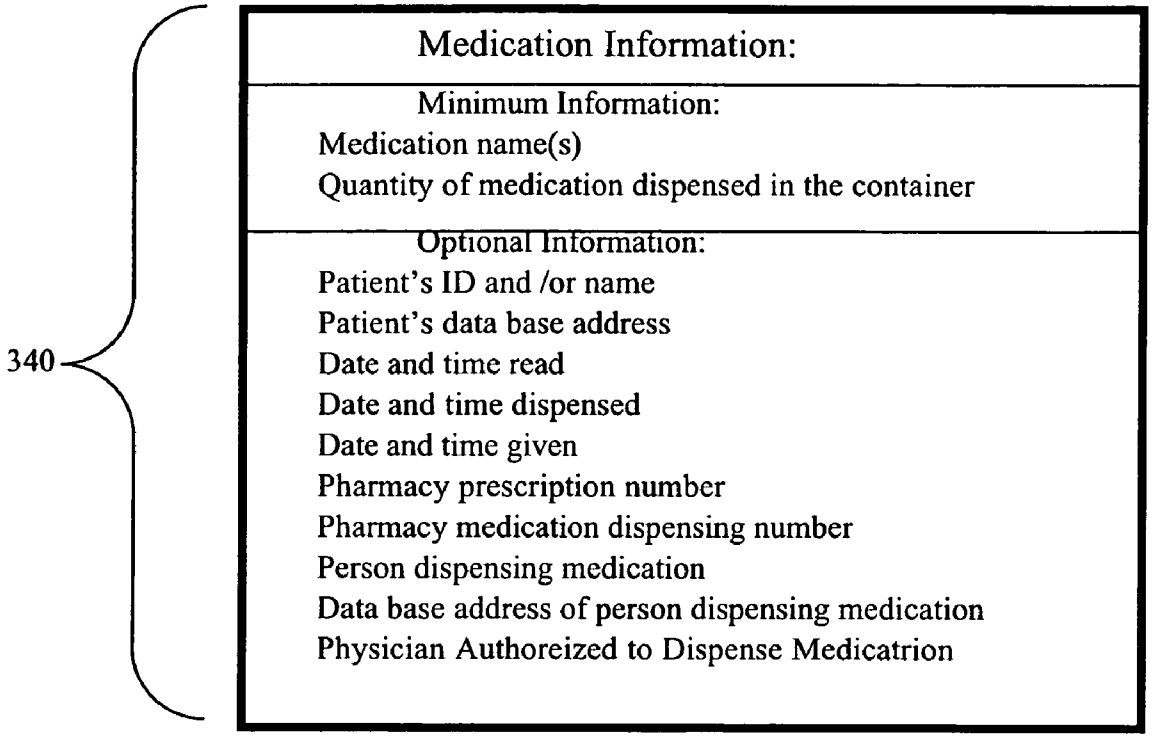


Figure 10

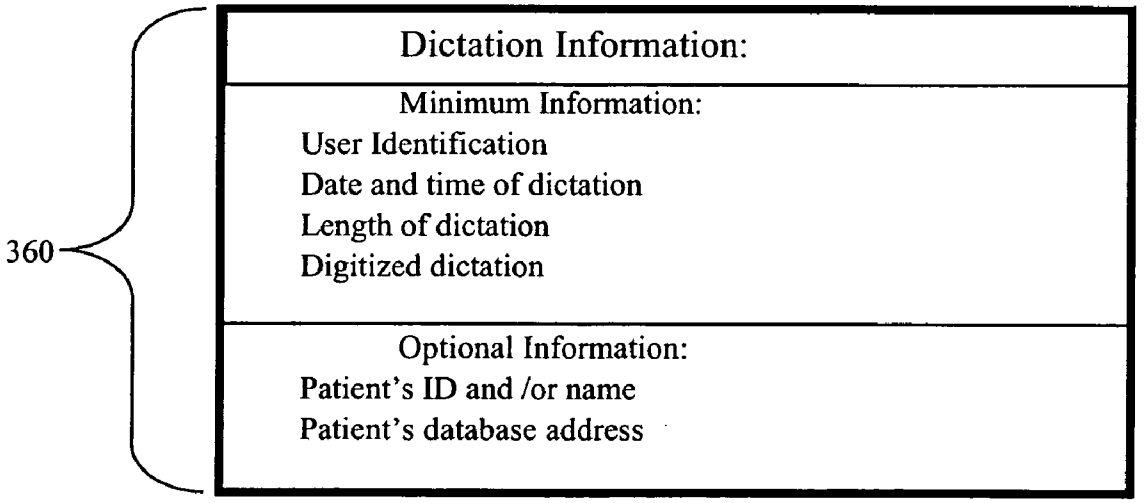


Figure 11

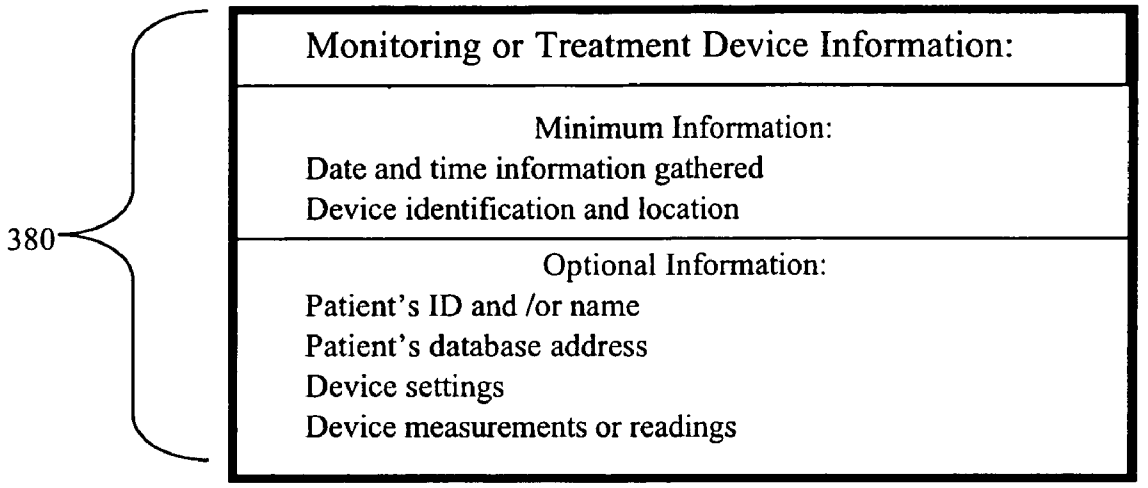


Figure 12

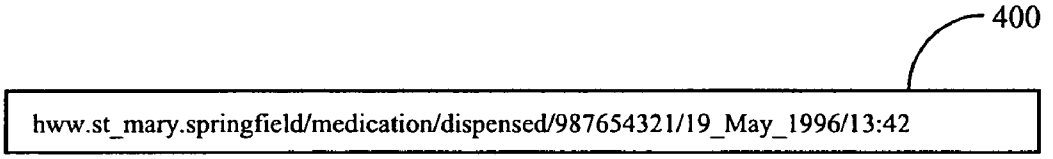


Figure 13A

404

```
<html>
<body>
<a href="http://hww.st._mary.springfield/demographics/987654321/19_May_1996">
ID: 987654321</a><br>
Date: 13:42 19-May-1996<br>
Report type: Medication Dispensing
<br><br>
<table border=2 cellspacing=5>
<tr><td colspan=3 align=center>Medication Given:</td></tr>
<tr><td>Penicillin</td><td>100mg</td><td>2 capsules</td></tr>
<tr><td>Tylenol w/Codeine</td><td>200mg</td><td>1 capsule</td></tr>
</table>
<br>
Dispensed by:
<a href="http://hww.st._mary.springfield/staff_directory/S_W_Johnson.html">
 Sam W. Johnston, R.N.</a>,  at: 13:42 19-May-1996<br>
<br>
ID Device Serial Number: 1265338<br>
</html>
```

415

468

Figure 13B

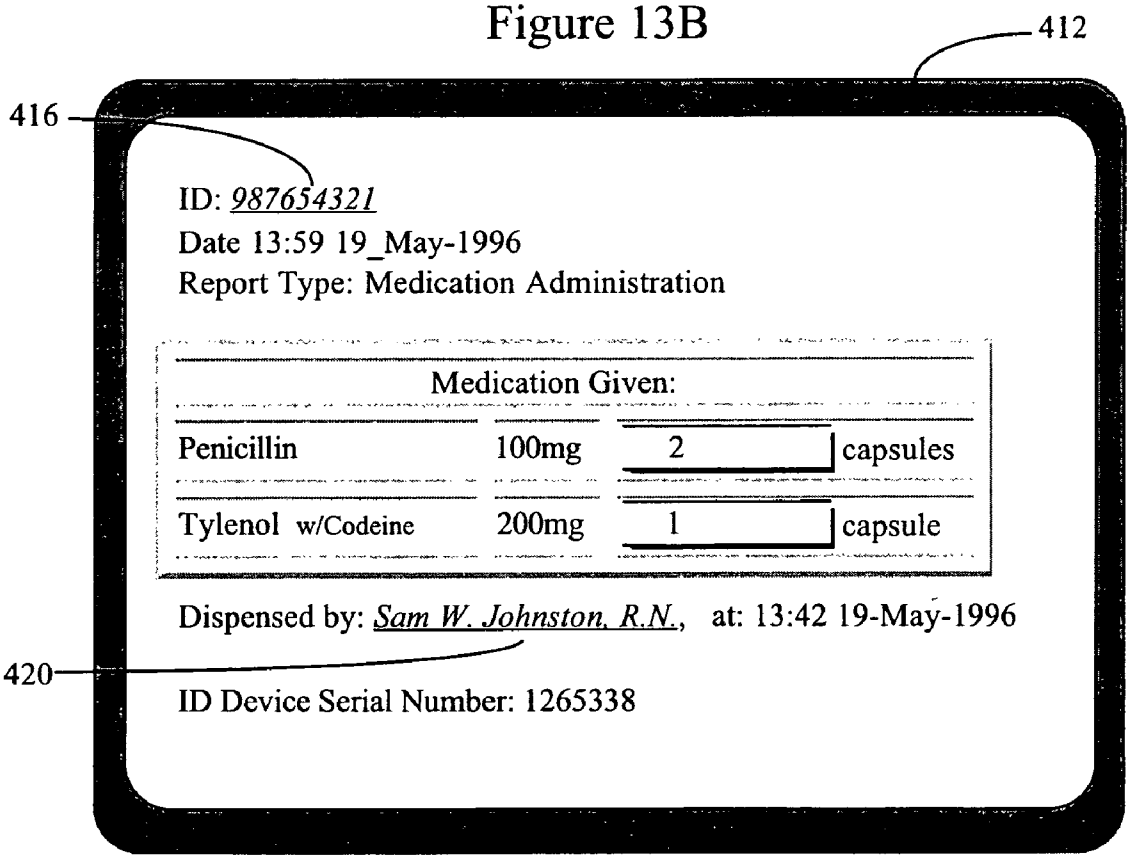


Figure 13C

```
<html>

<head>
<title>Medication Administration</title>
</head>

<form action="http://hww.st_mary.springfield/medication/given/987654321/
19_May_1996/13:42" method=put>

<a href="http://hww.st._mary.springfield/demographics/987654321/19_May_1996">
ID: 987654321</a><br>

Report type: Medication Administration<br>
Patient ID Verified: YES
<br><br>

<table border=2 cellspacing=5>
<tr><td colspan=3 align=center>Medication Given:</td></tr>

<tr><td>Penicillin</td><td>100mg</td><td>
<select name=Penicillin>
<option>2
<option>1.5
<option>1
<option>0.5
<option>none
</select> capsules</td></tr>

<tr><td>Tylenol w/Codeine</td><td>200mg</td><td>
<select name=Tylenol_w/Codeine>
<option>1
<option>0.5
<option>none
</select>  capsule</td></tr>

</table>
<br>

Given by:
<a href="http://hww.st._mary.springfield/staff_directory/M_T_Adamson.html">
 Mary T. Adamson, R.N.</a>,   at: 13:49 19-May-1996<br>


Dispensed by:
<a href="http://hww.st._mary.springfield/staff_directory/S_W_Johnson.html">
 Sam W. Johnston, R.N.</a>,   at: 13:42 19-May-1996<br>
<br>
ID Device Serial Number: 1265338<br>
```

444

445

448

452

456

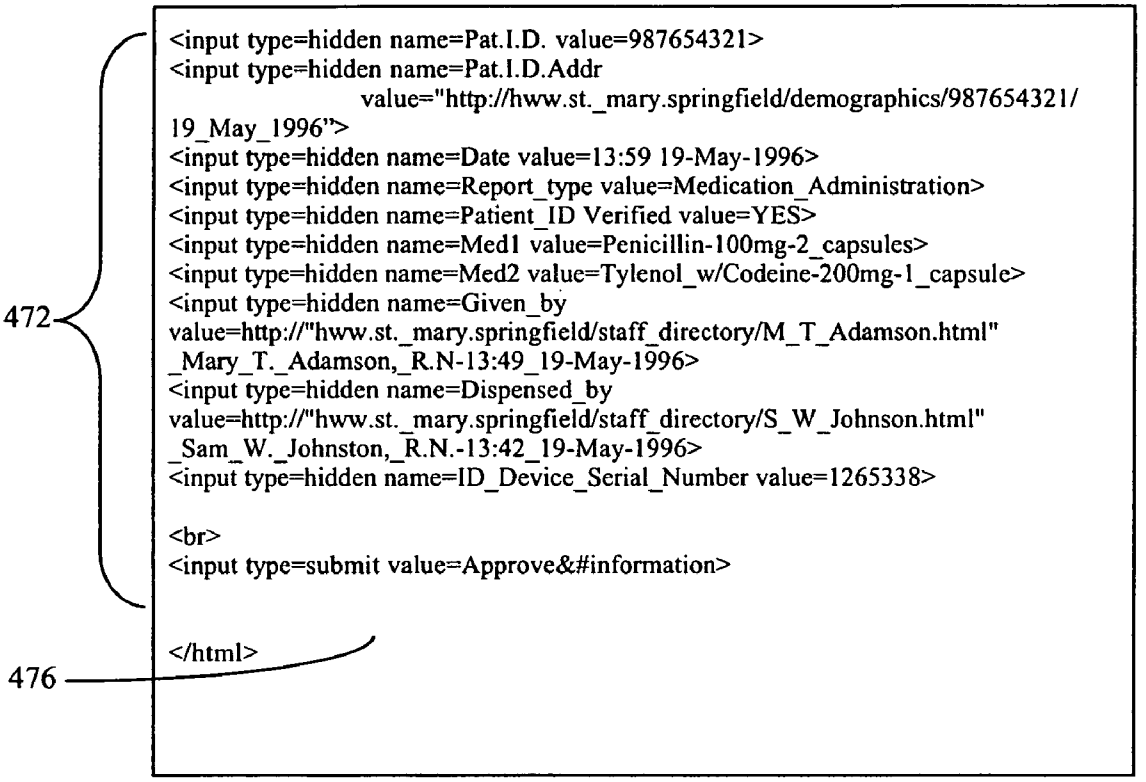
460

464

468

440

Figure 14A


<input type=hidden name=Pat.I.D. value=987654321>
<input type=hidden name=Pat.I.D.Addr
value="http://hww.st._mary.springfield/demographics/987654321/
19_May_1996">
<input type=hidden name=Date value=13:59 19-May-1996>
<input type=hidden name=Report_type value=Medication_Administration>
<input type=hidden name=Patient_ID Verified value=YES>
<input type=hidden name=Med1 value=Penicillin-100mg-2_capsules>
<input type=hidden name=Med2 value=Tylenol_w/Codeine-200mg-1_capsule>
<input type=hidden name=Given_by
value=http://"hww.st._mary.springfield/staff_directory/M_T_Adamson.html"
_Mary_T._Adamson,_R.N-13:49_19-May-1996>
<input type=hidden name=Dispensed_by
value=http://"hww.st._mary.springfield/staff_directory/S_W_Johnson.html"
_Sam_W._Johnston,_R.N.-13:42_19-May-1996>
<input type=hidden name=ID_Device_Serial_Number value=1265338>

<input type=submit value=Approve&#information>
</html>
472
476

Figure 14B

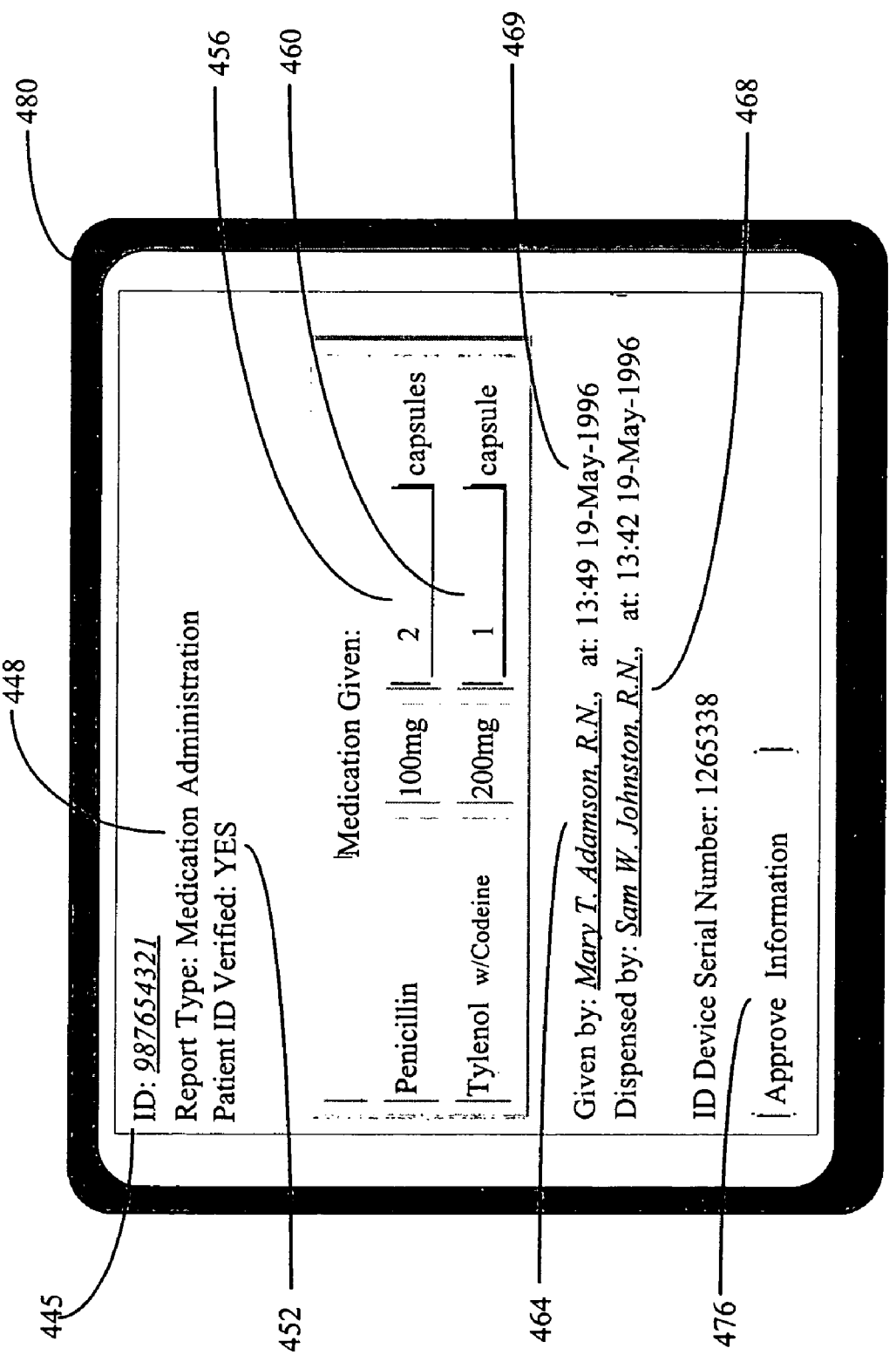

480
456
460
469
468
448
445
452
464
476
ID: 98765432 1
Report Type: Medication Administration
Patient ID Verified: YES
Medication Given:
Penicillin
100mg
2
capsules
Tylenol w/Codeine
200mg
1
capsule
Given by: Mary T. Adamson, R.N., at: 13:49 19-May-1996
Dispensed by: Sam W. Johnston, R.N., at: 13:42 19-May-1996
ID Device Serial Number: 1265338
Approve Information

Figure 14C

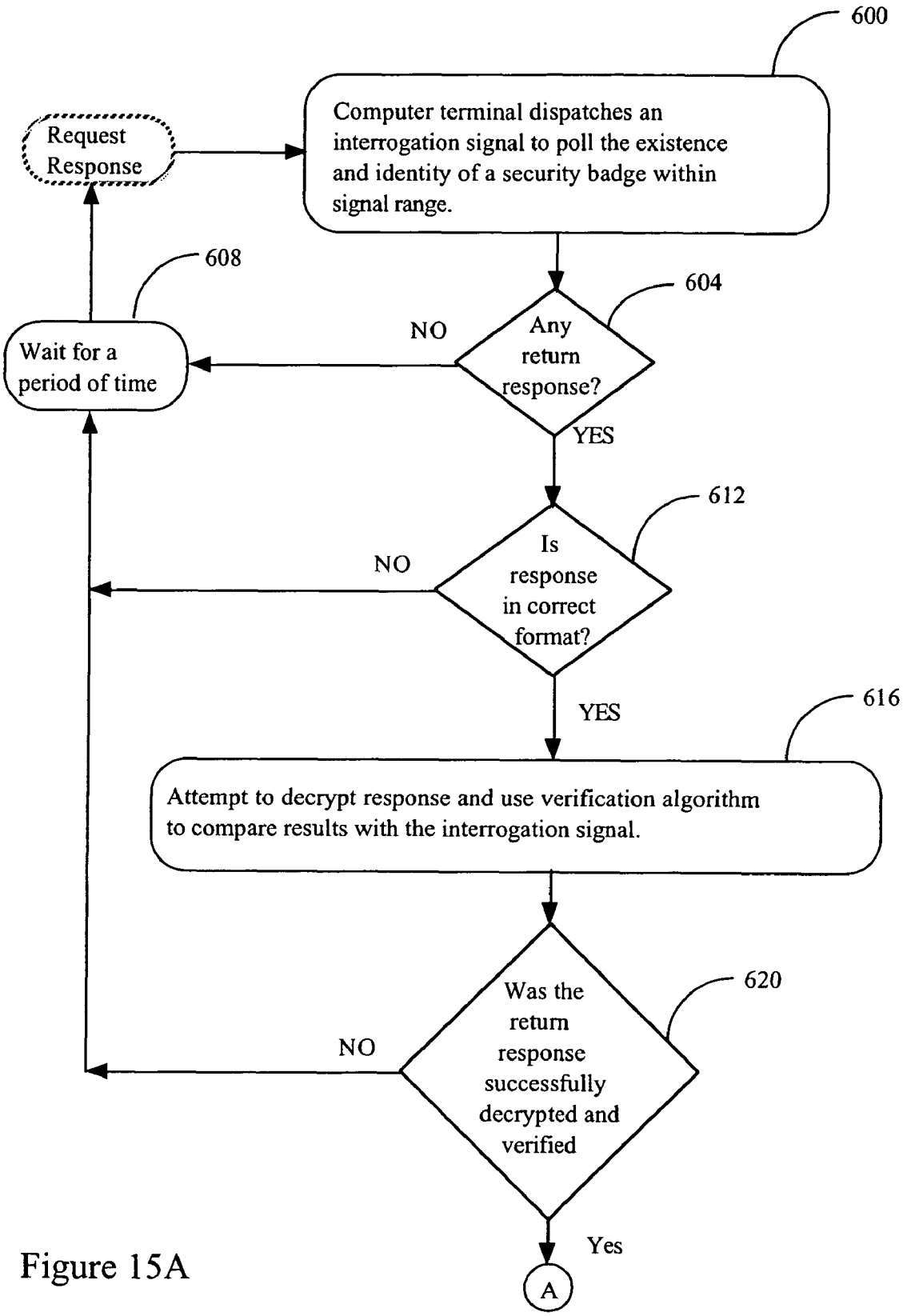

600
Request Response
Computer terminal dispatches an interrogation signal to poll the existence and identity of a security badge within signal range.
608
604
Wait for a period of time
NO
Any return response?
YES
612
NO
Is response in correct format?
YES
616
Attempt to decrypt response and use verification algorithm to compare results with the interrogation signal.
620
NO
Was the return response successfully decrypted and verified
Yes
A

Figure 15A

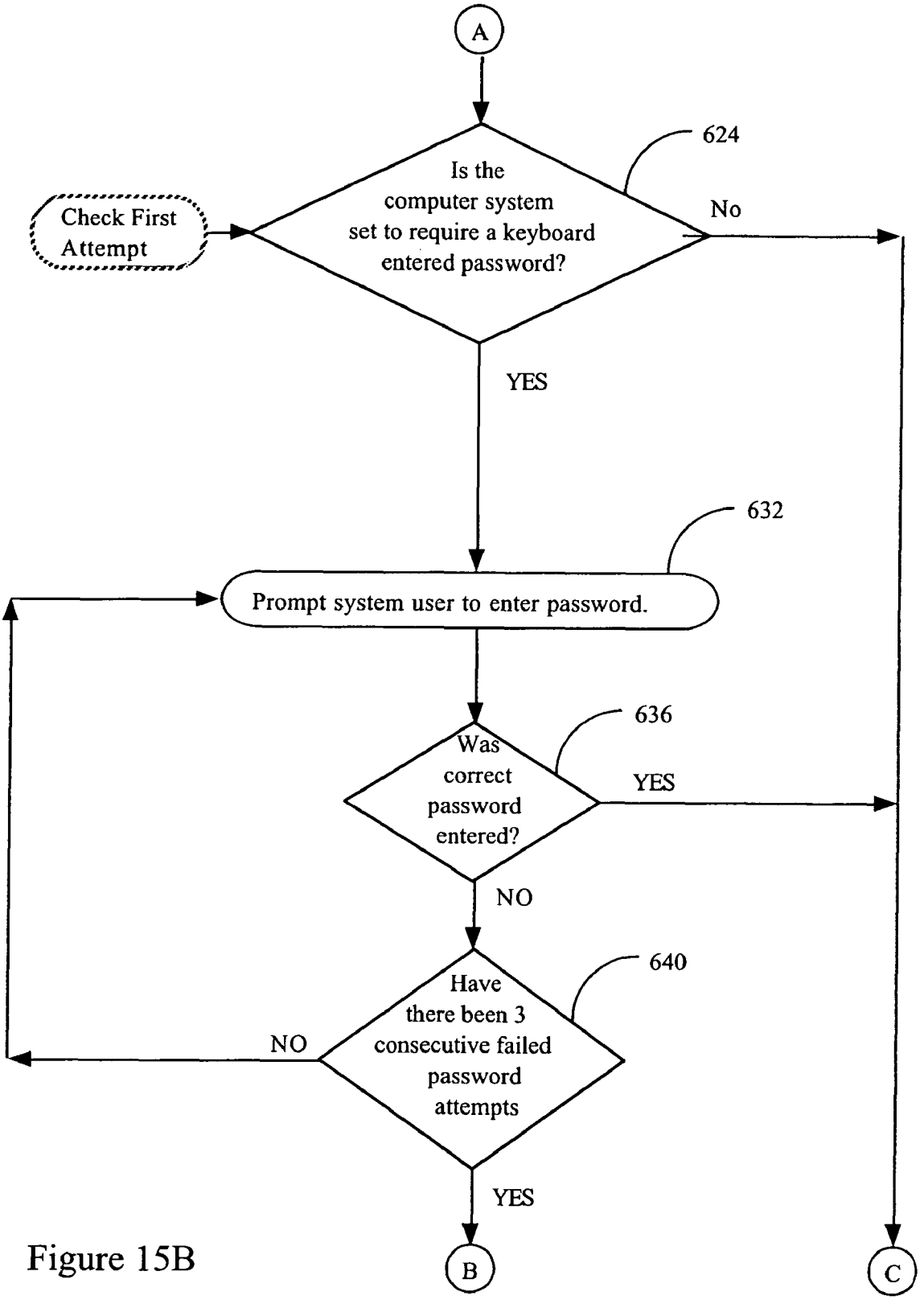

A
624
Is the computer system set to require a keyboard entered password?
Check First Attempt
No
YES
632
Prompt system user to enter password.
636
Was correct password entered?
YES
NO
640
Have there been 3 consecutive failed password attempts
NO
YES
B
C

Figure 15B

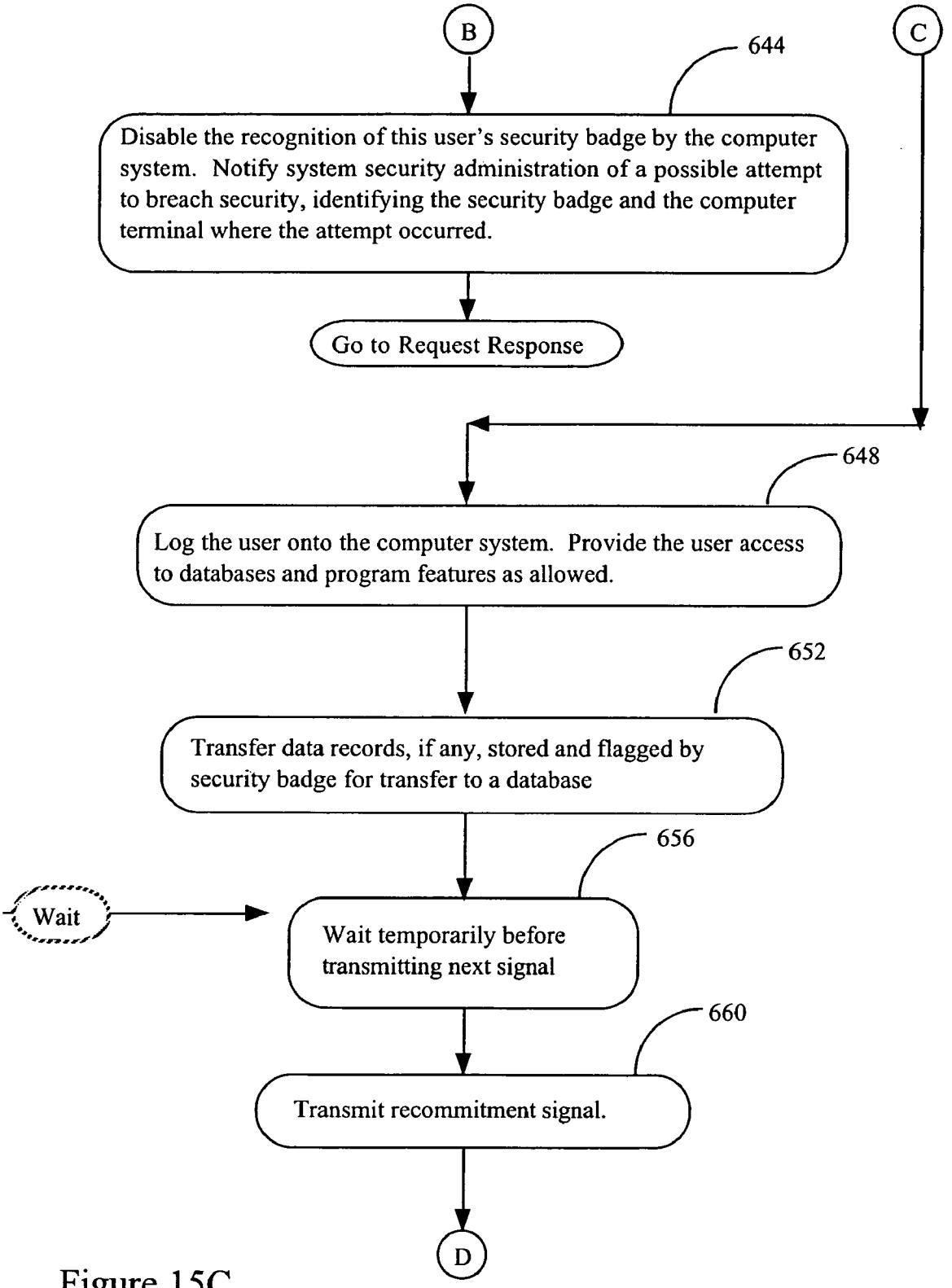

B
644
C
Disable the recognition of this user's security badge by the computer system. Notify system security administration of a possible attempt to breach security, identifying the security badge and the computer terminal where the attempt occurred.
Go to Request Response
648
Log the user onto the computer system. Provide the user access to databases and program features as allowed.
652
Transfer data records, if any, stored and flagged by security badge for transfer to a database
656
Wait
Wait temporarily before transmitting next signal
660
Transmit recommitment signal.
D

Figure 15C

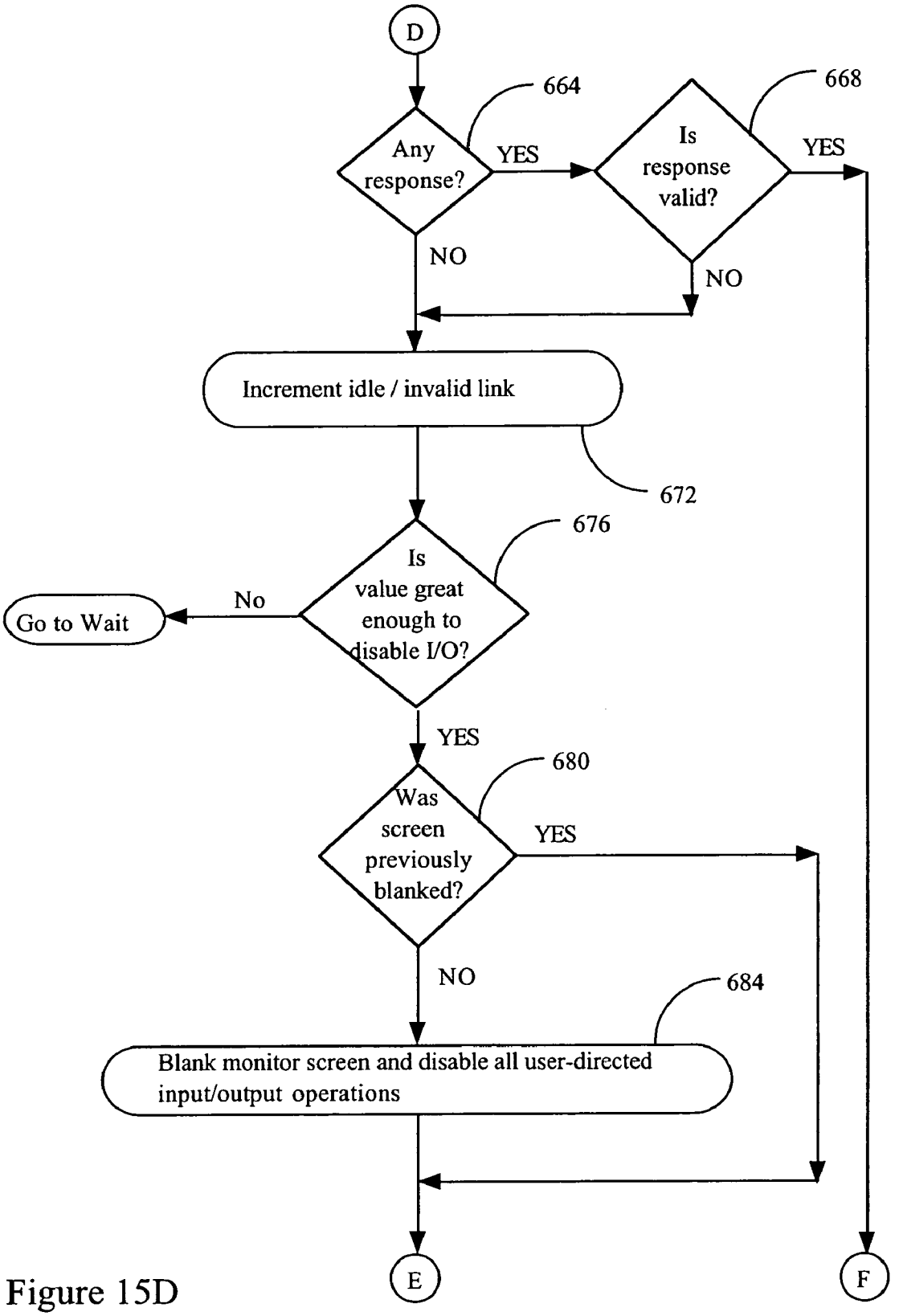

D
664
668
Any response?
YES
Is response valid?
YES
NO
NO
Increment idle / invalid link
672
676
Is value great enough to disable I/O?
No
Go to Wait
YES
680
Was screen previously blanked?
YES
NO
684
Blank monitor screen and disable all user-directed input/output operations
E
F

Figure 15D

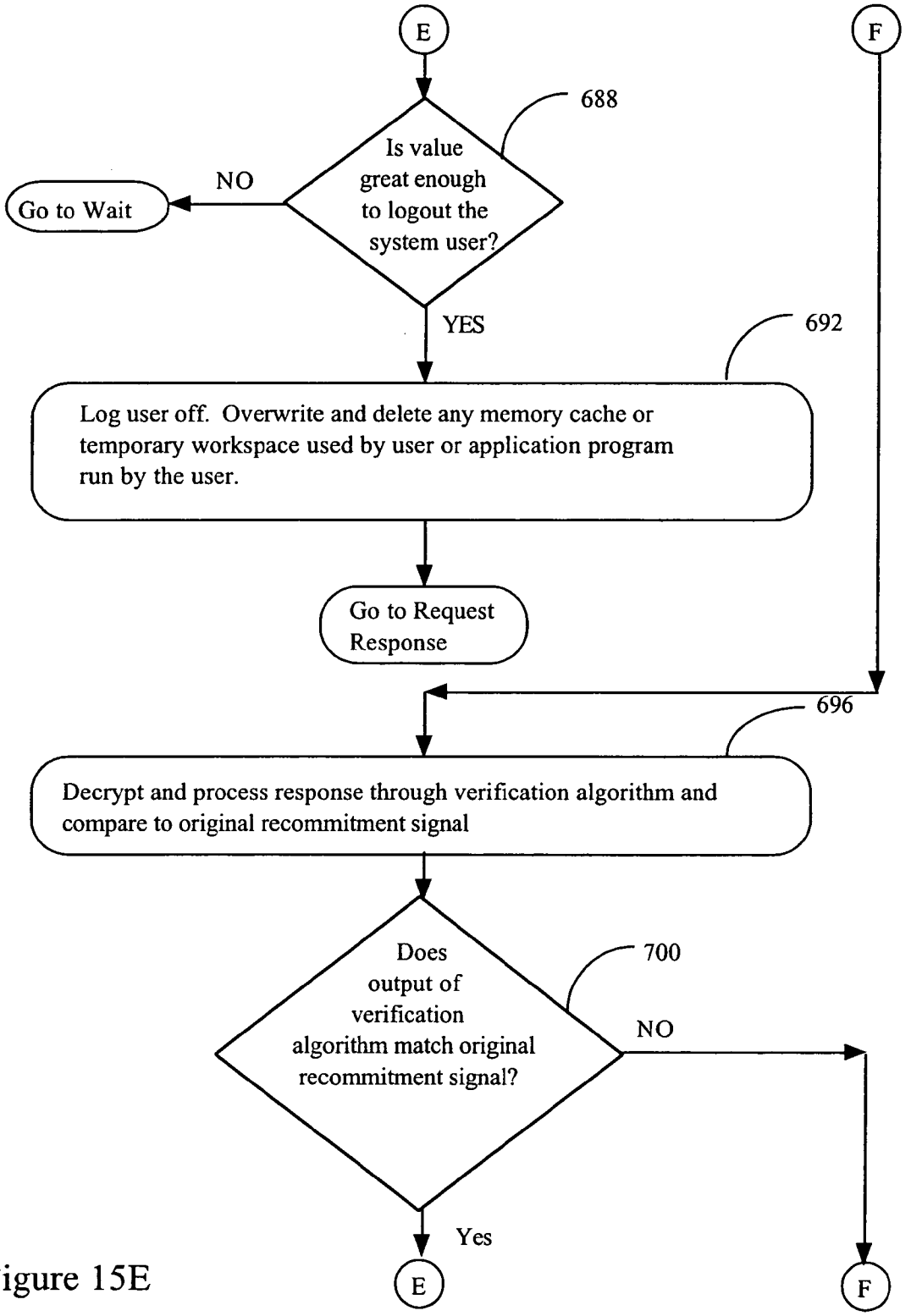

E
F
688
Is value great enough to logout the system user?
NO
Go to Wait
YES
692
Log user off. Overwrite and delete any memory cache or temporary workspace used by user or application program run by the user.
Go to Request Response
696
Decrypt and process response through verification algorithm and compare to original recommitment signal
700
Does output of verification algorithm match original recommitment signal?
NO
Yes
E
F

Figure 15E

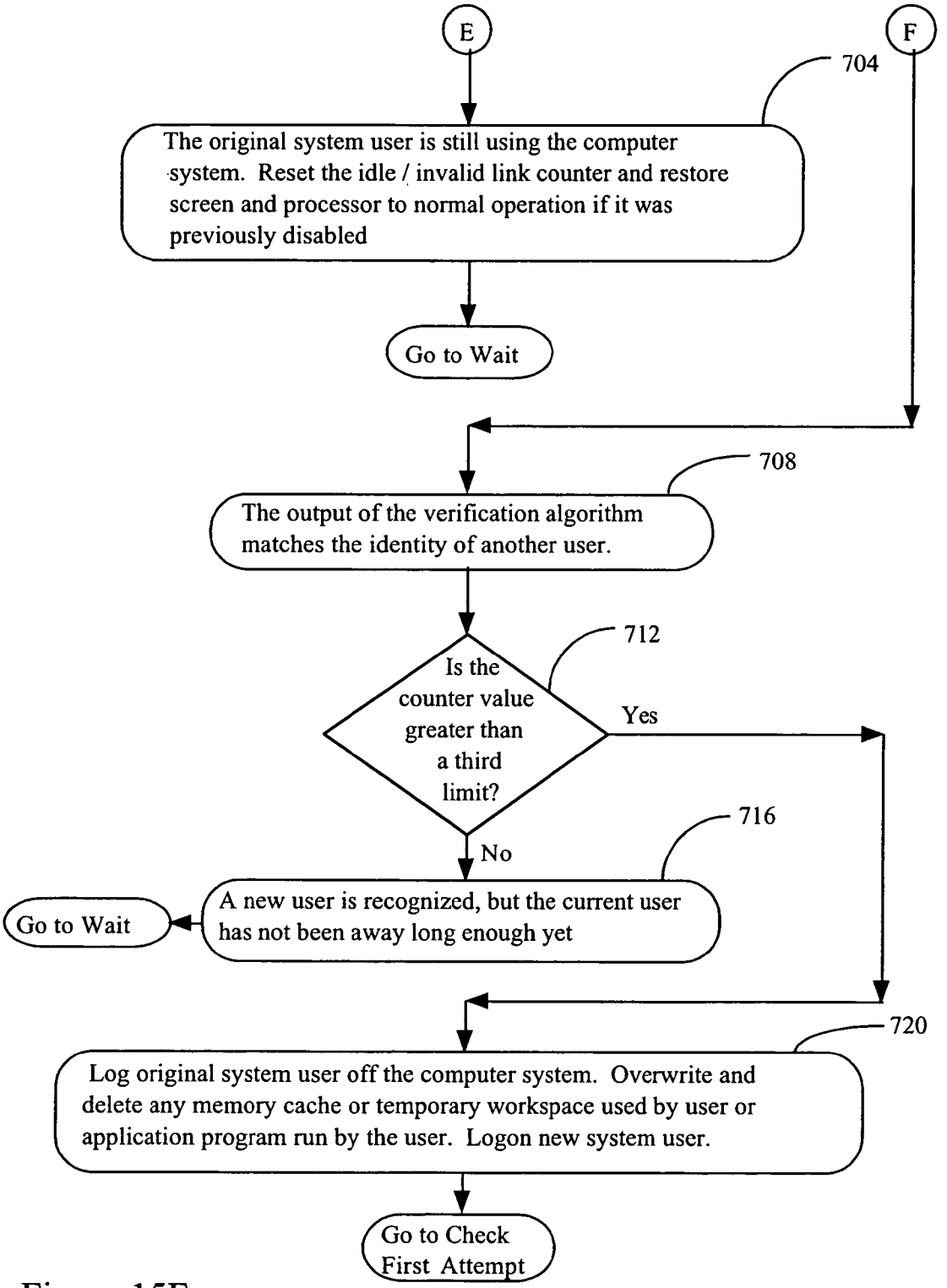

E
F
704
The original system user is still using the computer system. Reset the idle / invalid link counter and restore screen and processor to normal operation if it was previously disabled
Go to Wait
708
The output of the verification algorithm matches the identity of another user.
712
Is the counter value greater than a third limit?
Yes
No
716
A new user is recognized, but the current user has not been away long enough yet
Go to Wait
720
Log original system user off the computer system. Overwrite and delete any memory cache or temporary workspace used by user or application program run by the user. Logon new system user.
Go to Check First Attempt

Figure 15F

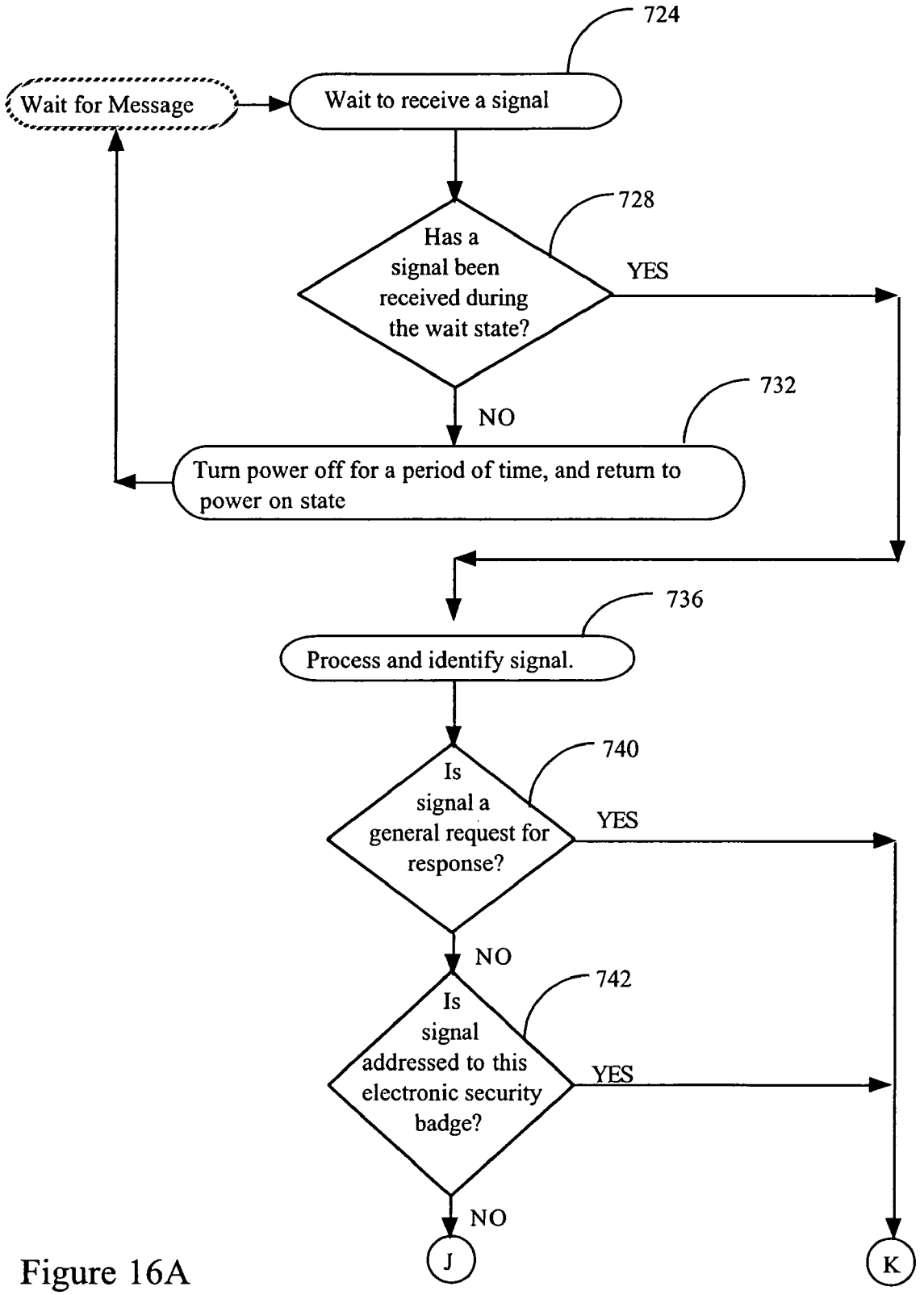

724
Wait for Message
Wait to receive a signal
728
Has a signal been received during the wait state?
YES
NO
732
Turn power off for a period of time, and return to power on state
736
Process and identify signal.
740
Is signal a general request for response?
YES
NO
742
Is signal addressed to this electronic security badge?
YES
NO
J
K

Figure 16A

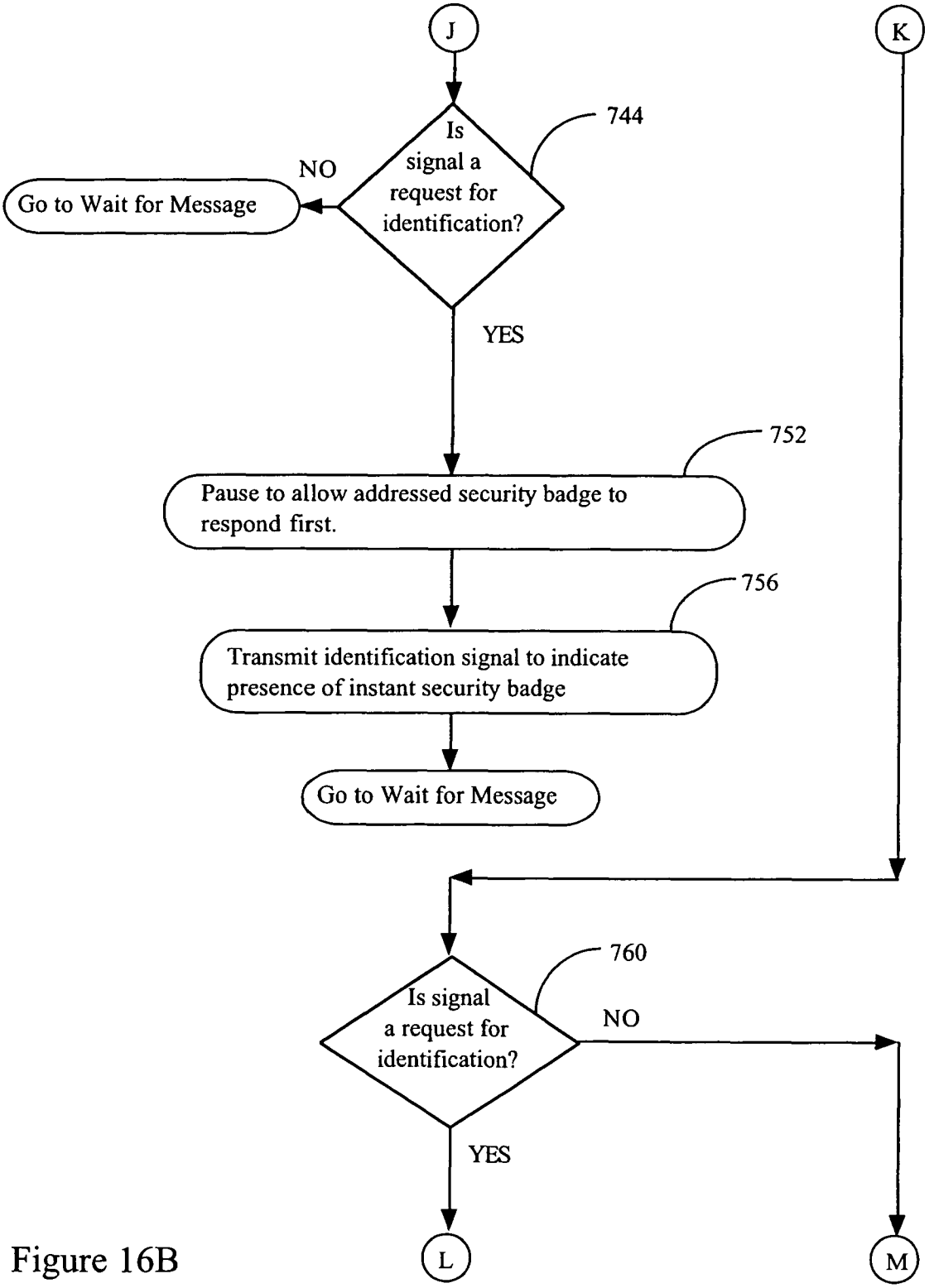

J
K
744
Is signal a request for identification?
NO
Go to Wait for Message
YES
752
Pause to allow addressed security badge to respond first.
756
Transmit identification signal to indicate presence of instant security badge
Go to Wait for Message
760
Is signal a request for identification?
NO
YES
L
M

Figure 16B

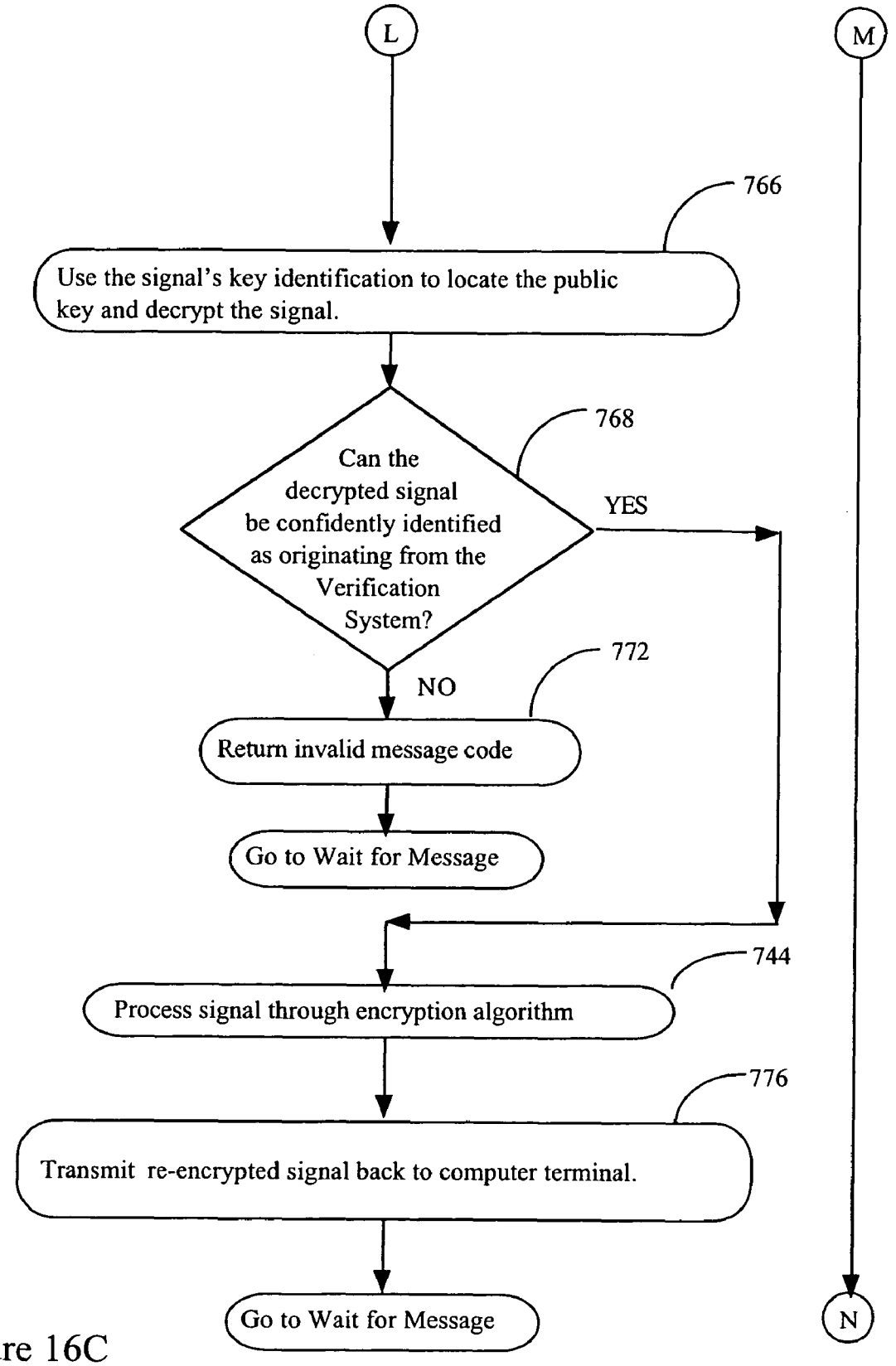

L
M
766
Use the signal's key identification to locate the public key and decrypt the signal.
768
Can the decrypted signal be confidently identified as originating from the Verification System?
YES
NO
772
Return invalid message code
Go to Wait for Message
744
Process signal through encryption algorithm
776
Transmit re-encrypted signal back to computer terminal.
Go to Wait for Message
N

Figure 16C

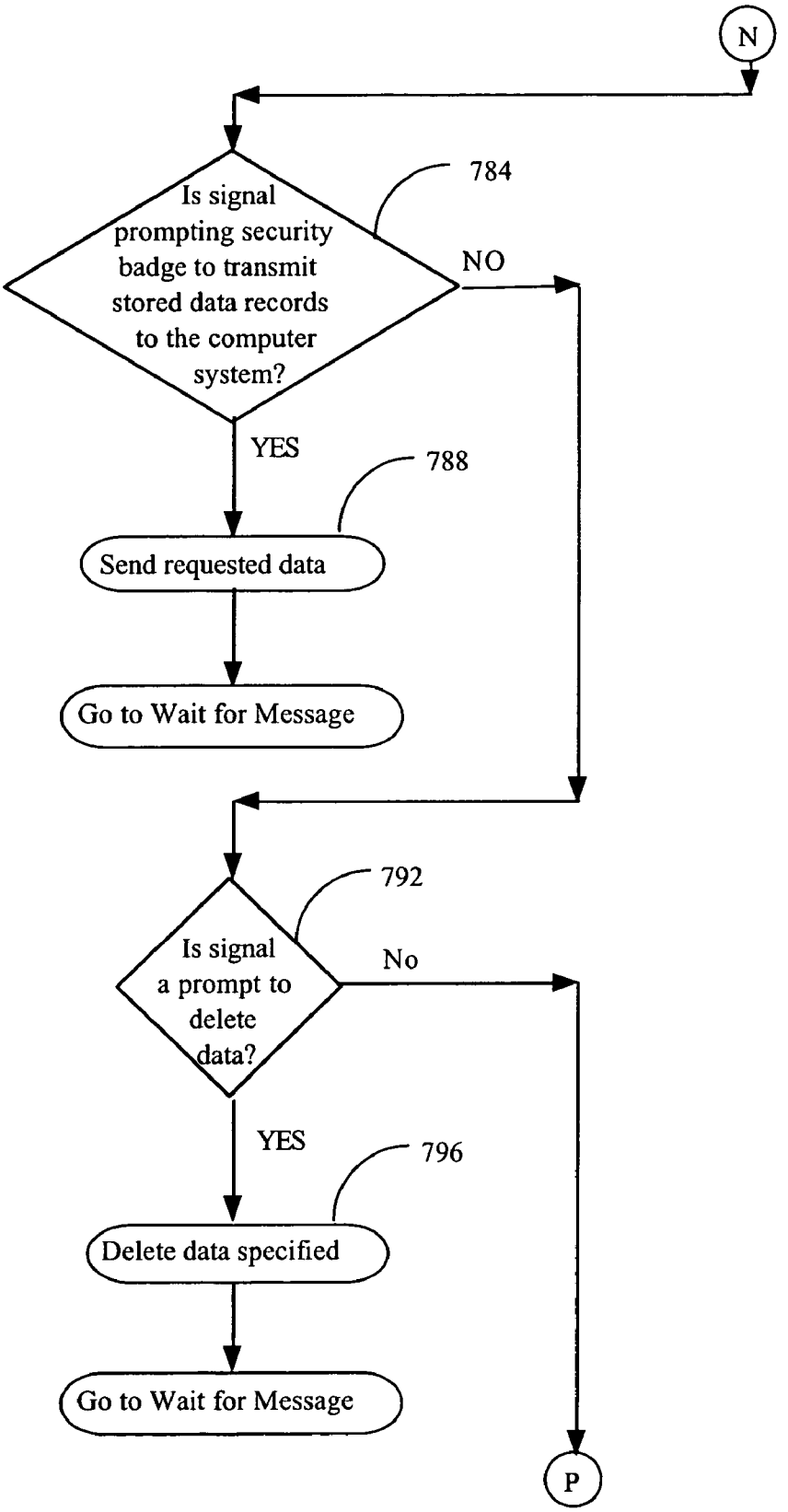

N
Is signal prompting security badge to transmit stored data records to the computer system?
784
NO
YES
788
Send requested data
Go to Wait for Message
792
Is signal a prompt to delete data?
No
YES
796
Delete data specified
Go to Wait for Message
P

Figure 16D

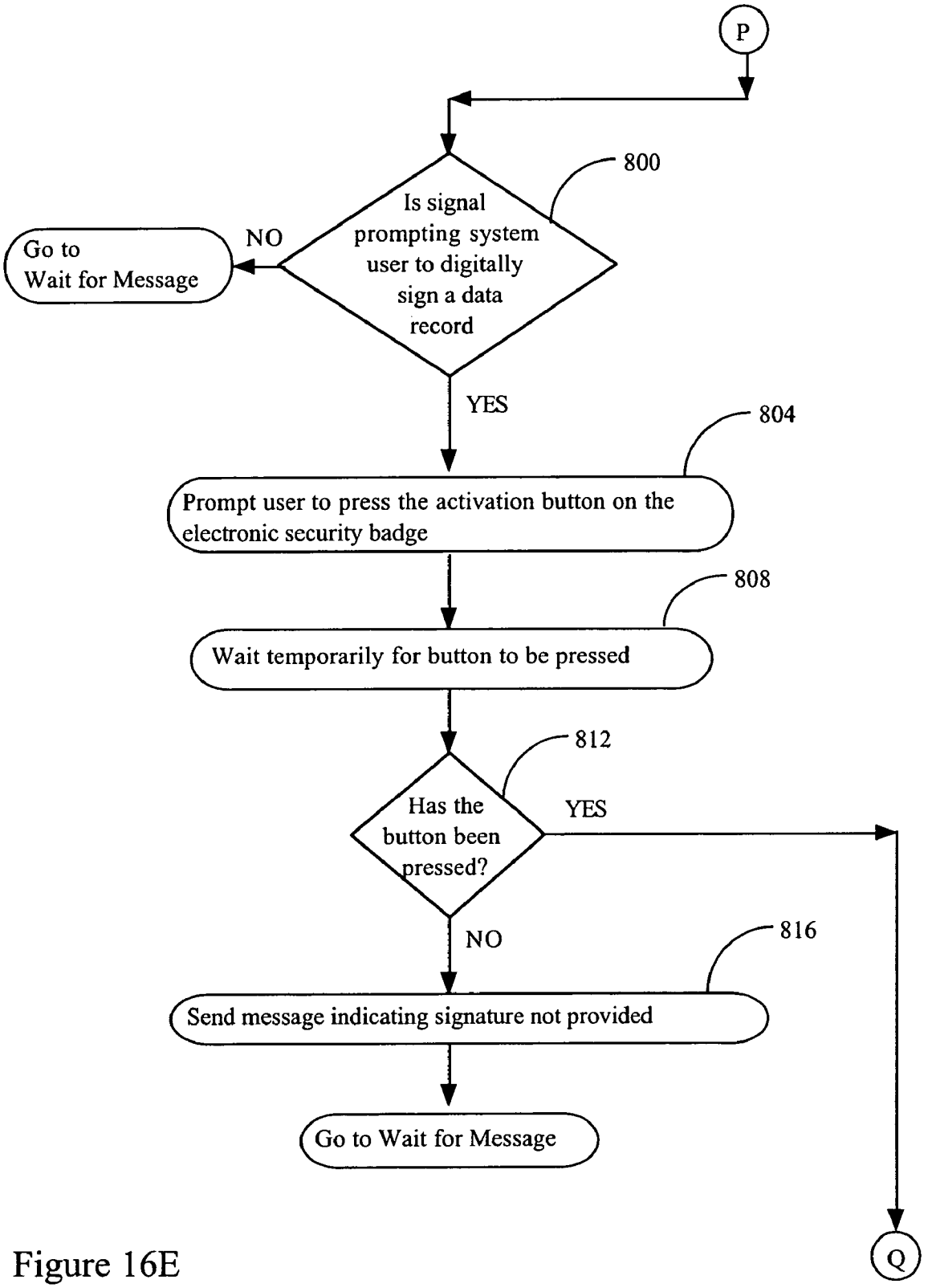

P
800
Is signal prompting system user to digitally sign a data record
NO
Go to Wait for Message
YES
804
Prompt user to press the activation button on the electronic security badge
808
Wait temporarily for button to be pressed
812
Has the button been pressed?
YES
NO
816
Send message indicating signature not provided
Go to Wait for Message
Q

Figure 16E

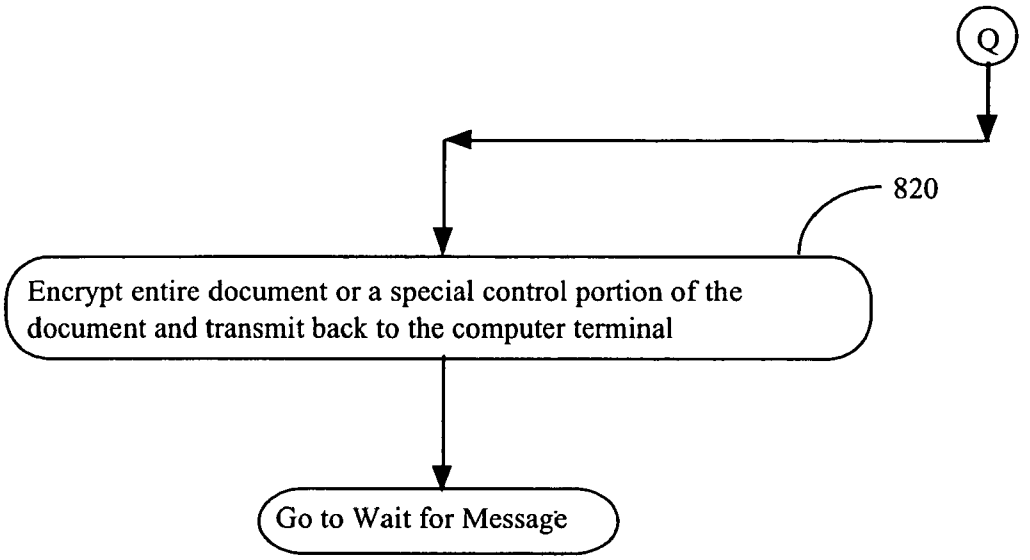

Q
820
Encrypt entire document or a special control portion of the document and transmit back to the computer terminal
Go to Wait for Message

Figure 16F

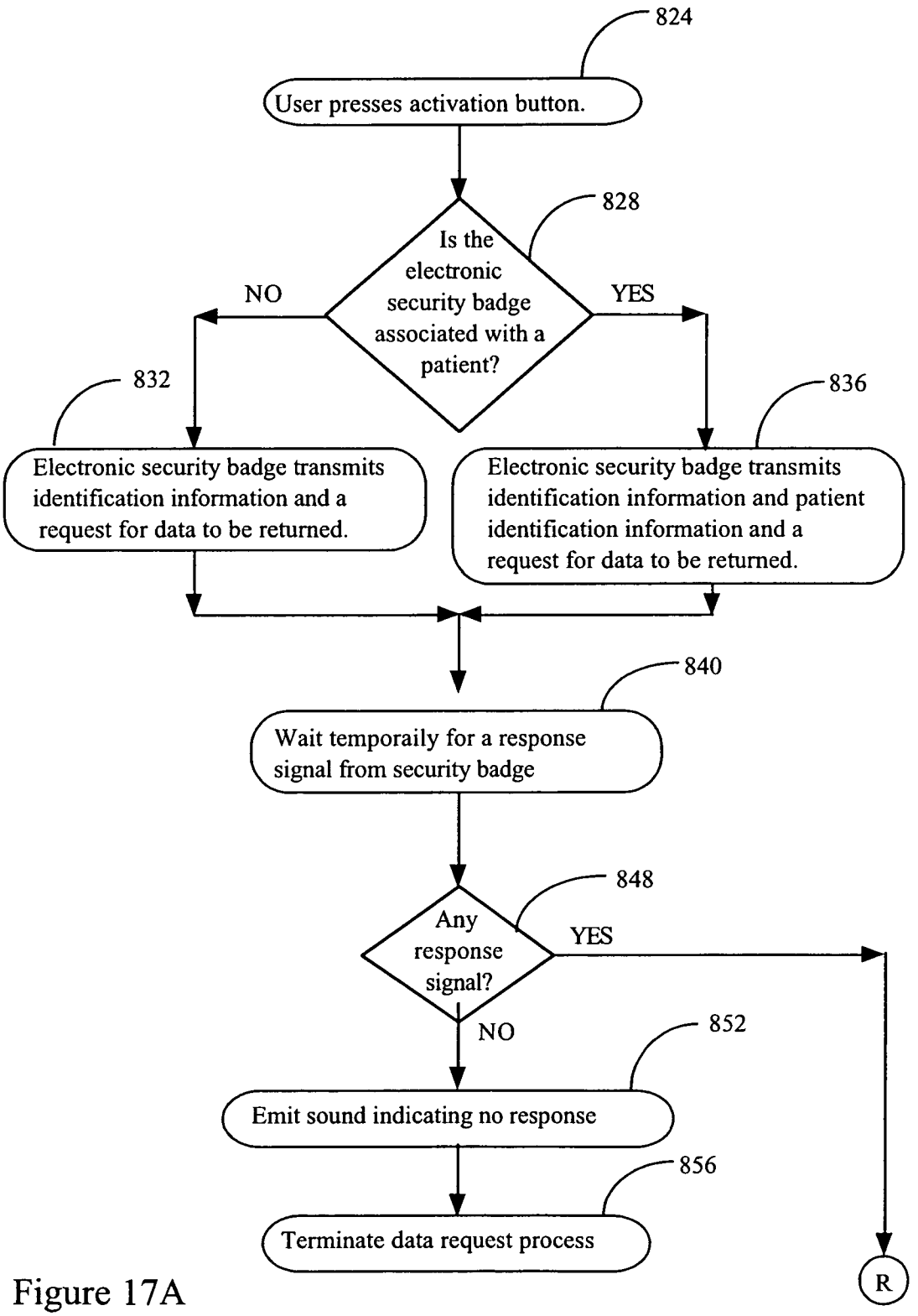

824
User presses activation button.
828
Is the electronic security badge associated with a patient?
NO
YES
832
Electronic security badge transmits identification information and a request for data to be returned.
836
Electronic security badge transmits identification information and patient identification information and a request for data to be returned.
840
Wait temporaily for a response signal from security badge
848
Any response signal?
YES
NO
852
Emit sound indicating no response
856
Terminate data request process
R

Figure 17A

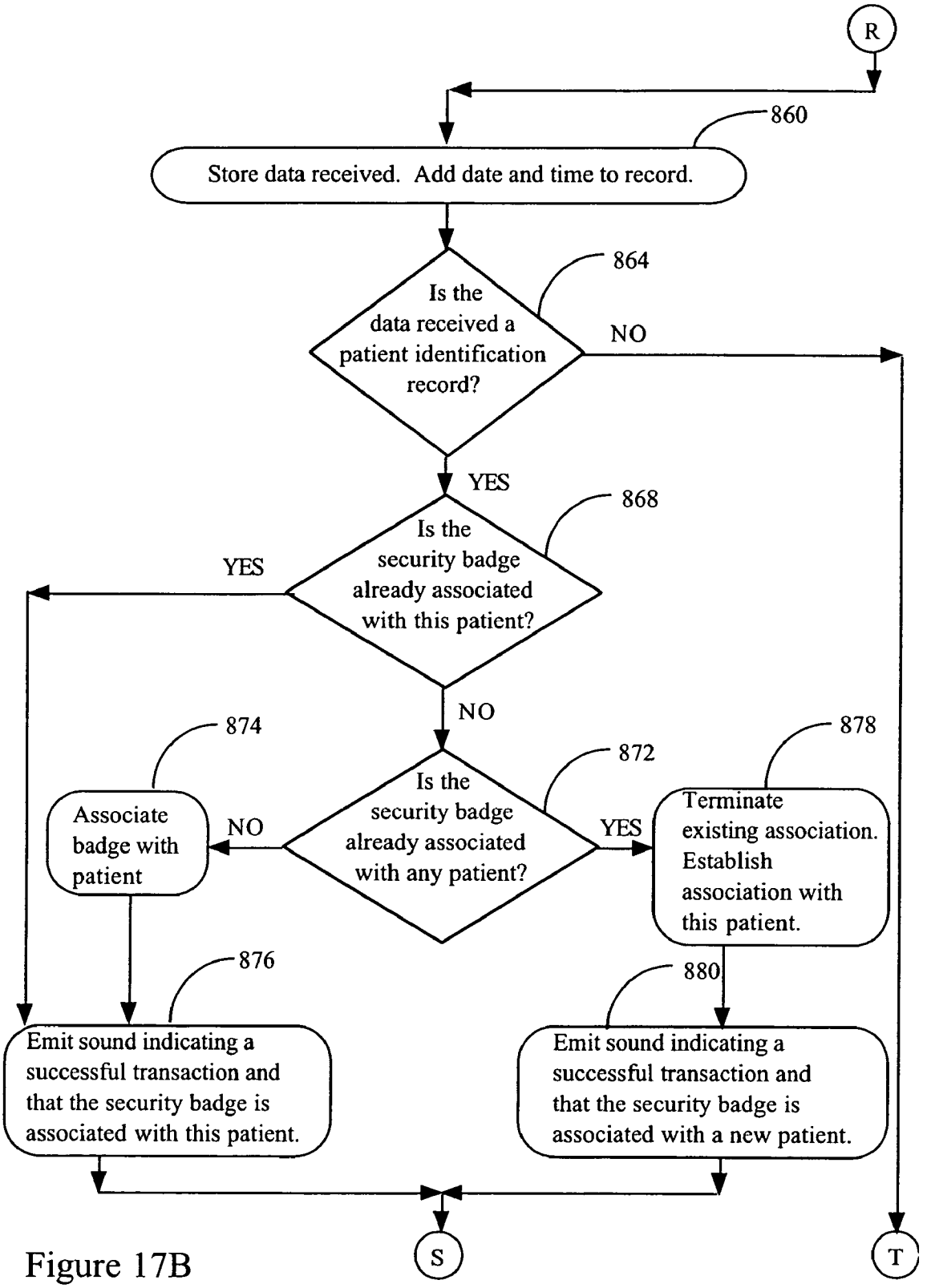

R
860
Store data received. Add date and time to record.
864
Is the data received a patient identification record?
NO
YES
868
Is the security badge already associated with this patient?
YES
NO
874
872
878
Associate badge with patient
NO
Is the security badge already associated with any patient?
YES
Terminate existing association. Establish association with this patient.
876
880
Emit sound indicating a successful transaction and that the security badge is associated with this patient.
Emit sound indicating a successful transaction and that the security badge is associated with a new patient.
S
T

Figure 17B

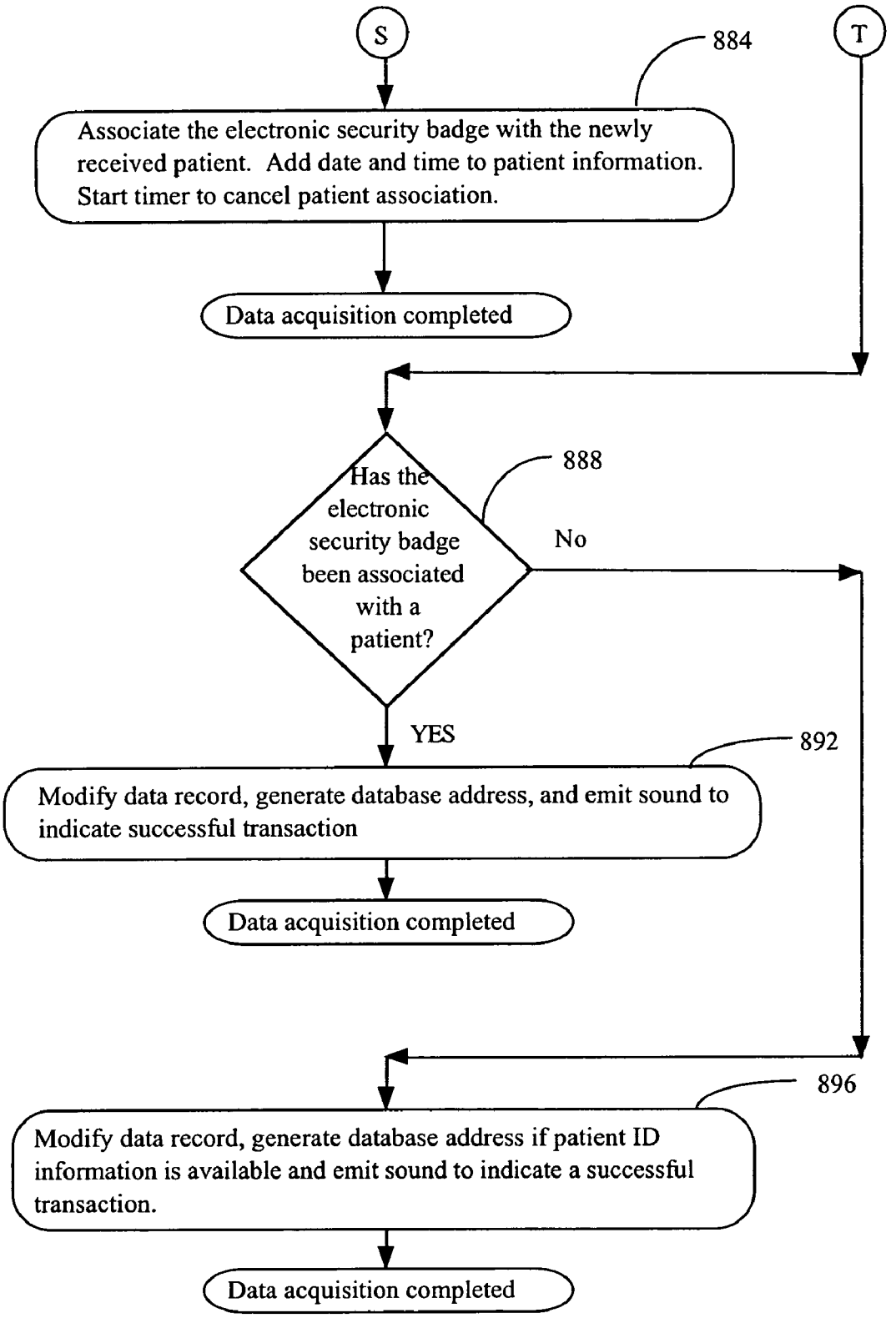

S
884
T
Associate the electronic security badge with the newly received patient. Add date and time to patient information. Start timer to cancel patient association.
Data acquisition completed
888
Has the electronic security badge been associated with a patient?
No
YES
892
Modify data record, generate database address, and emit sound to indicate successful transaction
Data acquisition completed
896
Modify data record, generate database address if patient ID information is available and emit sound to indicate a successful transaction.
Data acquisition completed

Figure 17C

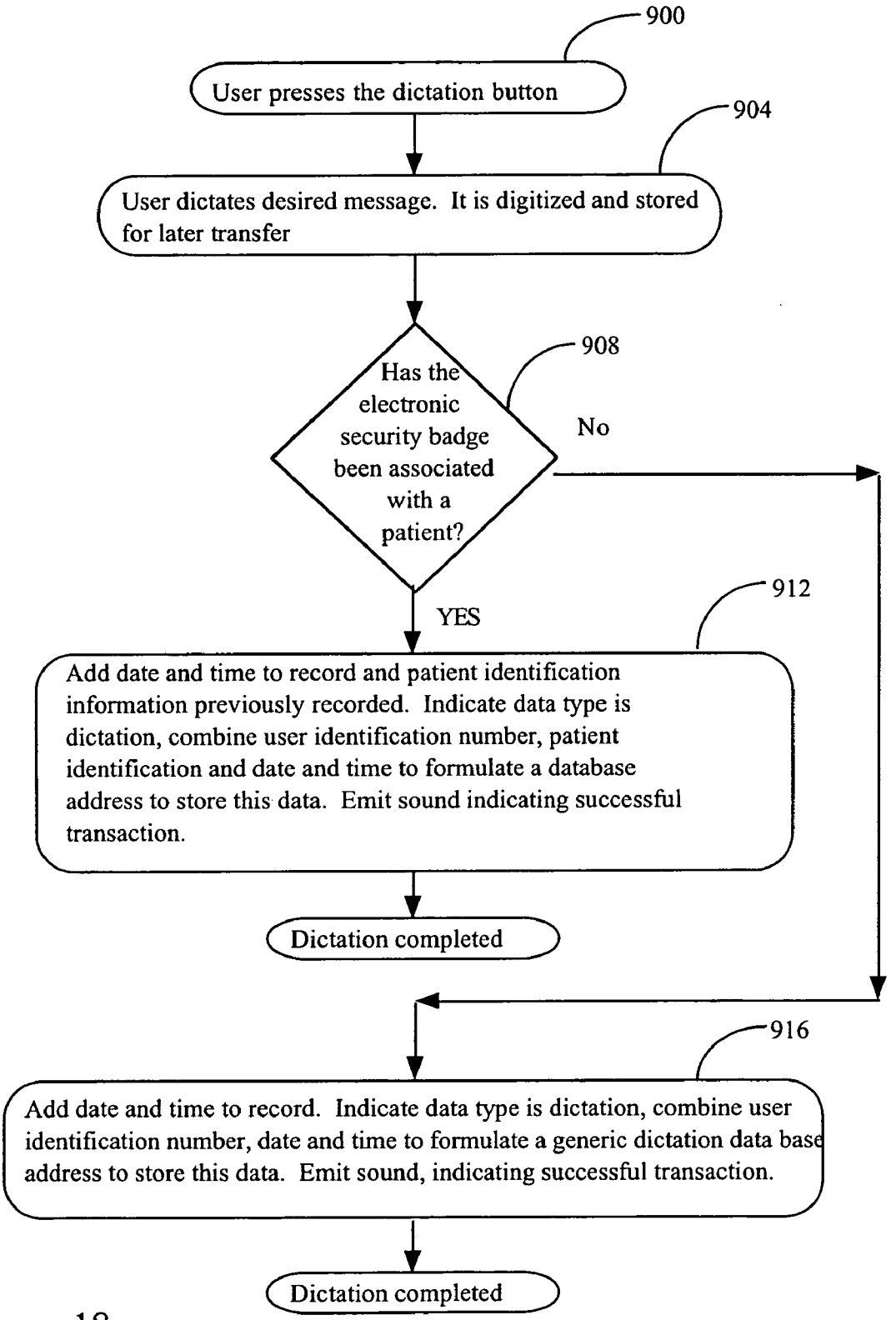

900
User presses the dictation button
904
User dictates desired message. It is digitized and stored for later transfer
908
Has the electronic security badge been associated with a patient?
No
YES
912
Add date and time to record and patient identification information previously recorded. Indicate data type is dictation, combine user identification number, patient identification and date and time to formulate a database address to store this data. Emit sound indicating successful transaction.
Dictation completed
916
Add date and time to record. Indicate data type is dictation, combine user identification number, date and time to formulate a generic dictation data base address to store this data. Emit sound, indicating successful transaction.
Dictation completed

Figure 18

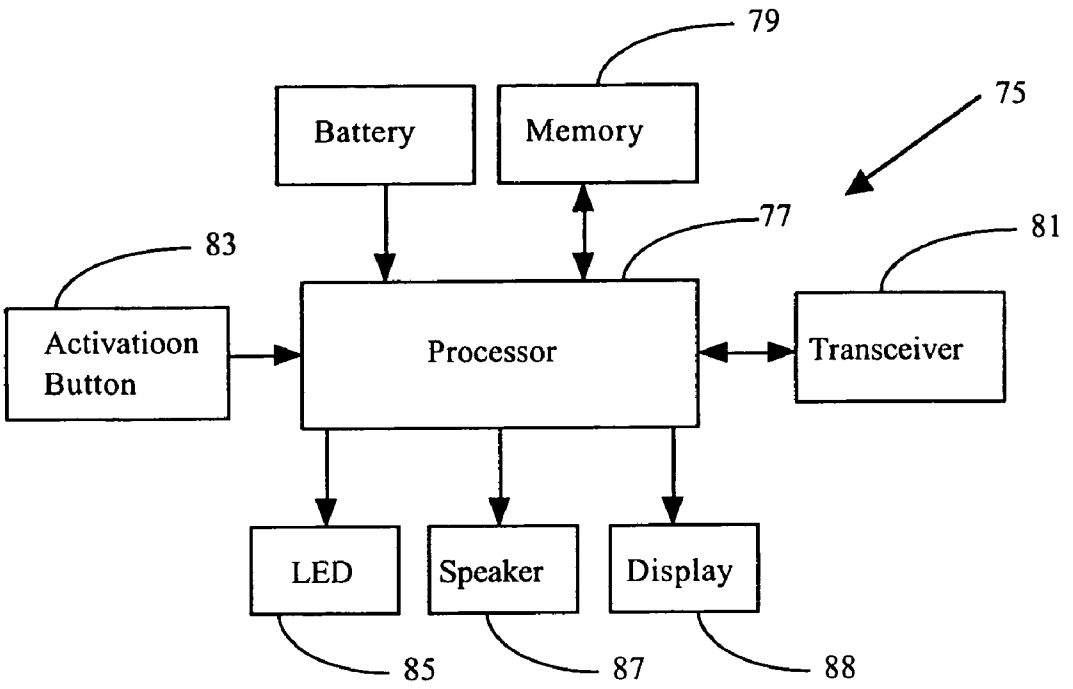


Figure 19

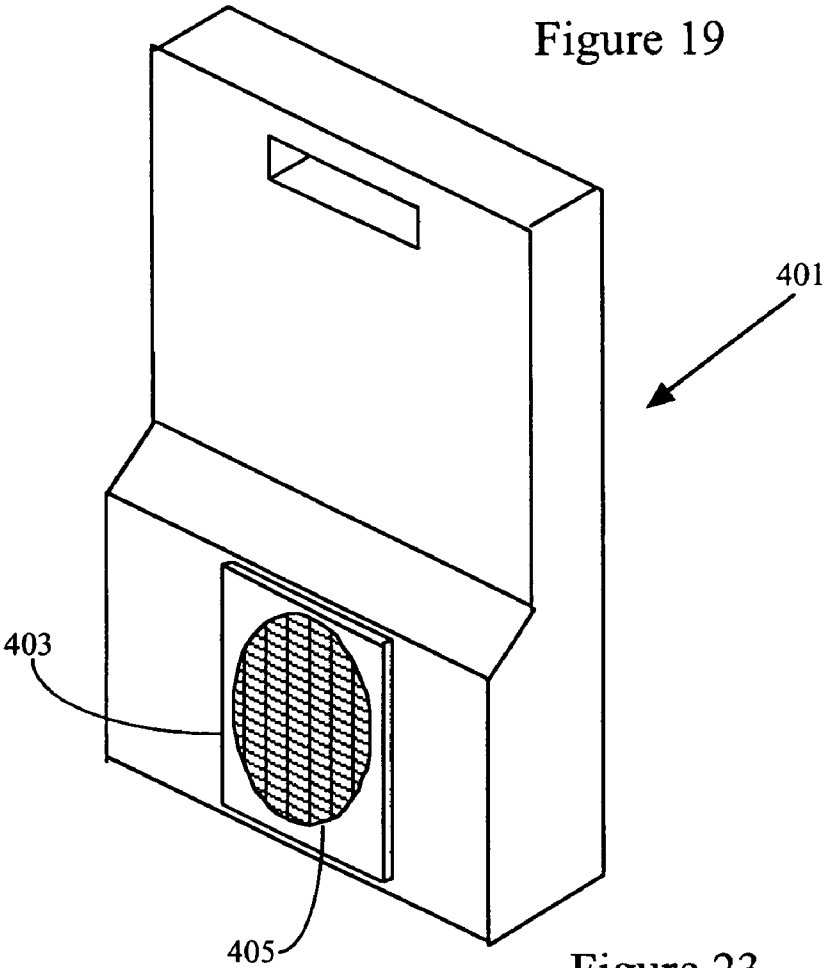


Figure 23

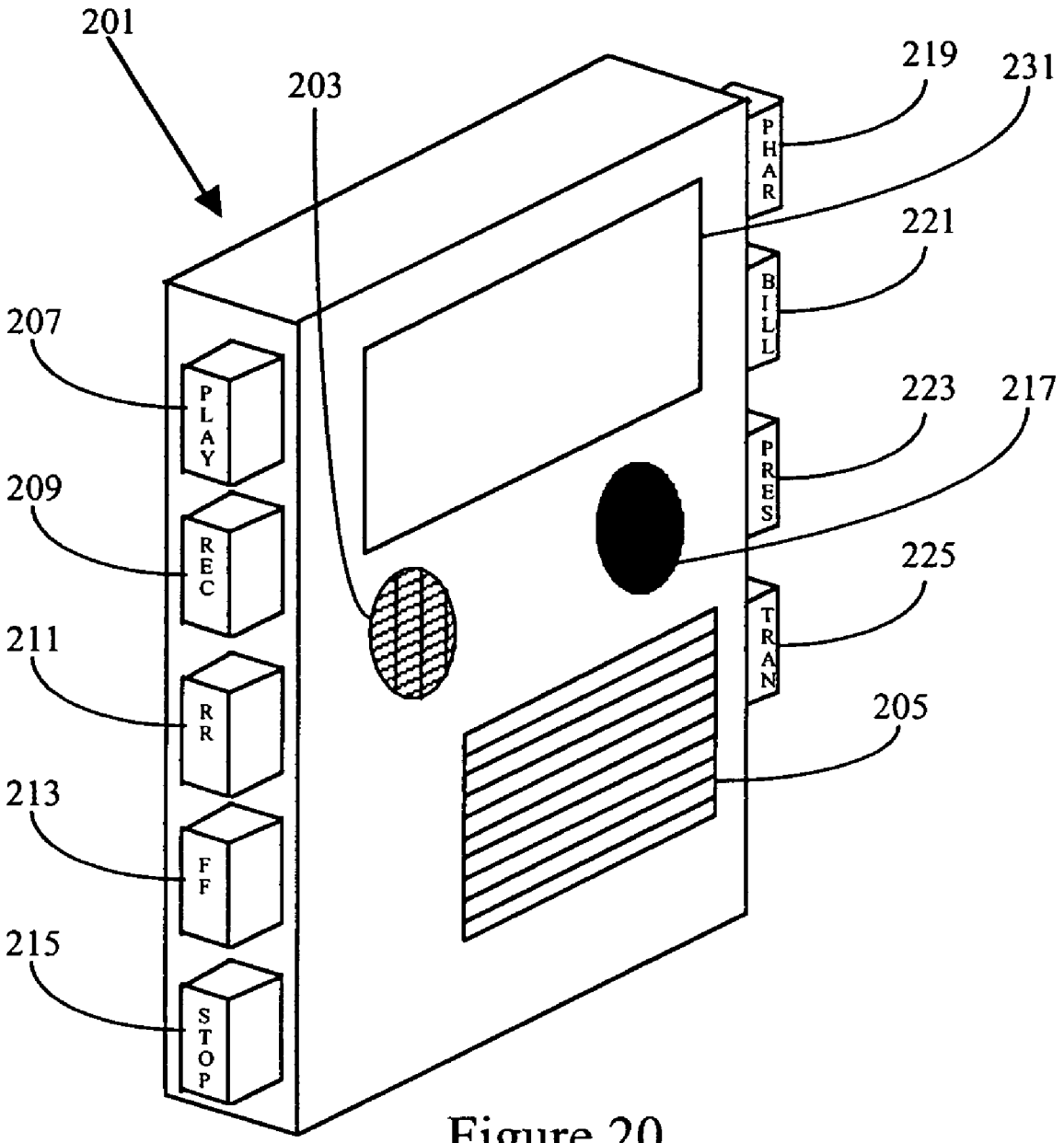

201
203
219
231
PHAR
221
BILL
207
PLAY
223
217
PRES
209
REC
225
TRAN
211
RR
205
213
FF
215
STOP

Figure 20

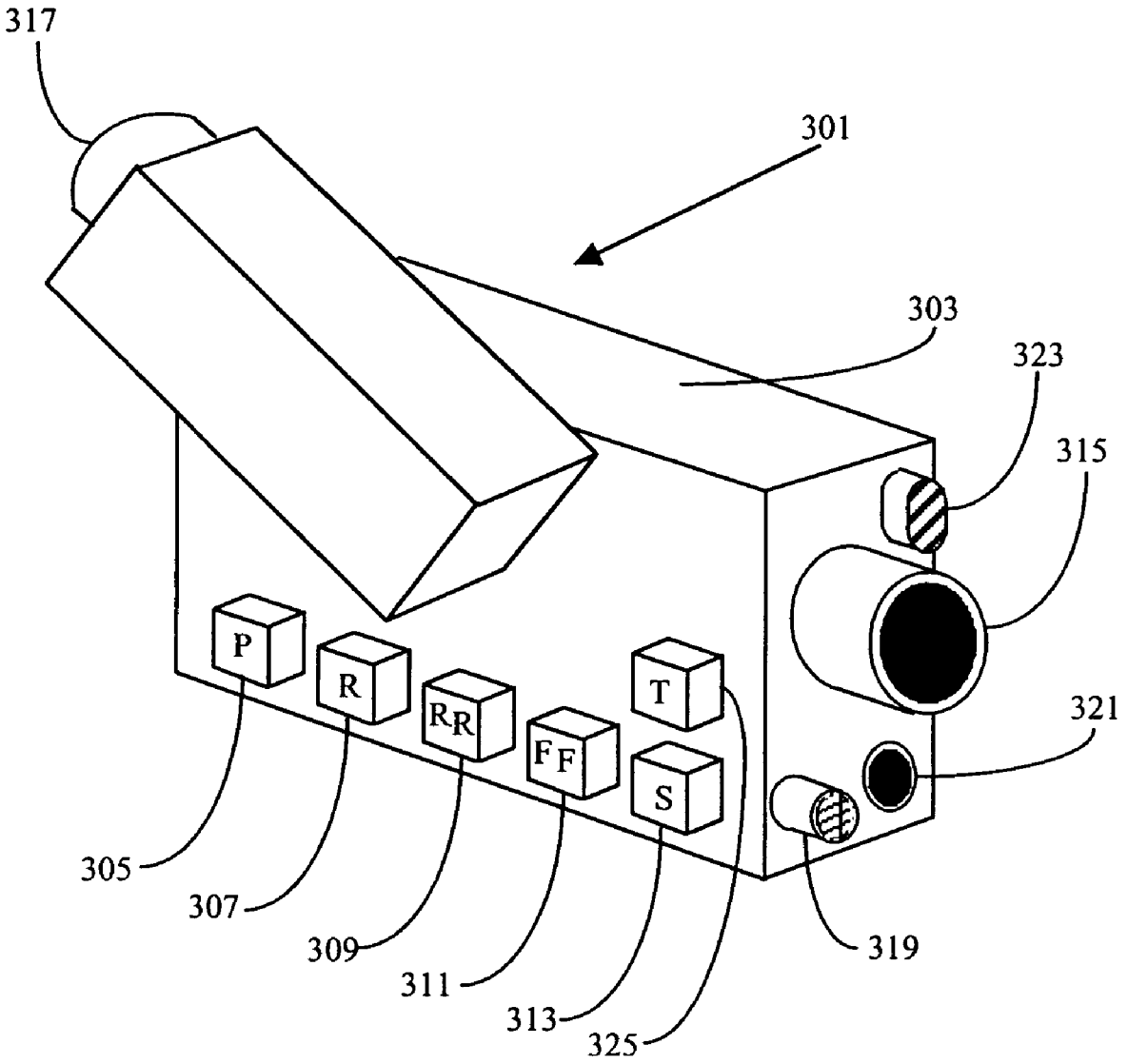


Figure 21

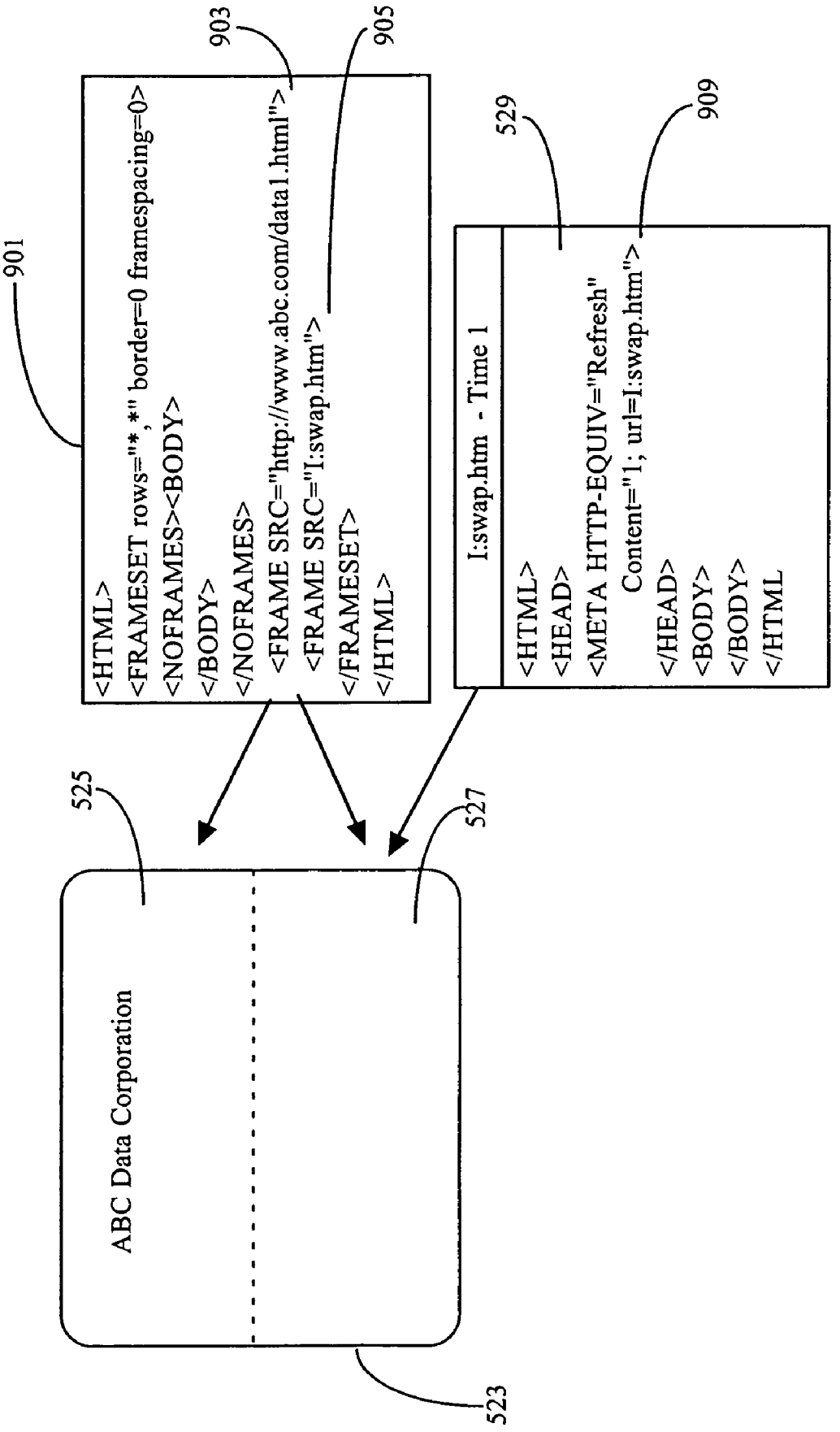

901
903
905
<HTML>
<FRAMESET rows="*,*" border=0 framespacing=0>
<NOFRAMES><BODY>
</BODY>
</NOFRAMES>
<FRAME SRC="http://www.abc.com/data1.html">
<FRAME SRC="I:swap.htm">
</FRAMESET>
</HTML>
529
909
I:swap.htm - Time 1
<HTML>
<HEAD>
<META HTTP-EQUIV="Refresh"
Content="1; url=I:swap.htm">
</HEAD>
<BODY>
</BODY>
</HTML
525
527
ABC Data Corporation
523

Figure 22

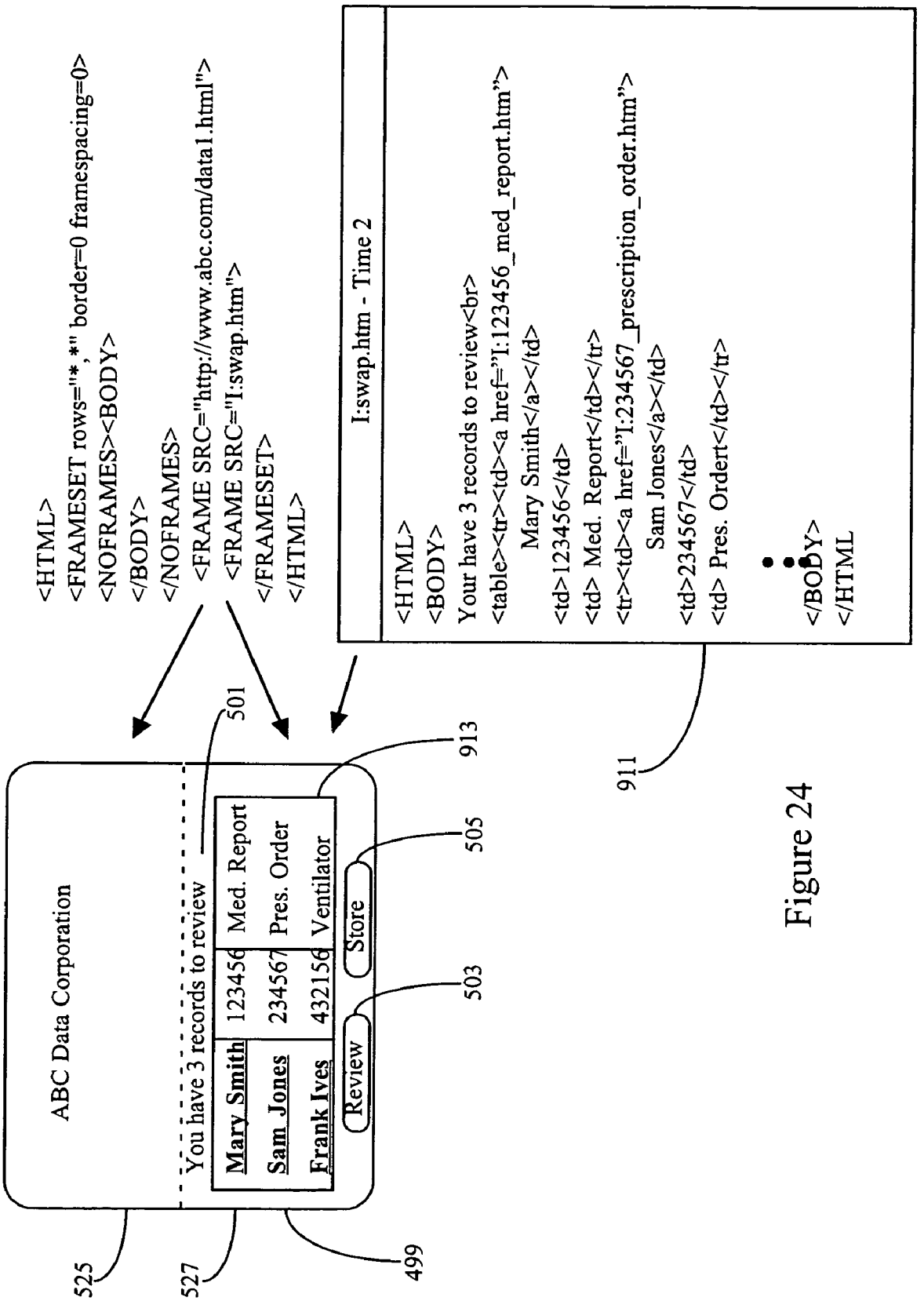

<HTML>
<FRAMESET rows="* *" border=0 framespacing=0>
<NOFRAMES><BODY>
</BODY>
</NOFRAMES>
<FRAME SRC="http://www.abc.com/data1.html">
<FRAME SRC="I:swap.htm">
</FRAMESET>
</HTML>
I:swap.htm - Time 2
<HTML>
<BODY>
Your have 3 records to review
<table><tr><td>
Mary Smith</td>
<td>123456</td>
<td> Med. Report</td></tr>
<tr><td>
Sam Jones</td>
<td>234567</td>
<td> Pres. Ordert</td></tr>
</BODY>
</HTML
ABC Data Corporation
You have 3 records to review
Mary Smith
Sam Jones
Frank Ives
123456
234567
432156
Med. Report
Pres. Order
Ventilator
Review
Store
525
527
499
501
503
505
913
911

Figure 24

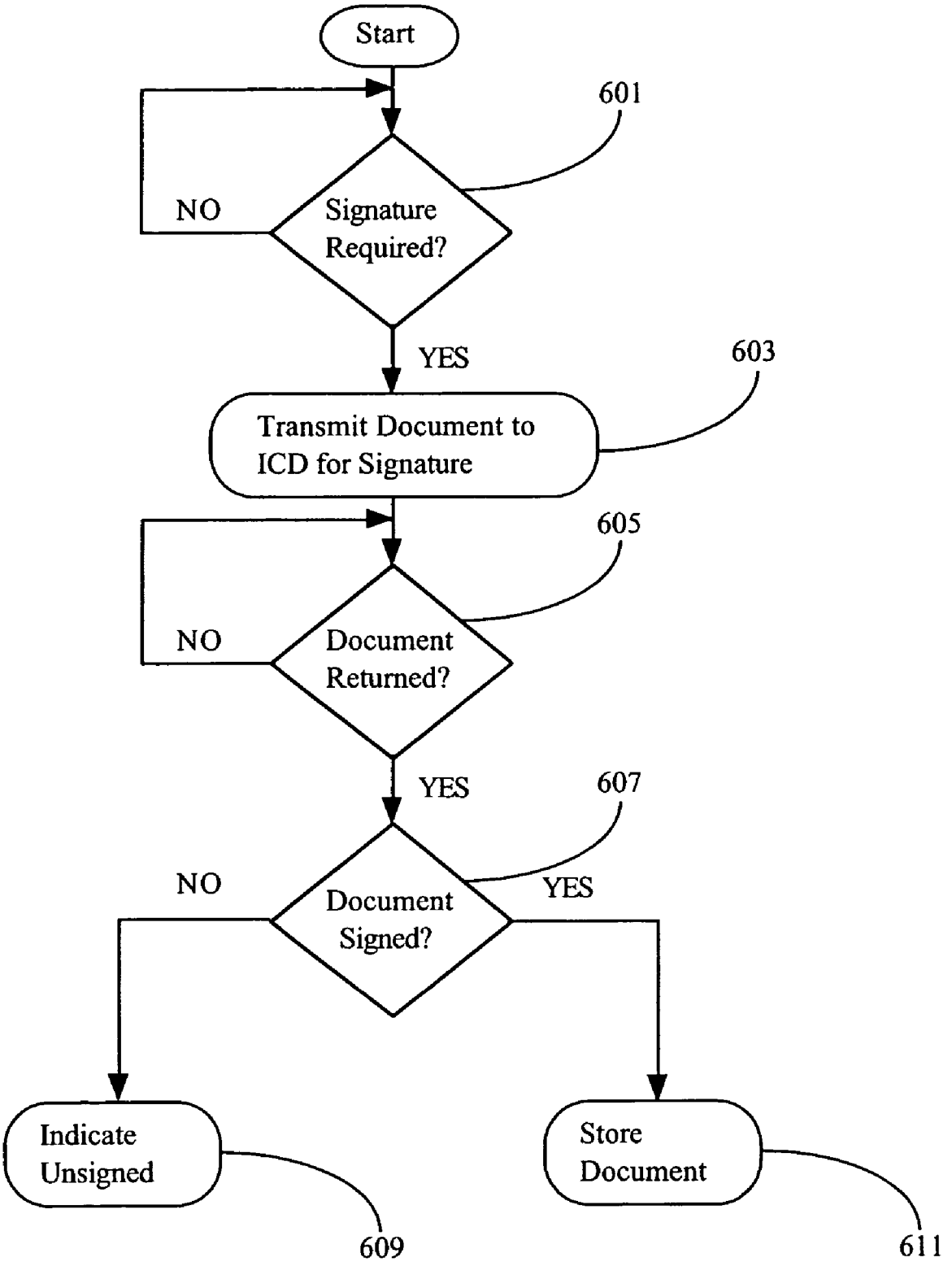

Start
601
Signature Required?
NO
YES
603
Transmit Document to ICD for Signature
605
Document Returned?
NO
YES
607
Document Signed?
NO
YES
Indicate Unsigned
609
Store Document
611

Figure 25

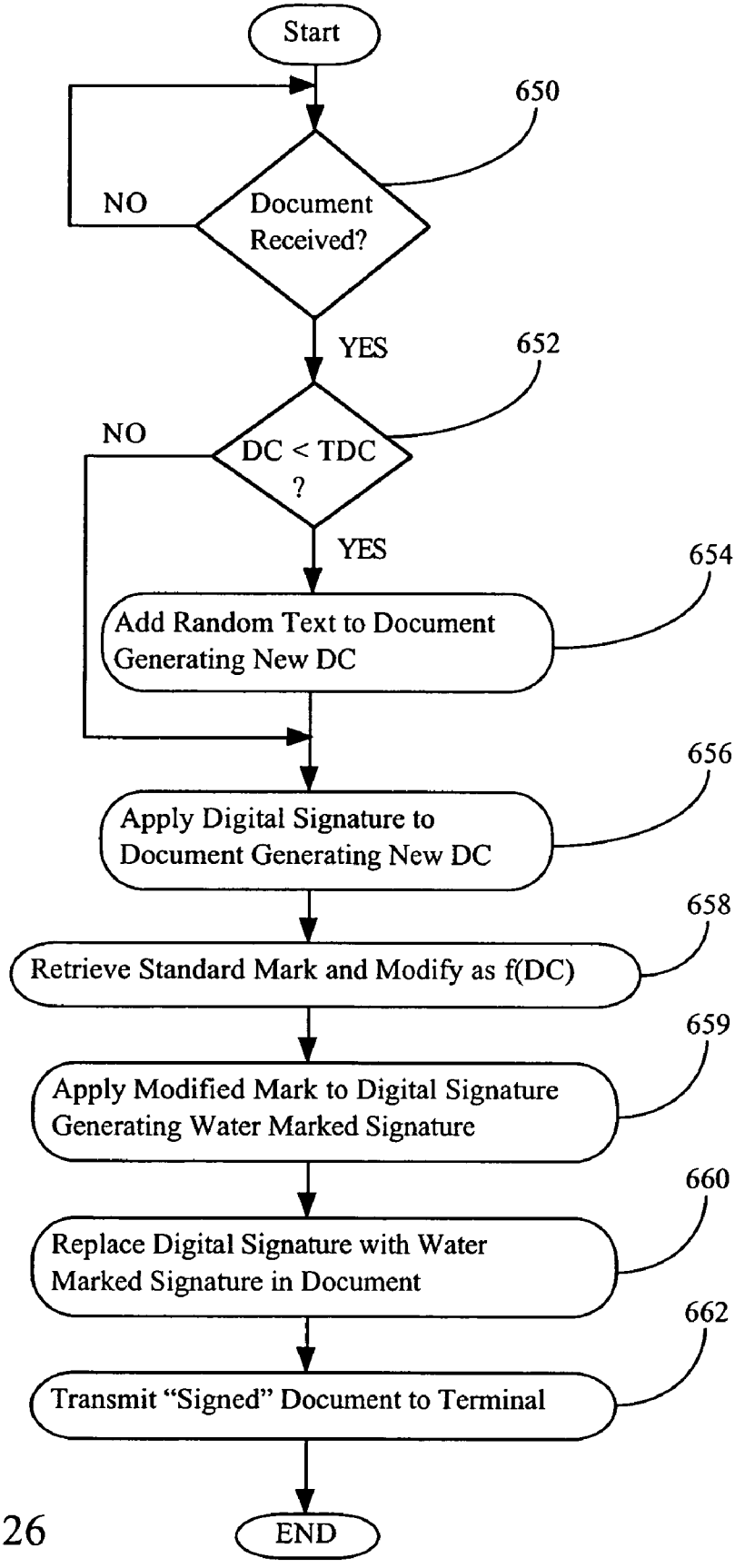

Start
650
Document Received?
NO
YES
652
DC < TDC ?
NO
YES
654
Add Random Text to Document Generating New DC
656
Apply Digital Signature to Document Generating New DC
658
Retrieve Standard Mark and Modify as f(DC)
659
Apply Modified Mark to Digital Signature Generating Water Marked Signature
660
Replace Digital Signature with Water Marked Signature in Document
662
Transmit "Signed" Document to Terminal
END

Figure 26

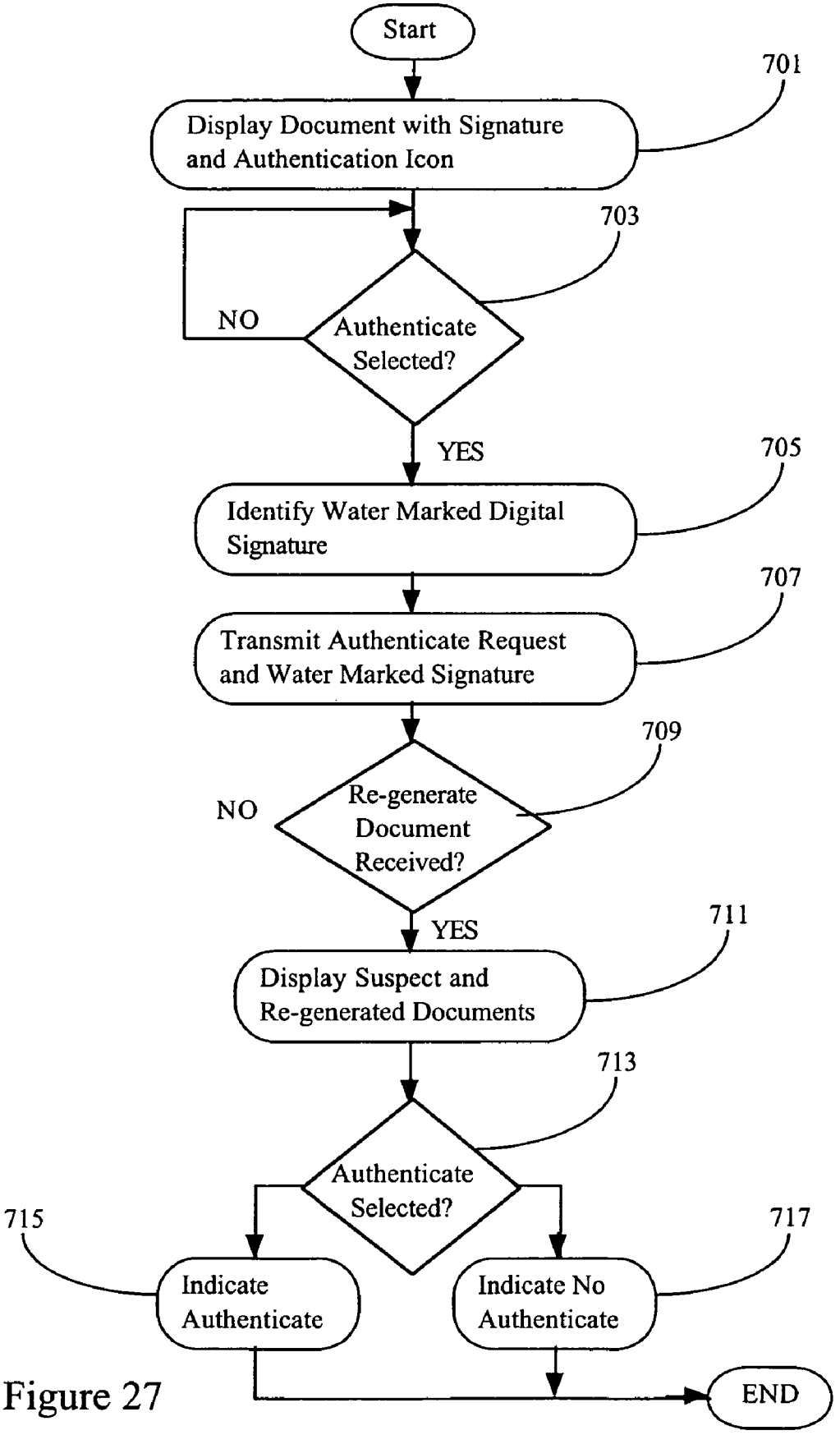

Start
701
Display Document with Signature and Authentication Icon
703
NO
Authenticate Selected?
YES
705
Identify Water Marked Digital Signature
707
Transmit Authenticate Request and Water Marked Signature
709
NO
Re-generate Document Received?
YES
711
Display Suspect and Re-generated Documents
713
Authenticate Selected?
715
Indicate Authenticate
717
Indicate No Authenticate
END

Figure 27

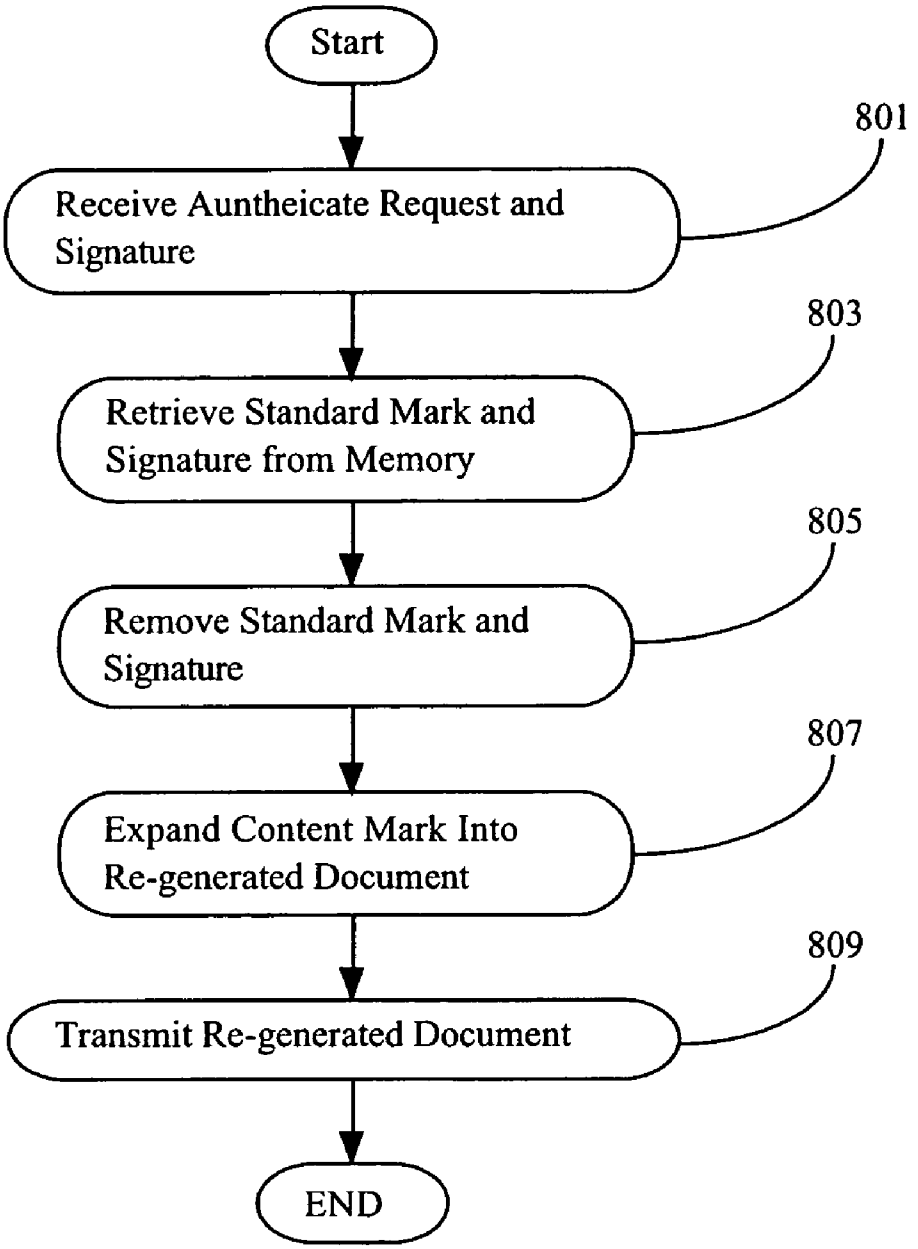

Start
801
Receive Auntheicate Request and Signature
803
Retrieve Standard Mark and Signature from Memory
805
Remove Standard Mark and Signature
807
Expand Content Mark Into Re-generated Document
809
Transmit Re-generated Document
END

Figure 28

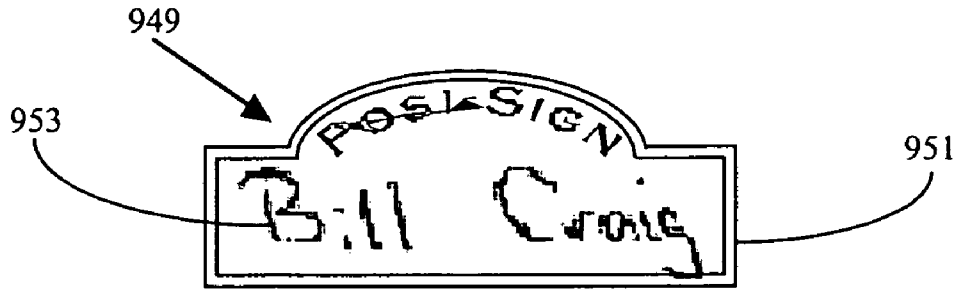


Figure 29

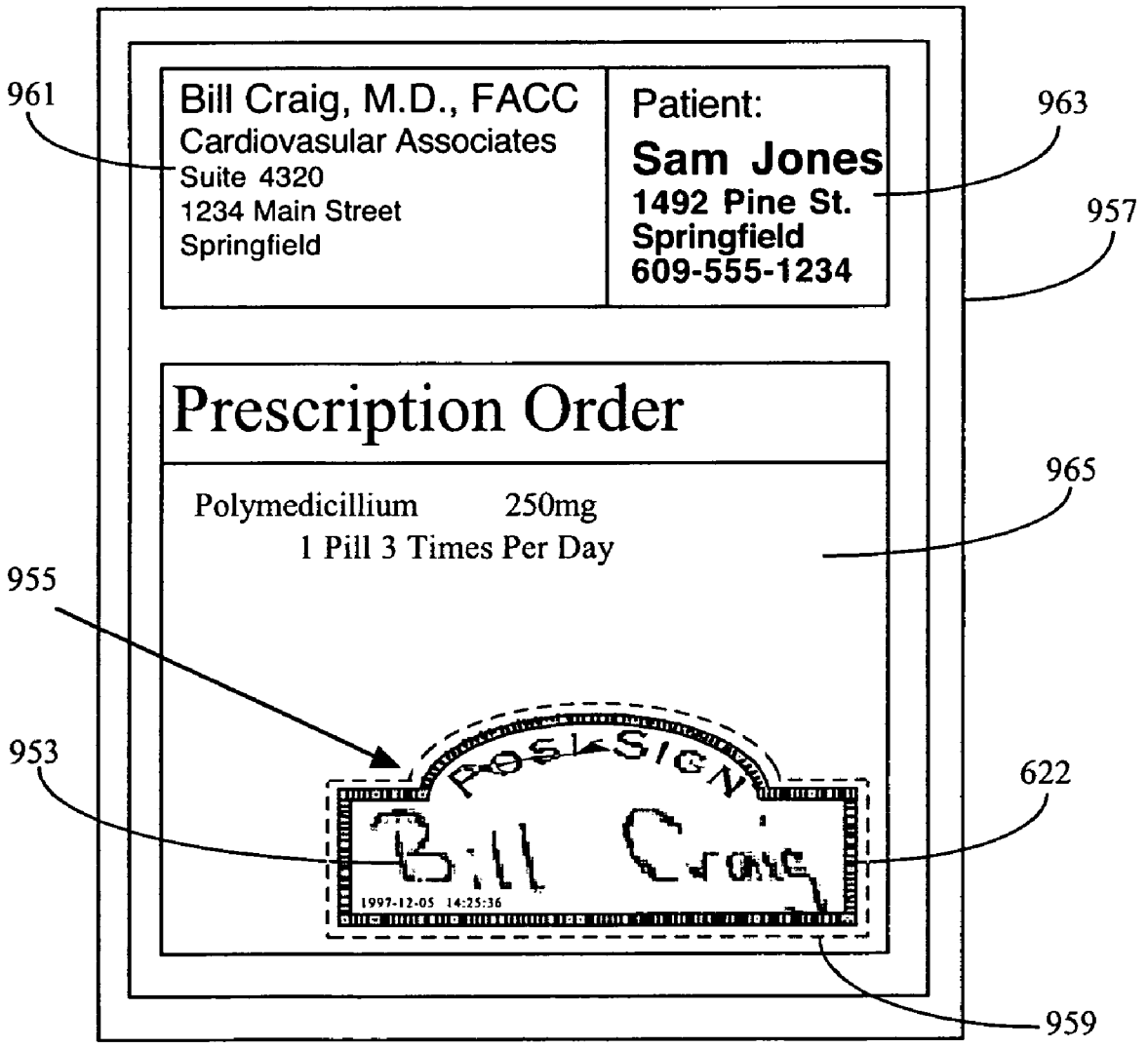


Figure 30

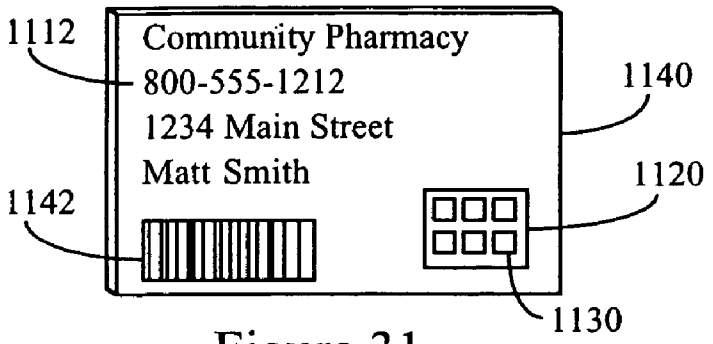


Figure 31

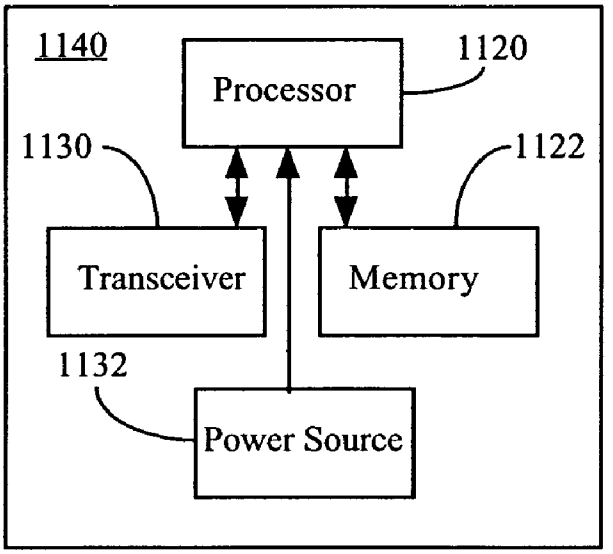


Figure 32

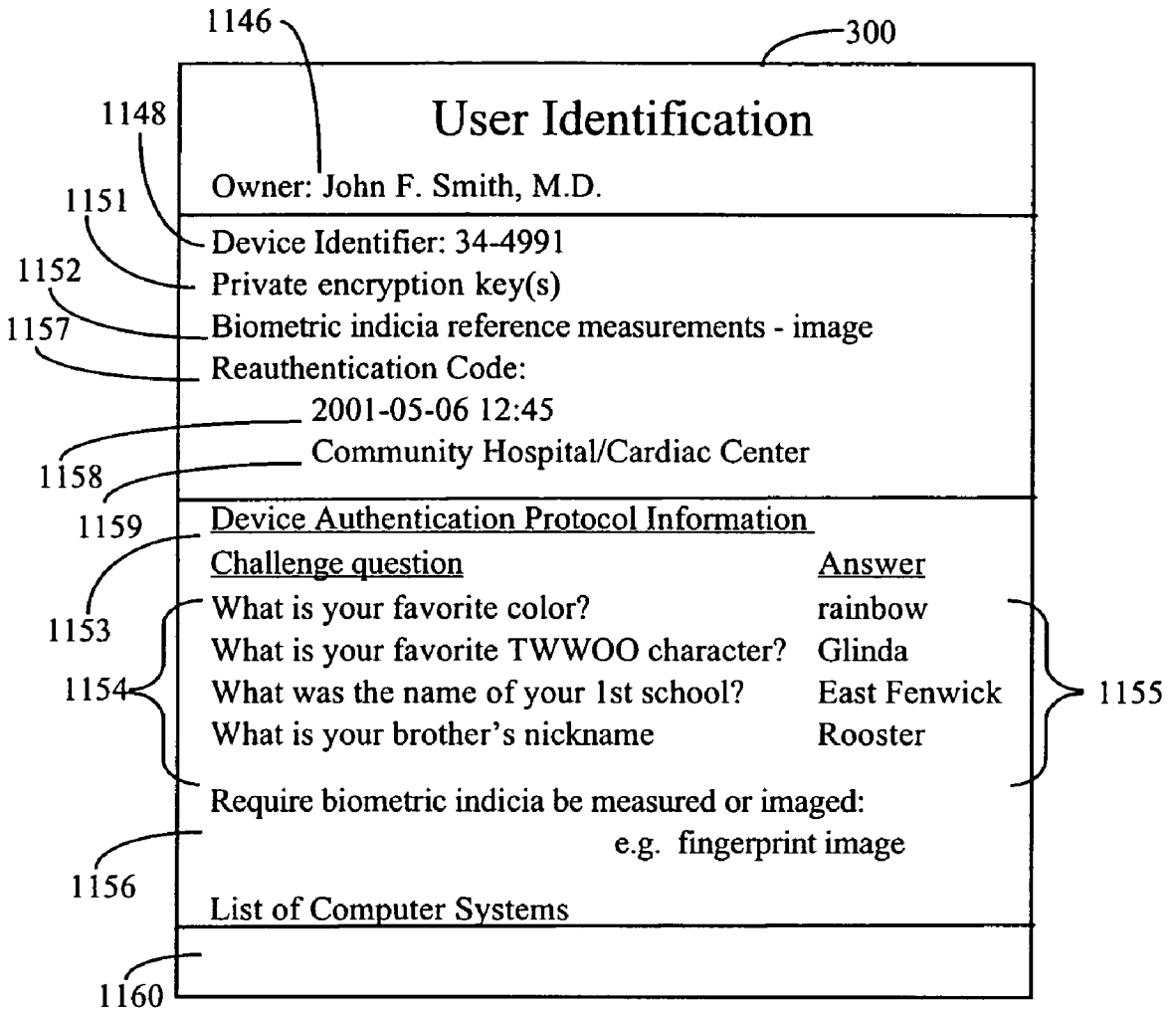

1146
300
1148
User Identification
Owner: John F. Smith, M.D.
1151
Device Identifier: 34-4991
1152
Private encryption key(s)
1157
Biometric indicia reference measurements - image
Reauthentication Code:
2001-05-06 12:45
Community Hospital/Cardiac Center
1158
1159
Device Authentication Protocol Information
Challenge question
Answer
1153
What is your favorite color?
rainbow
1154
What is your favorite TWWOO character?
Glinda
What was the name of your 1st school?
East Fenwick
1155
What is your brother's nickname
Rooster
Require biometric indicia be measured or imaged:
e.g. fingerprint image
1156
List of Computer Systems
1160

Figure 33

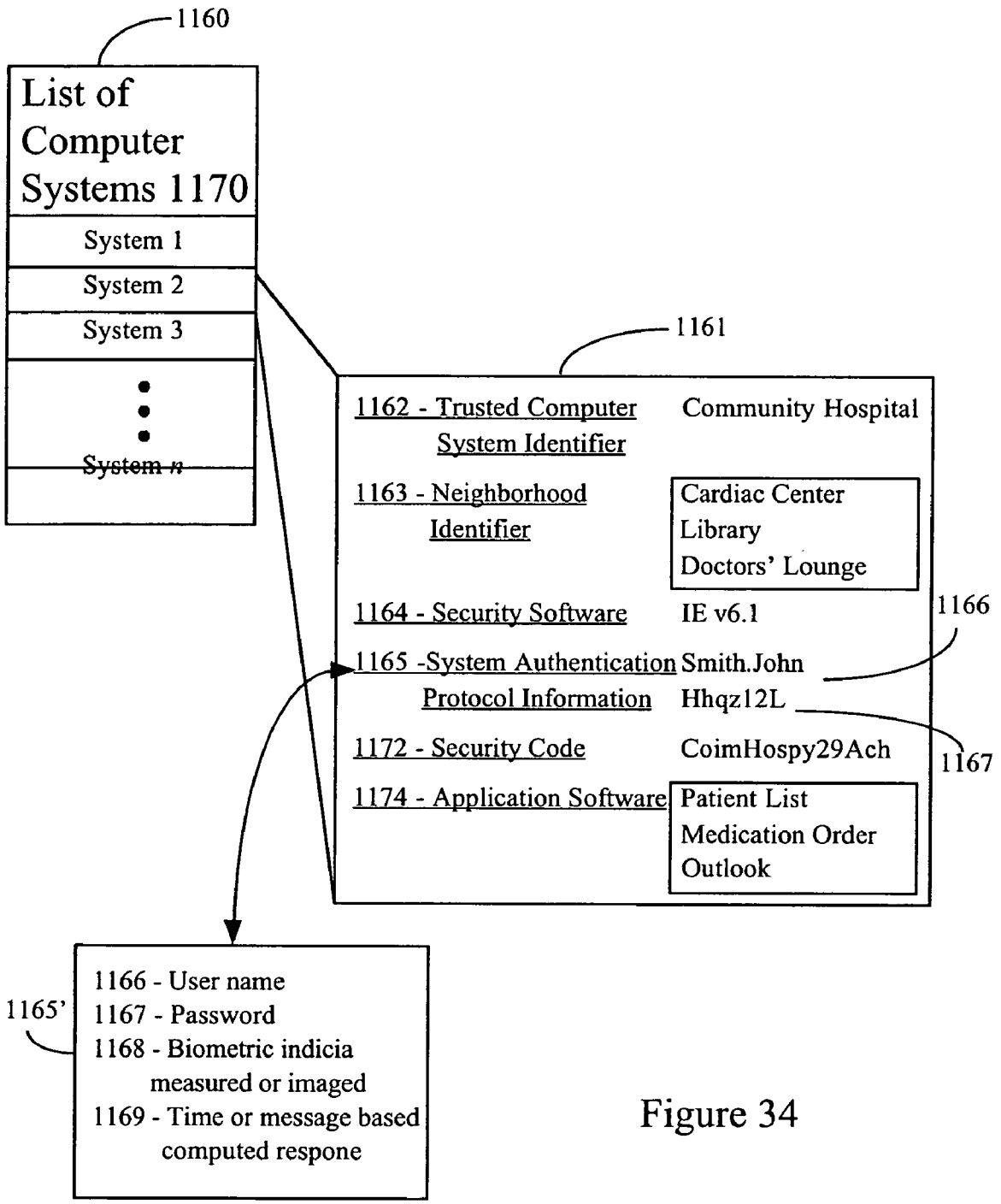

1160
List of Computer Systems 1170
System 1
System 2
System 3
System n
1161
1162 - Trusted Computer System Identifier
Community Hospital
1163 - Neighborhood Identifier
Cardiac Center
Library
Doctors' Lounge
1164 - Security Software
IE v6.1
1166
1165 -System Authentication Protocol Information
Smith.John
Hhqz12L
1167
1172 - Security Code
CoimHospy29Ach
1174 - Application Software
Patient List
Medication Order
Outlook
1165'
1166 - User name
1167 - Password
1168 - Biometric indicia measured or imaged
1169 - Time or message based computed respone

Figure 34

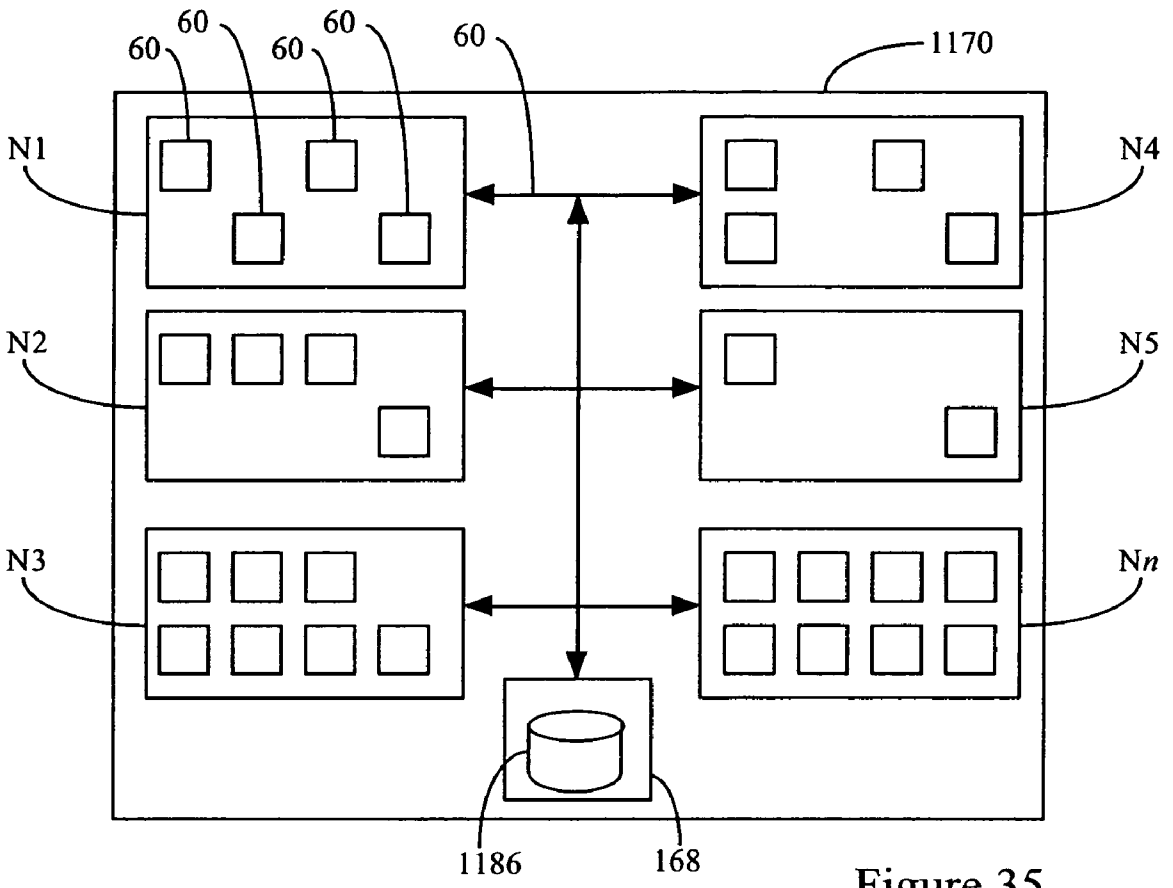


Figure 35

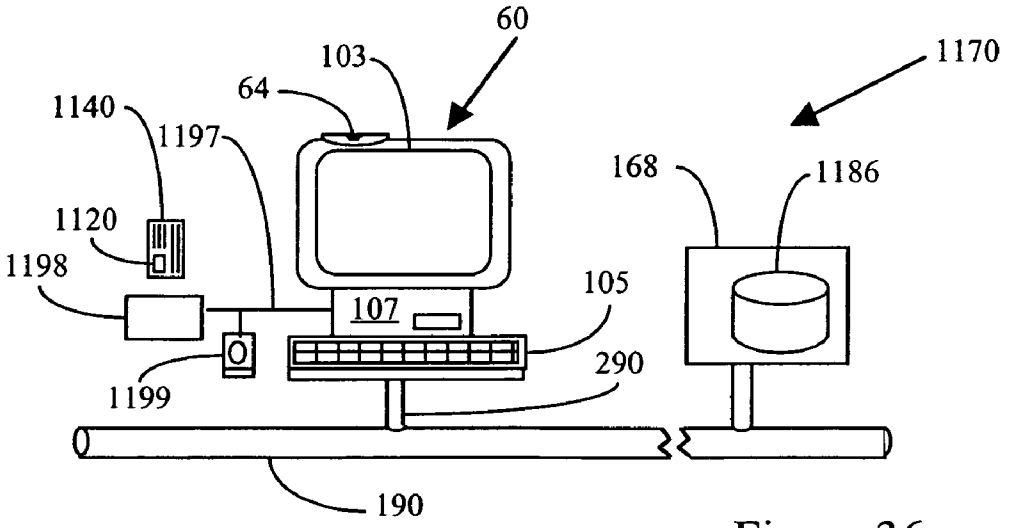


Figure 36

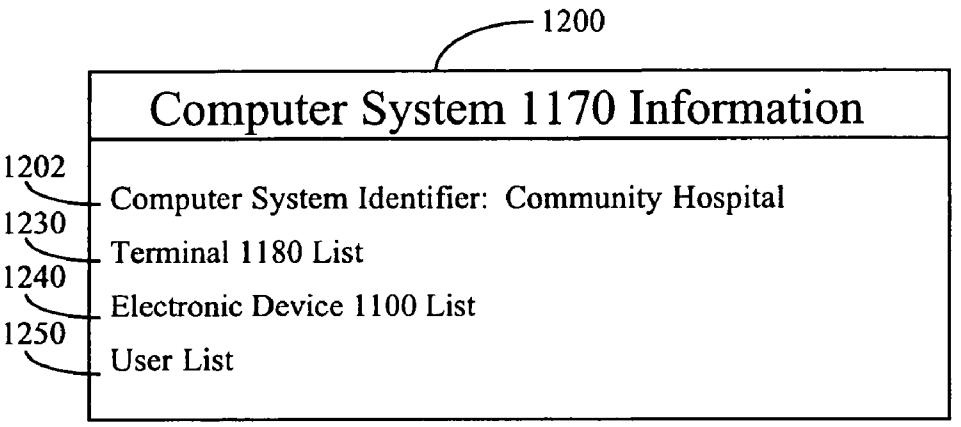


Figure 37

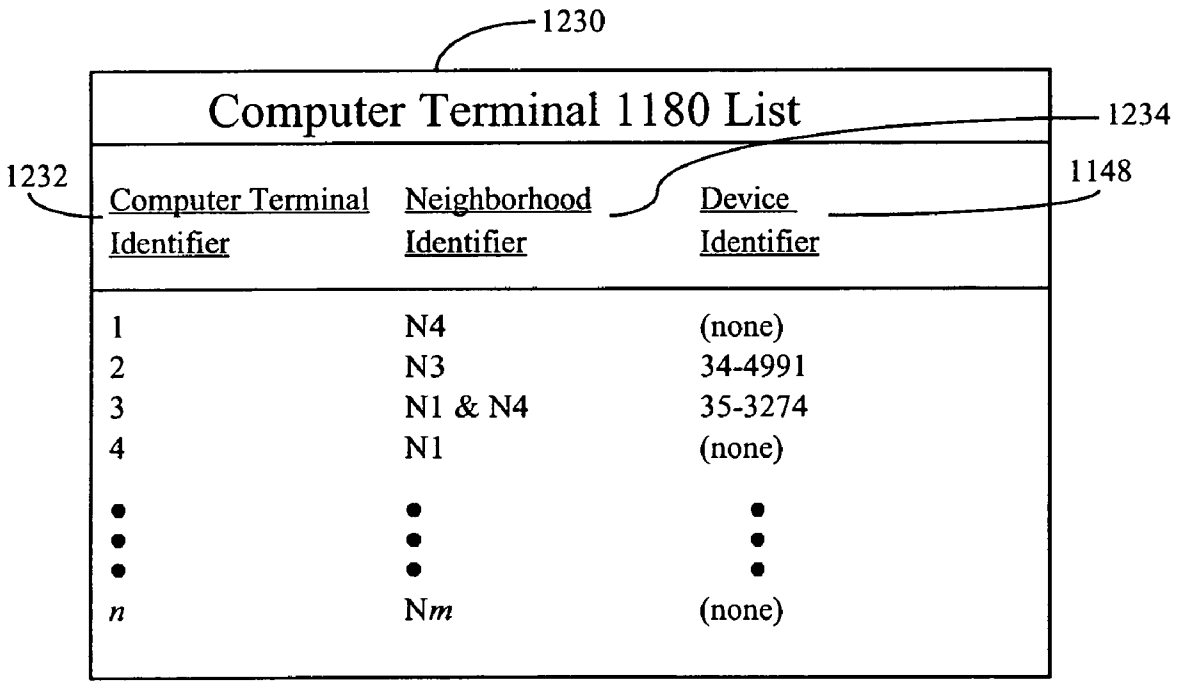


Figure 38

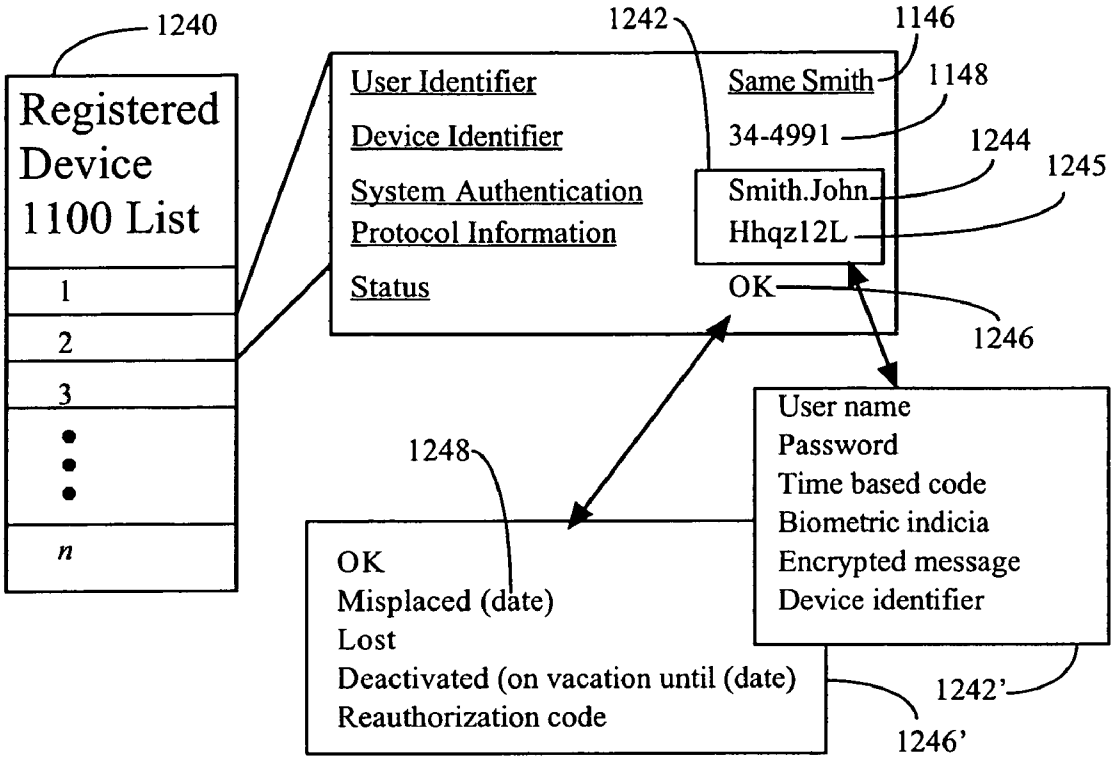


Figure 39

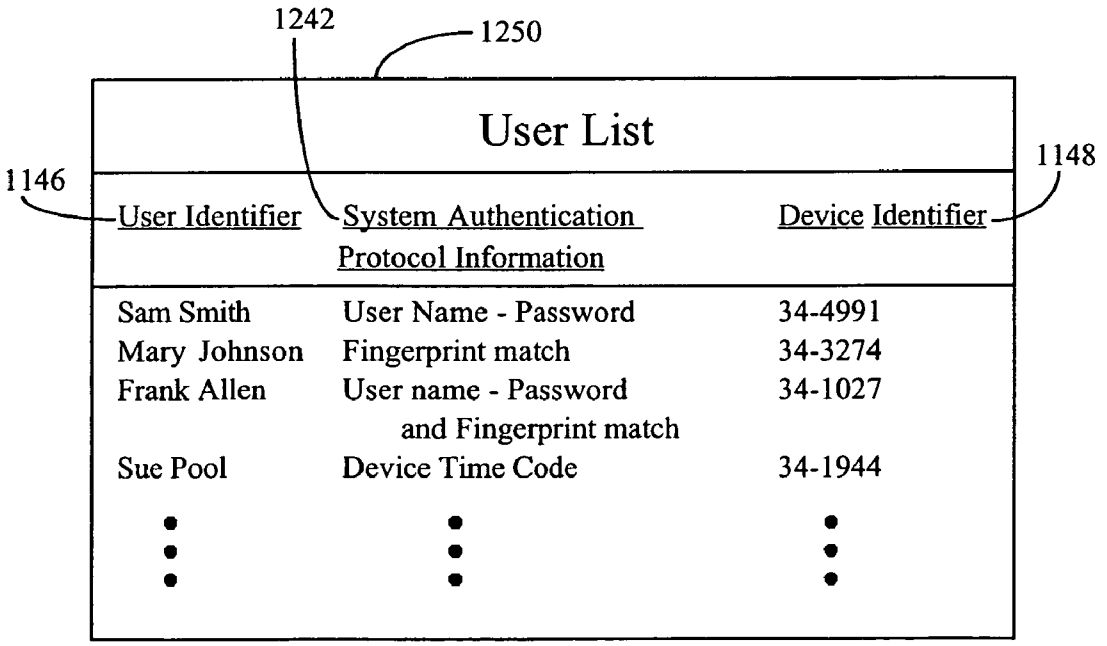


Figure 40

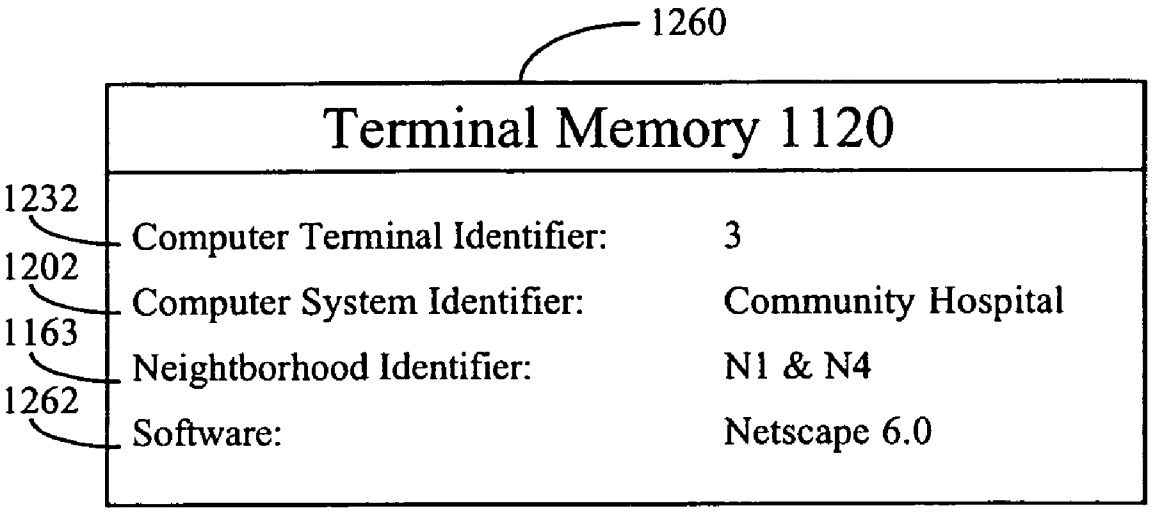

1260
Terminal Memory 1120
1232
Computer Terminal Identifier: 3
1202
Computer System Identifier: Community Hospital
1163
Neightborhood Identifier: N1 & N4
1262
Software: Netscape 6.0

Figure 41

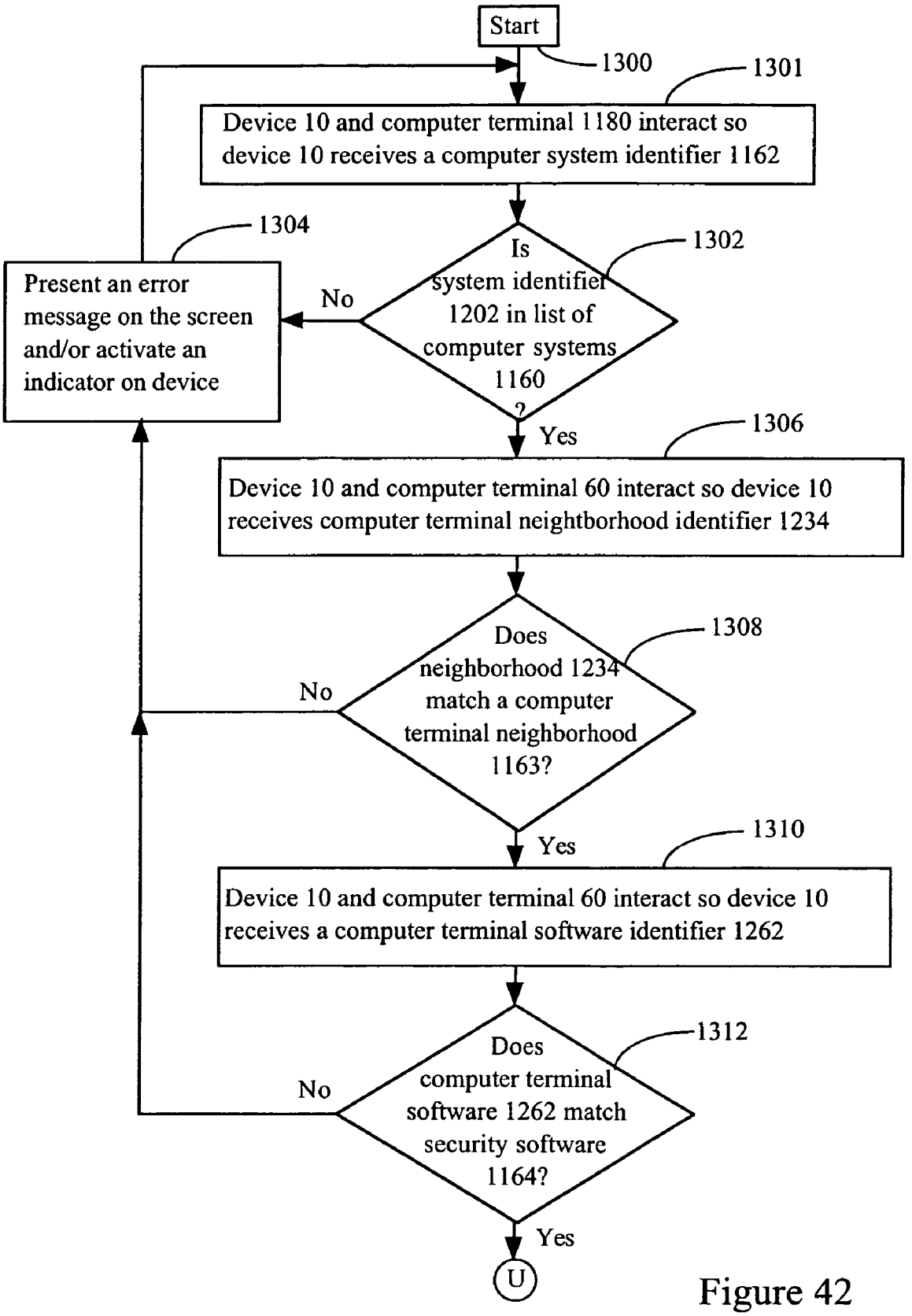

Start
1300
1301
Device 10 and computer terminal 1180 interact so device 10 receives a computer system identifier 1162
1304
1302
Present an error message on the screen and/or activate an indicator on device
No
Is system identifier 1202 in list of computer systems 1160 ?
Yes
1306
Device 10 and computer terminal 60 interact so device 10 receives computer terminal neightborhood identifier 1234
1308
No
Does neighborhood 1234 match a computer terminal neighborhood 1163?
Yes
1310
Device 10 and computer terminal 60 interact so device 10 receives a computer terminal software identifier 1262
1312
No
Does computer terminal software 1262 match security software 1164?
Yes
U

Figure 42

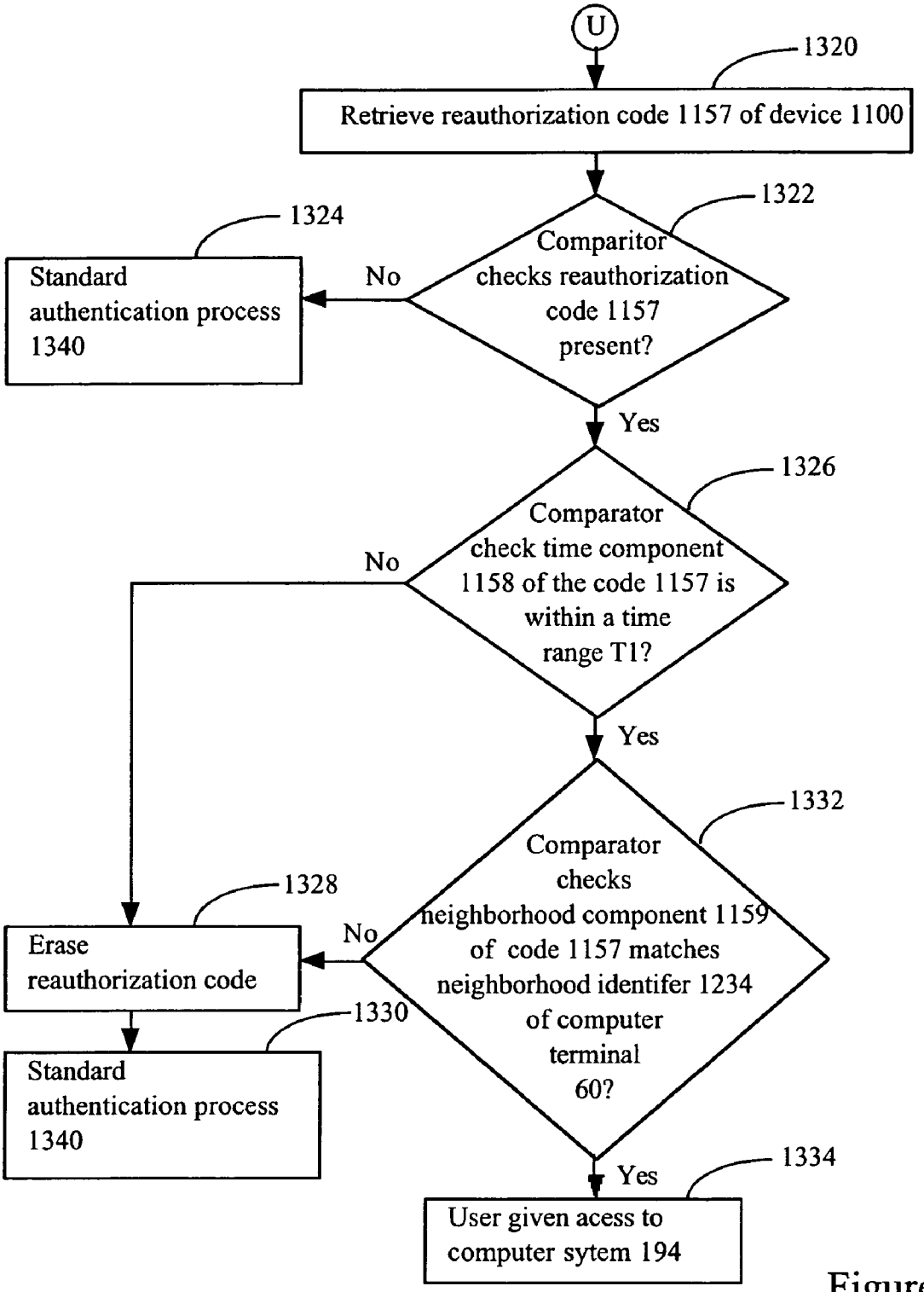

U
1320
Retrieve reauthorization code 1157 of device 1100
1322
Comparitor checks reauthorization code 1157 present?
No
1324
Standard authentication process 1340
Yes
1326
Comparator check time component 1158 of the code 1157 is within a time range T1?
No
Yes
1332
Comparator checks neighborhood component 1159 of code 1157 matches neighborhood identifer 1234 of computer terminal 60?
No
1328
Erase reauthorization code
1330
Standard authentication process 1340
Yes
1334
User given acess to computer sytem 194

Figure 43

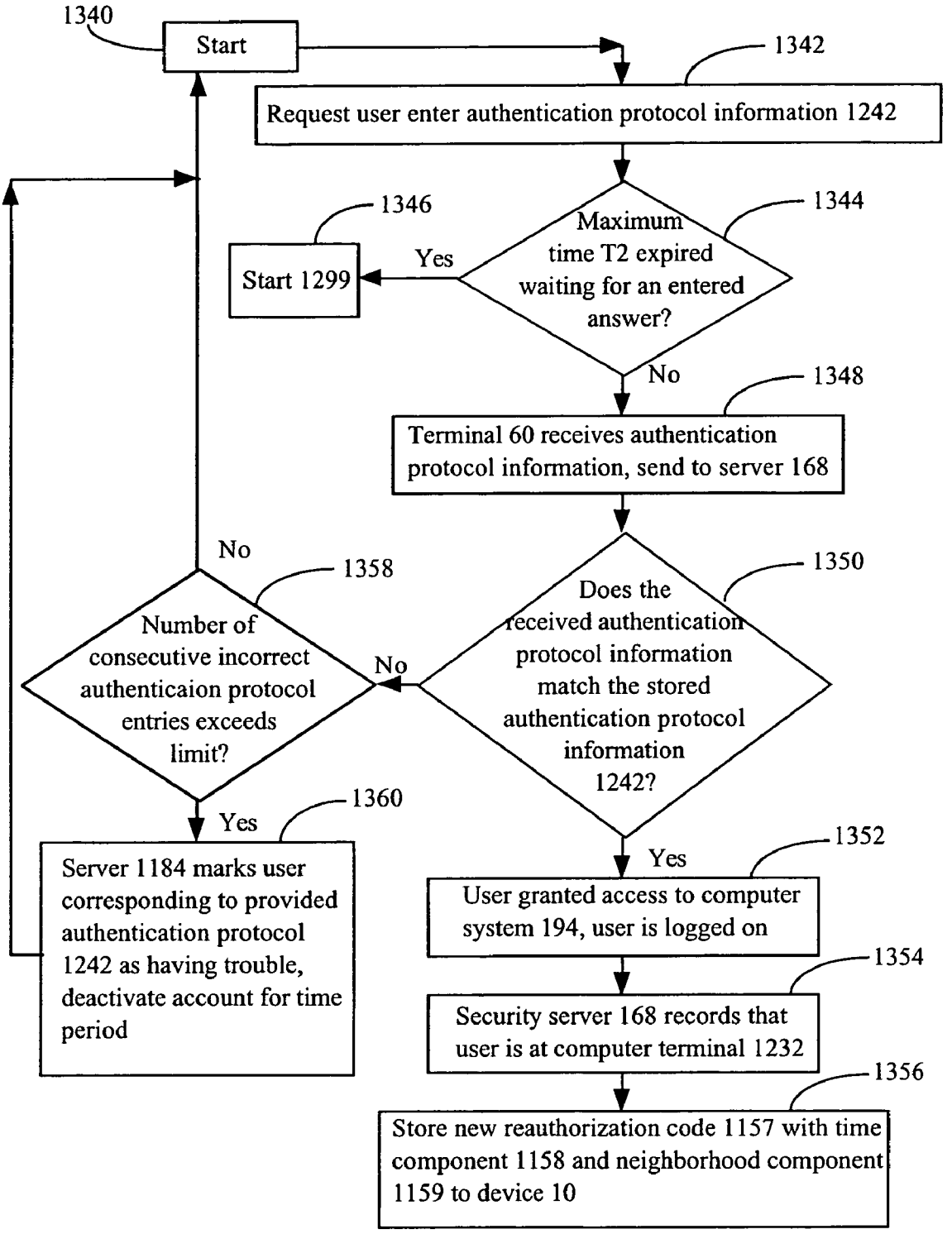

1340
Start
1342
Request user enter authentication protocol information 1242
1344
Maximum time T2 expired waiting for an entered answer?
Yes
1346
Start 1299
No
1348
Terminal 60 receives authentication protocol information, send to server 168
1350
Does the received authentication protocol information match the stored authentication protocol information 1242?
No
1358
Number of consecutive incorrect authenticaion protocol entries exceeds limit?
No
Yes
1360
Server 1184 marks user corresponding to provided authentication protocol 1242 as having trouble, deactivate account for time period
Yes
1352
User granted access to computer system 194, user is logged on
1354
Security server 168 records that user is at computer terminal 1232
1356
Store new reauthorization code 1157 with time component 1158 and neighborhood component 1159 to device 10

Figure 44

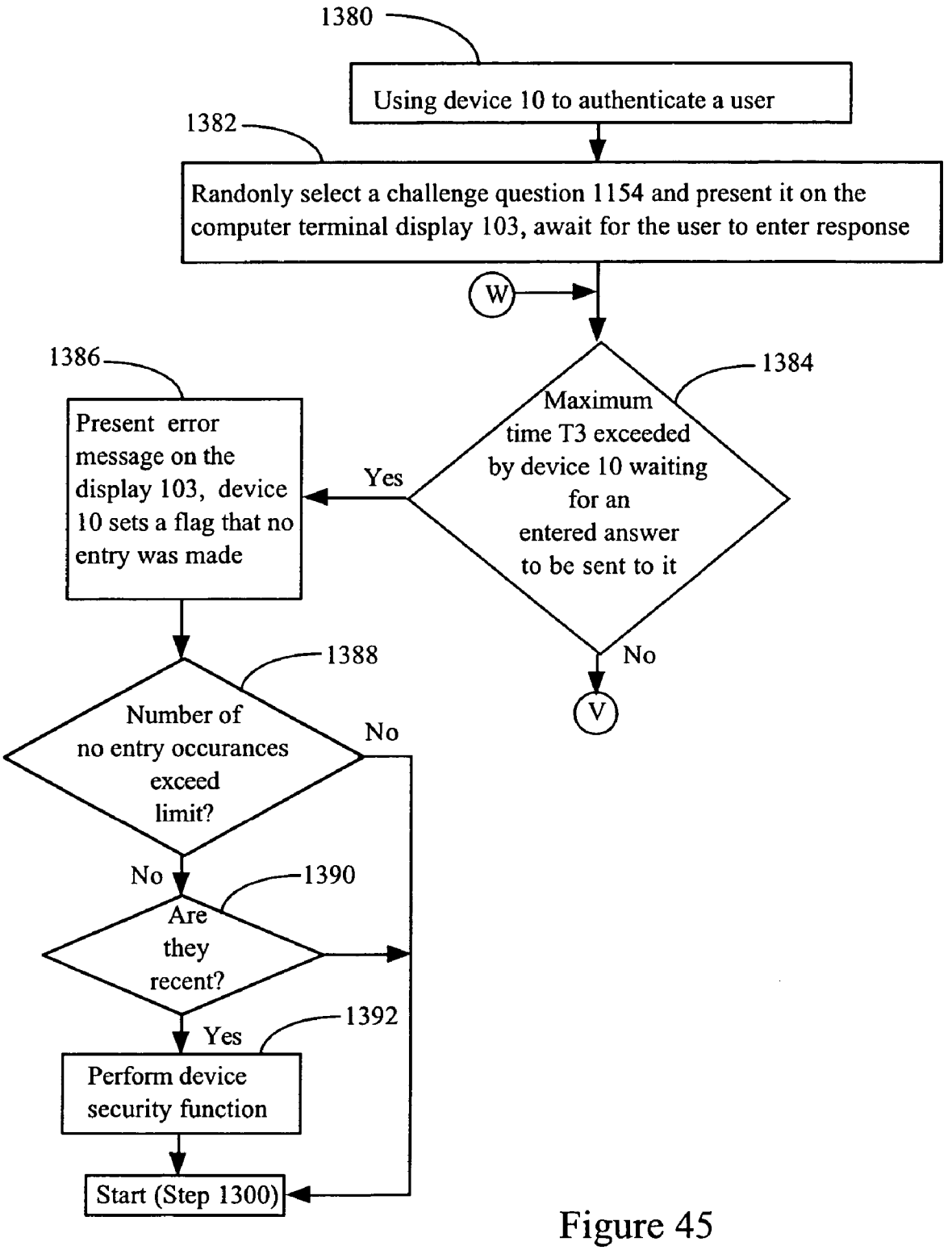

1380
Using device 10 to authenticate a user
1382
Randonly select a challenge question 1154 and present it on the computer terminal display 103, await for the user to enter response
W
1384
Maximum time T3 exceeded by device 10 waiting for an entered answer to be sent to it
Yes
No
1386
Present error message on the display 103, device 10 sets a flag that no entry was made
V
1388
Number of no entry occurances exceed limit?
No
No
1390
Are they recent?
Yes
1392
Perform device security function
Start (Step 1300)

Figure 45

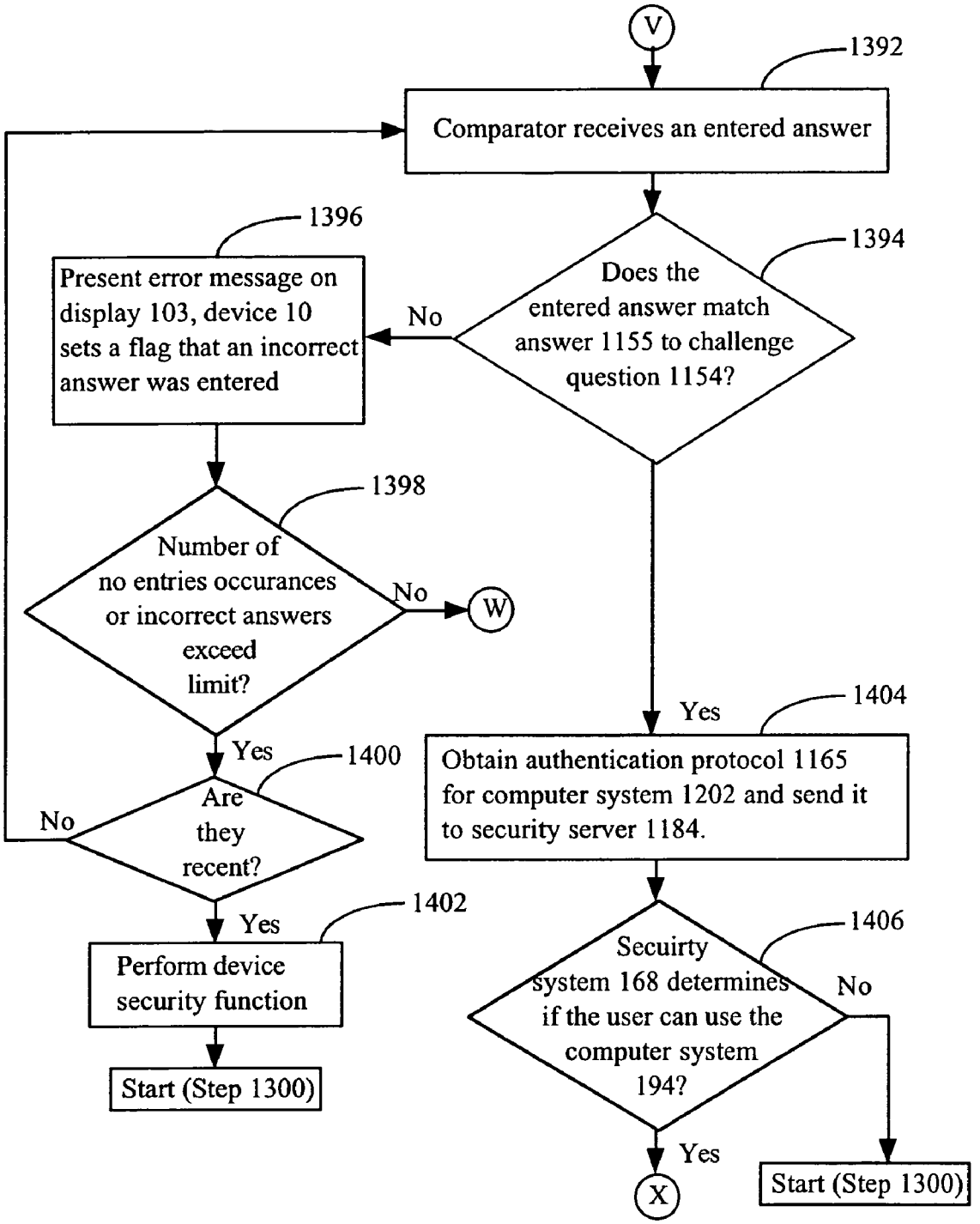

V
1392
Comparator receives an entered answer
1396
Present error message on display 103, device 10 sets a flag that an incorrect answer was entered
No
1394
Does the entered answer match answer 1155 to challenge question 1154?
1398
Number of no entries occurances or incorrect answers exceed limit?
No
W
Yes
1400
Are they recent?
No
Yes
1402
Perform device security function
Start (Step 1300)
Yes
1404
Obtain authentication protocol 1165 for computer system 1202 and send it to security server 1184.
1406
Secuirty system 168 determines if the user can use the computer system 194?
No
Yes
X
Start (Step 1300)

Figure 46

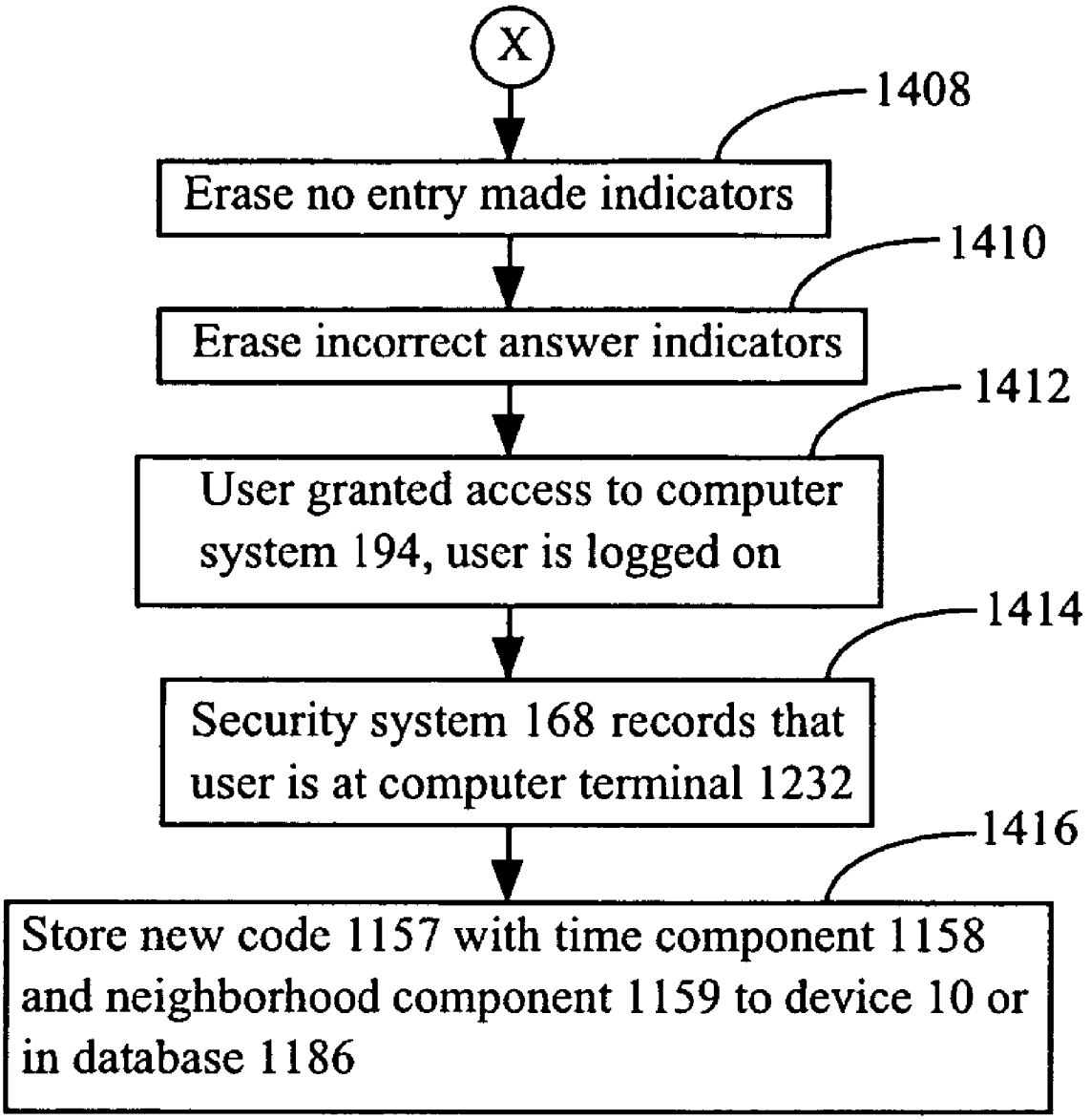

X
1408
Erase no entry made indicators
1410
Erase incorrect answer indicators
1412
User granted access to computer system 194, user is logged on
1414
Security system 168 records that user is at computer terminal 1232
1416
Store new code 1157 with time component 1158 and neighborhood component 1159 to device 10 or in database 1186

Figure 47

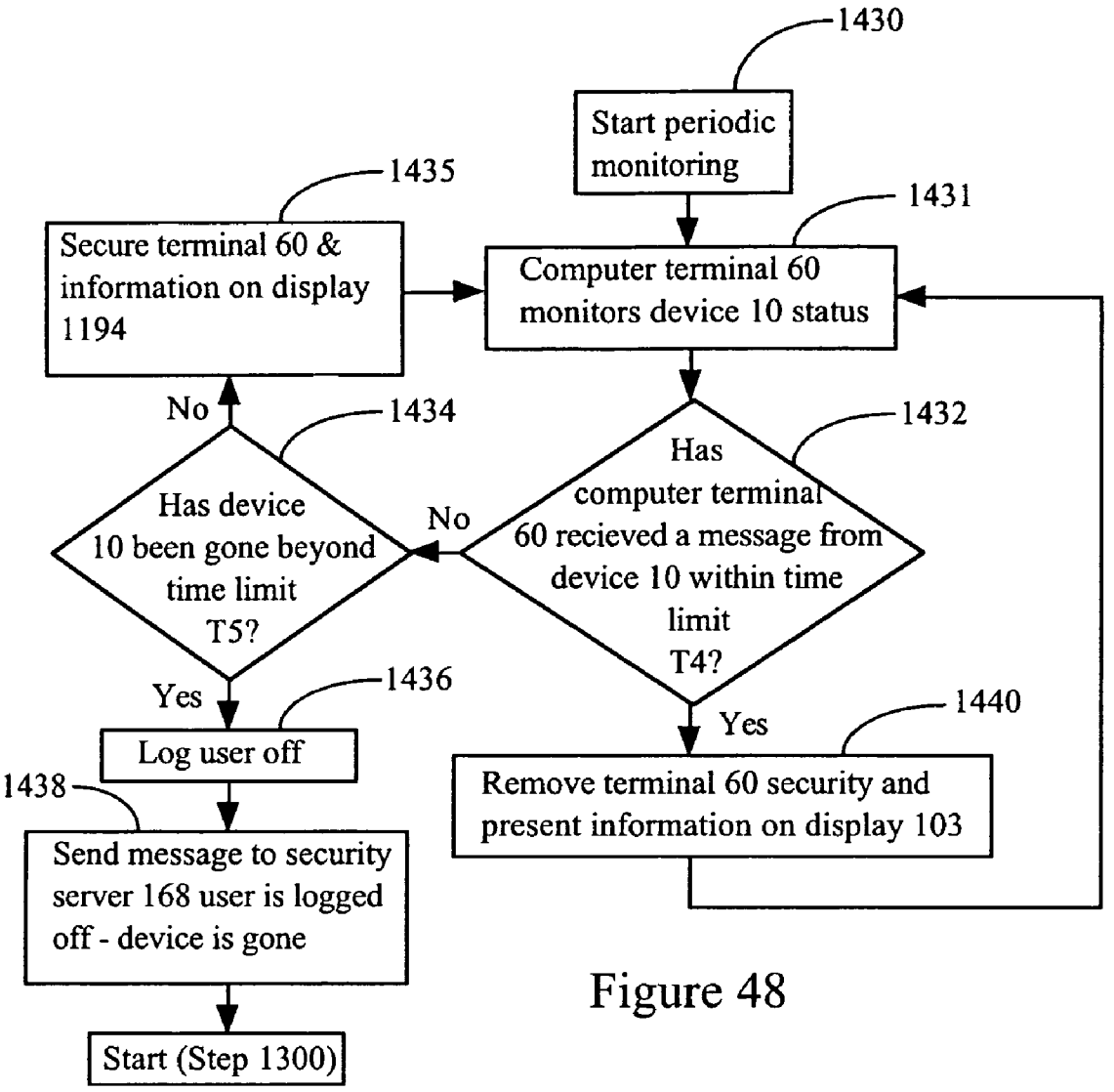

1430
Start periodic monitoring
1431
Computer terminal 60 monitors device 10 status
1432
Has computer terminal 60 recieved a message from device 10 within time limit T4?
No
Yes
1434
Has device 10 been gone beyond time limit T5?
No
Yes
1435
Secure terminal 60 & information on display 1194
1436
Log user off
1438
Send message to security server 168 user is logged off - device is gone
Start (Step 1300)
1440
Remove terminal 60 security and present information on display 103

Figure 48

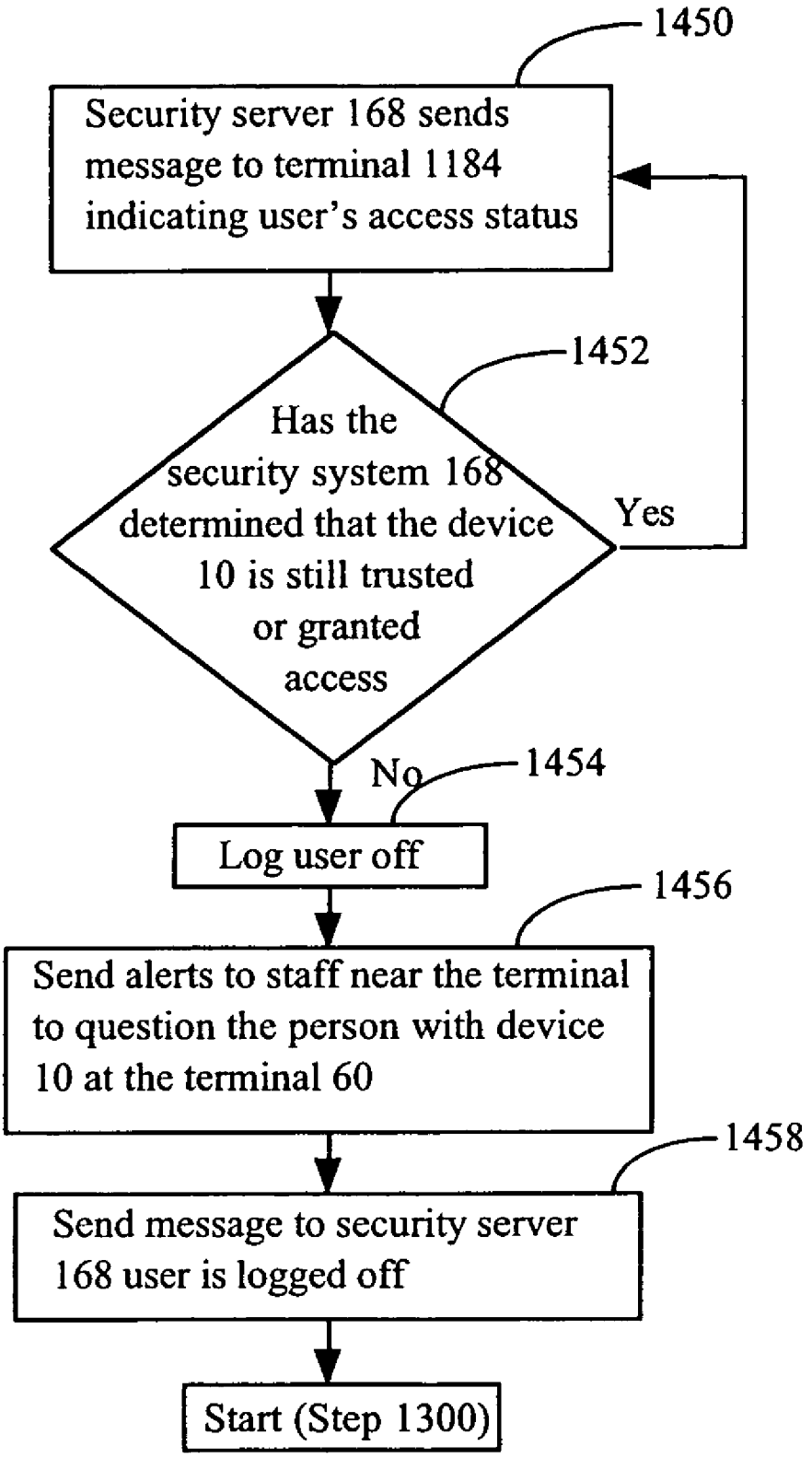

1450
Security server 168 sends message to terminal 1184 indicating user's access status
1452
Has the security system 168 determined that the device 10 is still trusted or granted access
Yes
No
1454
Log user off
1456
Send alerts to staff near the terminal to question the person with device 10 at the terminal 60
1458
Send message to security server 168 user is logged off
Start (Step 1300)

Figure 49

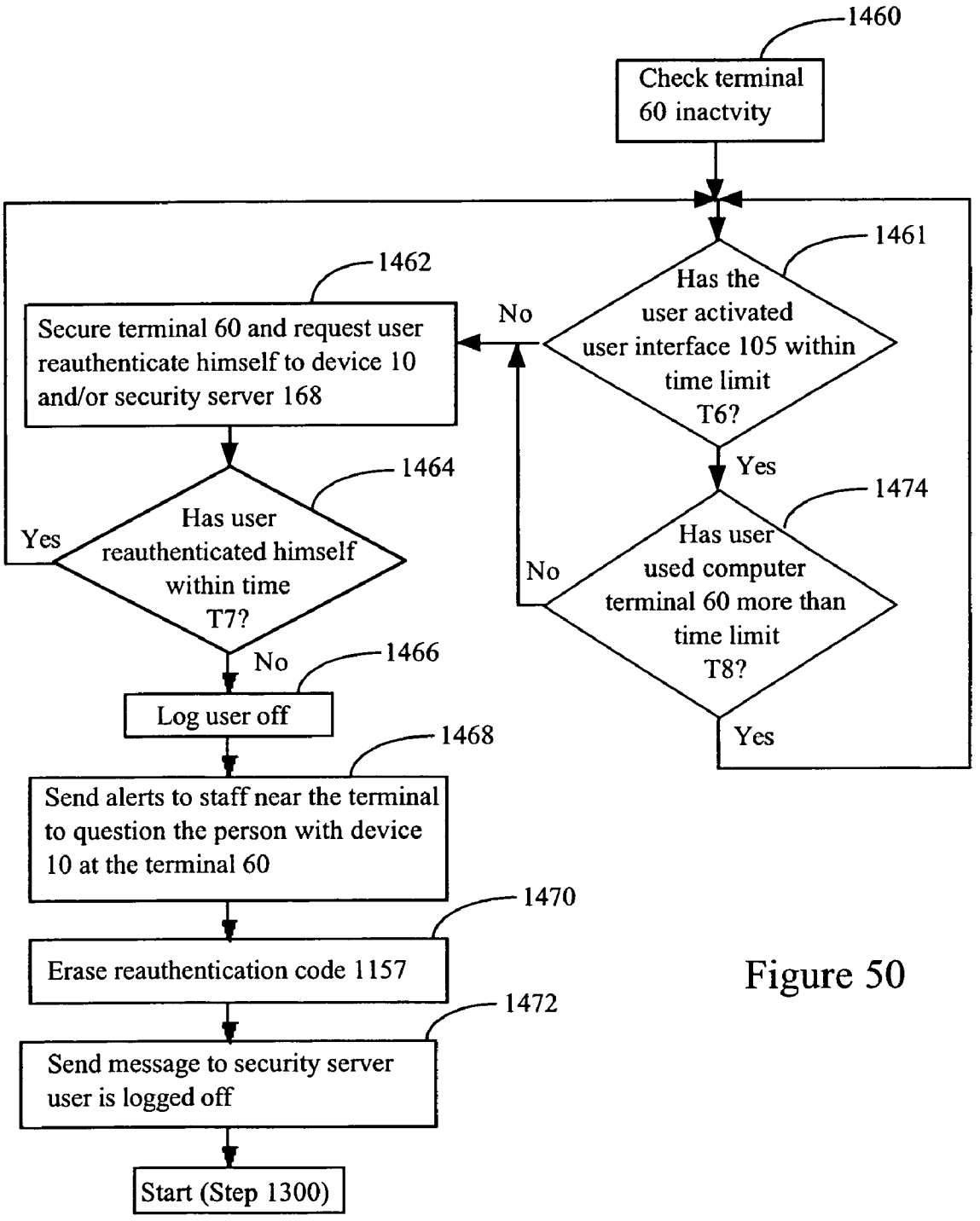

1460
Check terminal 60 inactvity
1461
Has the user activated user interface 105 within time limit T6?
No
1462
Secure terminal 60 and request user reauthenticate himself to device 10 and/or security server 168
Yes
1474
Has user used computer terminal 60 more than time limit T8?
No
Yes
1464
Has user reauthenticated himself within time T7?
Yes
No
1466
Log user off
1468
Send alerts to staff near the terminal to question the person with device 10 at the terminal 60
1470
Erase reauthentication code 1157
1472
Send message to security server user is logged off
Start (Step 1300)

Figure 50

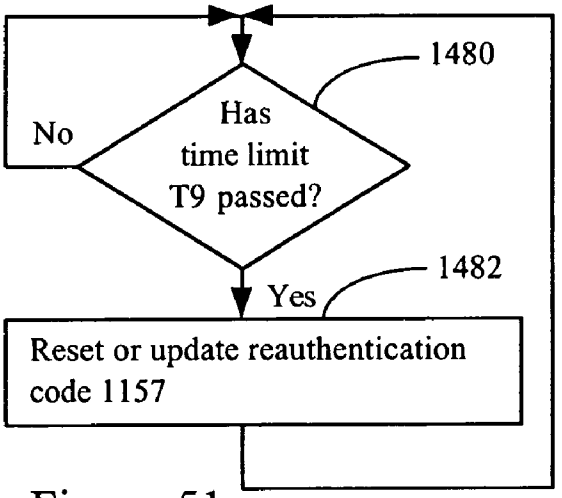


Figure 51

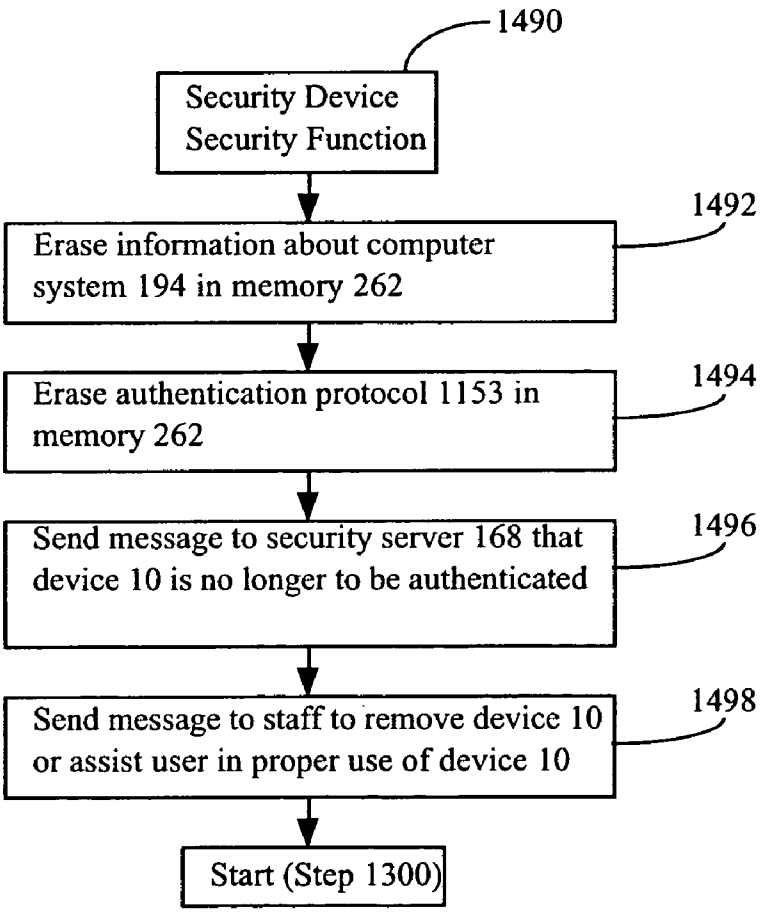


Figure 52

SYSTEM AND METHOD TO AUTHENTICATE USERS TO COMPUTER SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation in part of U.S. patent application Ser. No. 10/127,734 which was filed on Apr. 22, 2002 now U.S. Pat. No. 6,779,024 and is entitled "Data Collection Device System" and which was a continuation in part of U.S. patent application Ser. No. 09/170,169, filed Oct. 13, 1998, now U.S. Pat. No. 6,408,330 entitled "Remote Data Collecting And Address Providing Method And Apparatus" which issued on Jun. 18, 2002 and U.S. patent application Ser. No. 08/834,634, filed Apr. 14, 1997, now U.S. Pat. No. 5,960,085 entitled "Security Badge For Automated Access Control And Secure Data Gathering" which issued on Sep. 28, 1999. Each of the references is incorporated by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

BACKGROUND OF THE INVENTION

The present invention relates to computer systems for the management of information distributed across a plurality of electronic system devices. More particularly, the invention relates to a system which includes a plurality of network servers, interface terminals, remote data collecting devices and other smart devices to facilitate information collection, approval, editing and storage such that the network server storage location of specific information can be specified using a remote collecting device. The invention also relates to record verification methods.

As an initial matter, in the interest of simplifying this explanation and unless indicated otherwise, the description which follows describes the invention in the context of a medical facility. However, it should be recognized that the invention should not be so limited and clearly has applications which are outside a medical facility, only some of which are specifically discussed hereinafter.

In many industries a need exists for remote information collection and information storage which facilitates easy subsequent information retrieval. For example, in medical facilities there is a need, for purposes of patient protection, quality control, record keeping, billing, and forensics, to monitor, control, and record access to medicine dispensation, medicine administration, IVs, blood transfusions, and other treatments as well as the collection, administration, and testing of blood and tissue samples. These events have traditionally been controlled and monitored manually by doctors, nurses and other facility personnel (hereinafter "physicians" generally).

Unfortunately the increasing specialization and complexity of medical care has vastly increased both the types and amount of routine record keeping that is required to track all events which occur in a facility. Advantageously, rapid growth of computer technologies has provided tools which can be used to store and retrieve specific information from a vast quantity of medical records. In particular, Internet technology is now routinely used to create hospital Intranets, link discrete hospital databases and make their data, images, and audio video records commonly accessible.

Most medical facility Intranet systems include a plurality of network servers disposed in either one central information systems department or at various locations throughout the facility, a plurality of computer terminals located throughout the facility and a data bus which links all of the servers and computers together. Software is loaded onto each computer to facilitate information entry and specify server addresses for information retrieval and storage.

The first Intranet systems were used for only very few applications and therefore were not extremely complex. However, over time, as Intranet applications became more numerous and their use as information management tools became more widely recognized, single server systems could no longer meet the information management needs of even a single medical facility. This information management capacity problem has been exacerbated by prolific mergers and acquisitions among medical groups such that many medical groups now have several locations and vast amounts of information to manage.

To facilitate information management on such a huge scale Intranet systems have evolved over time. In most cases, so as to increase management capability without wasting existing capability (i.e. without completely replacing existing servers and computers), instead of replacing entire Intranet systems, additional servers and computers are simply added to an existing Intranet network.

While this piecemeal approach to Intranet enhancement minimizes hardware costs, this approach results in an extremely complex system wherein it is often relatively difficult to direct information to known electronic memory locations (i.e. server storage addresses) which are later easily accessible. While such storage addresses could be manually provided, providing such addresses manually is particularly cumbersome as many addresses are complex and difficult to specify. This is because a single facility or related facilities may employ many different servers and each server may have access to several different memory devices. Addressing schemes have been further exacerbated by the Internet where there may be several thousand servers and it would be impractical for a user to attempt to manually enter every server address used for storage.

To overcome the addressing problem most Intranet servers are equipped to automatically assign server addresses to specific types of user provided information. To this end, a browser is typically loaded onto each Intranet capable computer which communicates with system servers. When a user contacts a server to interact therewith (i.e. to provide information thereto or receive information therefrom), the server sends instructions to the browser indicating what should be displayed on the computer screen. Typically the screen indicates the server which originated the browser instructions, includes hyperlinks to various related server addresses, includes some instructions on how to use the server via the browser and provides blanks for entering information which is to be returned to the server for storage or processing.

In addition the server provides addresses to displayed hyperlinks and for information which is to be entered by a user. Typically the server provided addresses are held in computer memory and not displayed. After the physician indicates that information has been entered or selects a hyperlink, the browser software transmits the information to the server or contacts the server indicated by the hyperlink address.

Where information is sent to a server, when the server receives information the server may do any of a number of different things including storing the information at a server address or some type of processing and sending additional instructions to the browser. Where a user selects a hyperlink the server indicated by the hyperlink address responds to the

selection by providing a different set of browser instructions for configuring the browser screen.

For example, in the hospital environment a first browser screen might display several user selectable hyperlinks for entering different types of information into the system and no blanks for entering information. For instance, a first hyperlink may be to a pharmacy server to request a screen presentation to enter pharmacy information, a second link may be to a billing server, a third link may be to a patient history server and a fourth link might be to a prescription server. In this case, to enter information the user first has to select one of the hyperlinks.

When a hyperlink is selected, the server indicated by the hyperlink address provides instructions to the browser for configuring the browser screen. For example, a server used by a pharmacy may provide instructions to configure a screen including, along with instructions for filling in blanks, a first blank for entry of a patient's name, a second blank for entry of a physician's name, a third blank for entry of a dispensed drug and a quantity indicator and a fourth blank for entry of the dispensing date and time.

After a physician indicates that required information has been provided, the browser transmits the information to the pharmacy server. When the server receives the information the server stores or processes the information and then typically returns a message indicating that the information has been stored or processed.

After a pharmacy-record has been stored, when a pharmacist reviews records on the pharmacy server the pharmacist can verify, among other things, that a specific prescription was dispensed, the date and time of dispensing, which patient received the prescription and which physician dispensed the prescription.

To enter some other type of information such as billing information, using the first screen, a physician might select a second billing server hyperlink. When the second hyperlink is selected, the billing server provides screen configuration instructions and a return target address for information to be returned to the server for storage. The browser displays the billing input screen and waits for the physician to indicate that information has been provided. Thereafter the provided information is transmitted to the server at the target address and is either stored or processed. In this manner all information addressing and control is facilitated by the servers, not the system user.

While such information receiving and addressing systems can meet the information gathering needs of some facilities, such systems have a number of shortcomings. First, information gathering and entry into such a system is extremely time consuming and therefore is often thought of as an onerous task which is to be avoided. For example, in a medical facility, when a physician makes her rounds, the physician may visit with twenty or more patients, performing examinations and procedures, diagnosing illnesses and prescribing and administering drugs. Each visit requires information gathering related to symptoms, diagnosis, prescription, procedures and examinations performed and drugs prescribed and administered. When this information is gathered via a pen and clip board, the information must later be entered into the system and stored at a specific and accessible location,

Most physicians are not particularly adept at data entry. In addition, most physicians are extremely busy and therefore do not have the time to personally enter written information into a system via a browser. For these reasons either information is never entered into a system or a person specifically earmarked for data entry is required. While a data entry person may be expensive, the alternative (i.e. not entering the information into a searchable form) is not acceptable as information must be properly archived.

Second, even where a data entry person is provided, under the press of time many physician's have developed their own, personalized shorthand to expedite note taking during patient visits. In addition, often physician's writing styles are very different making it difficult at best to decipher hand written records during data entry. Shorthand and sloppy or varying writing styles make data entry by someone other than a physician extremely difficult.

Third, when information is entered into a system manually by someone other than a physician, the likelihood of mistakes is extremely high due to imperfect translation of handwritten notes, the fact that entry personnel typically are not trained in medical terminology and the fact that many medical terms are very similar, thereby increasing the likelihood that one term may be substituted for another.

Fourth, because tolerance for errors in medical records is extremely low, there should be some way to force physicians to check the accuracy of system records prior to allowing permanent storage. The present server/browser systems do not require physician approval of records prior to storage. In other words, in many cases a data entry person may enter a physician's notes and the physician may never check the notes for accuracy.

Fifth, even when someone other than a physician enters information into a system and a physician intends to revisit the information prior to permanent storage to check accuracy, despite the importance of record review, because of the press of time, record review by physicians is typically low on a physician's priority list. Where a physician allows even a few days to pass prior to reviewing information for approval, a physician's recollection of what transpired during a patient visit may not be accurate and information errors may result.

Sixth, even where a physician takes on the task of entering all information into a system to ensure quality control, the task of moving about from one browser screen to another to input information which is directed to correct server storage locations is onerous where many different records have to be entered and stored. For example, a physician may collect twenty different records while making rounds. Five of the records may have to be stored in patient record's on a patient history server, five records may have to be stored on a pharmacy server, five records may have to be stored on a billing server and the remaining five records may have to be stored on an inventory server. In this case, the physician would have to jump from one browser screen to another during data entry to enter the twenty records into the system. While this simple task might not be objectionable where there are only a few records, clearly, as the number of records which a physician is expected to make increase, the task of jumping among different browser screens becomes more taxing.

Seventh, in many cases some information may have to be provided to many different servers and therefore might have to be entered by a physician or a data entry person more than once. For example, where a drug is prescribed for a patient drug dispensation and administration information may have to be provided to many different servers for different purposes. A pharmacy server may require an administration record to ensure that a drug has been delivered, a billing server may require a record of dispensation for billing purposes, a patient record server may have to be updated to indicate that the drug was received, when the drug was received, the quantity of the drug received, the physician who administered the drug and so on, an inventory server may require an administration record to update an inventory list and automatically order drugs to meet anticipated requirements, etc. To provide

all of these records to all of the servers, a physician would have to access four different browser screens, a separate browser screen for each server, and duplicative information would have to be entered to be delivered to each server.

Eighth, typical systems do not make any record of who approved information entered into a system and therefore there is no way to determine if an authorized physician approved a record or some clerical personnel accidentally approved a record before storage.

Various electronic devices have been developed to aid in the information gathering task. One handy information gathering device is the dictation device (DD) which can be used to record a physician's audio (i.e. voice) notes during a patient visit. To this end, a typical DD includes a processor, a memory (typically an electronic memory), a microphone, a speaker and some type of activation button. To take audio notes a physician positions the activation button in a record position and speaks into the microphone, the processor recording all voice notes in the memory. DDs often also allow audio review of oral notes and re-recording features to correct mistakes.

In facilities where physicians regularly use DDs, recorded notes are provided to data entry personnel who manually type audio records into an Intranet computer terminal for storage on a server. In the alternative, recently some software has been developed which can automatically convert audio records into text files for digital storage.

While DDs are preferred by some physicians, DDs do not overcome many of the shortcomings of manual (i.e. pen and paper) record keeping which are discussed above. For example, unless a system includes voice recognition software, data entry personnel are still required, physician shorthand causes transcription problems for both a data entry person and transcription software, mistakes may be made during transcription due to imperfect dictation and complex medical terminology, there is no procedure to ensure that information accuracy is checked or to indicate who approved information prior to permanent storage and it takes a large amount of time to enter information into the system.

Another handy information gathering device is a hand held device (HHD) which streamlines the information gathering process and the process of entering information into an Intranet system. To this end, a typical HHD may include a keyboard or the like, a processor, a memory and a transmitter. The board takes the place of a conventional clip board and is used to manually and remotely enter information which the processor stores in the memory. After information has been entered via an HHD, to provide the information to the system, the HHD transmitter is positioned in close proximity to a computer input device and the information is transmitted to the input device via a message including a series of signals.

To intelligibly receive a transmitted message and provide information contained therein to a browser for ultimate delivery to a server for storage or processing, a message receiving computer must be capable of translating the transmitted message into the language used by the server which is typically the hypertext markup language (HTML). This task is accomplished in one of two ways. First, the input device may include special dedicated hardware which converts the message into HTML, the hardware resembling a disk drive in the way it interacts with a browser. Second, the input device may simply provide the received message to the computer processor and software loaded onto the processor might be designed to translate the message into HTML.

Thus, HHDs can be used to eliminate physician's hand written notes thereby streamlining the data gathering/entry process. In addition, as a physician enters information into an HHD, the physician can approve entered information immediately eliminating the need to later revisit the information for approval.

While HHD technology goes a long way to solving many of the problems associated with remote information gathering, problems still exist. First, it is likely that physicians will object to having to manually enter information into an HHD for the same reasons that physicians object to entering information into regular computer terminals. In addition, with an HHD information entry is even more objectionable because most HHD keyboards are relatively small.

Second, patient's will likely object when they perceive that a physician's time during a visit is split between the patient and an HHD for information entry. This is particularly true in the case where it might be difficult to enter information into the HHD thereby requiring additional data entry time.

Third, even if there were some quick way to enter information into an HHD, transmission of the information from the HHD to a browser and ultimately to a server for storage or processing is a relatively complex task. For example, assuming five records are stored in an HHD for transmission to a browser and that each of the five records is different such that each record ultimately has to be stored on a different server. In this case, prior to transmitting each record to the browser, the physician would have to select the proper browser screen for data transmission. For example, if the first record is to be stored on a pharmacy server, the physician has to select the pharmacy browser screen prior to transmitting the first record. After the first record is transmitted to the browser the browser then provides the record to the pharmacy server which is associated with the screen. Next, assuming the second record is to be stored on the a billing server, the physician has to select the billing browser screen prior to transmitting the second record. After the second record is transmitted the browser provides the record to the billing server. Not only is this process cumbersome, but the HHD would have to have some mechanism which indicated to the physician which record is queued up for transmission so that the physician could select the proper browser screen and associated server address.

Fourth, conventional HHDs do not indicate who approved a record for ultimate storage.

Fifth, again, where duplicative information must be provided to several different servers, a physician has to separately select a browser screen associated with each server and transmit the information to be stored once for each server which is to receive the information. This is time consuming and therefore objectionable.

Some HHDs have been designed to facilitate a pseudo-addressing scheme whereby an ultimate server target address can be selected for some specific types of HHD information. For example, some HHDs allow a user to enter an E-mail address for a message to be delivered via an Intranet or Internet system.

At first blush an HHD which specifies a pseudo-address appears to overcome many of the problems associated with transferring information from an HHD to a server for ultimate storage. Thus, if server addresses can be specified, a single generic browser screen can be used as an intermediary between an HHD and servers, the HHD, not the servers, specifying where HHD information should ultimately be delivered for storage or processing.

Unfortunately, instead of simplifying the information management task, pseudo-address specifying HHDs add a new wrinkle of complexity to a browser system. To this end, while existing address specifying HHDs can provide both information (i.e. a message in the case of E-mail) and an ultimate

target address, a dedicated "clearing house" server is required for a number of purposes. First, because the HHD cannot specify configuration of a browser screen, a clearing house server is required for screen configuration.

Second, because Intranet addresses are often extremely complex and difficult to manually specify, to simplify address specification, HHD provided addresses usually take a short hand form which in and of itself cannot be used by a browser to direct information to a specific server. The short hand address is provided to the clearing house server via the browser. Thereafter, the clearing house server uses the short hand address to formulate a more detailed target address specifying a different server for message delivery. Thus, the clearing house server must have some clearing house software for processing received information.

Third, in addition to providing browser screen configuration information, the clearing house server also has to specify the clearing house server address so that HHD information and the short hand target address are provided to the clearing house server for further distribution.

In short, even where an HHD can provide a pseudo-address for targeting information, a dedicated clearing house server with special processing software is required.

To appreciate the added wrinkle of complexity in systems which facilitate pseudo-address specification, consider an exemplary system including HHDs which can specify E-mail messages and associated pseudo-addresses. In this case, to provide an E-mail message to an Intranet, an HHD user must first select an E-mail browser screen via a computer. When the E-mail screen is selected, the computer communicates with an associated E-mail server which provides information to the browser including screen configuration information and the E-mail server address. The browser thereafter displays a properly configured screen for receiving information from the HHD.

Next, the HHD user positions the HHD in close proximity to a computer input device and transmits the E-mail message, including E-mail address, to the browser. The device provides the message and E-mail address to the browser which in turn transmits the message and E-mail address to the E-mail server specified by the server address associated with the screen. When the E-mail server receives the message and E-mail address, the E-mail server uses the E-mail address to form a relatively more complex address specifying the target for the E-mail message and then transmits the E-mail message to the more complex address and intended recipient. Clearly this system is more complex than a typical Intranet system as a dedicated clearing house server is required for both screen configuration and additional processing.

One advantage of conventional paper type reporting systems is that original documents can be authenticated simply via a personal signature. Thus, to determine authenticity an original document can be located and a signature examined.

Unfortunately, often original documents cannot be located for authentication. Because copies are easy to manipulate (e.g. signature cut and paste and general information modification), document copies usually cannot be relied upon for verification of their content. Usually, the only reason copies are relied upon is because original documents cannot be retrieved.

Document authentication problems are further exacerbated in the digital realm as document modification and signature picture cutting and pasting is relatively easy using standard computer functions. Thus, for example, where a document is transmitted from one computer to another and includes some type of signature picture, it would be advantageous to have some way to authenticate the content of the received document.

One solution to this authentication problem is described in U.S. Pat. No. 5,689,567 (the "'567 patent") which is entitled "Electronic Signature Method and Apparatus," which issued on Nov. 18, 1997. In the '567 patent, to enable document authentication of a digitally stored document which is subsequently accessed, prior to storing the document, a digital signature picture is encrypted as a function of the document content and is further encrypted as a function of a private (i.e. secret) key. The encrypted signature picture and document are stored.

Thereafter, when the document is reaccessed, the signature picture is decrypted using a public key and as a function of the document content thereby generating the document including a signature picture. Where the document is authentic, the resulting signature picture matches the original signature picture. Authentication is performed by visually comparing the resulting signature picture to the original signature picture.

While the '567 patent invention is useful, the '567 invention has a number of shortcomings. First, after a document is retrieved and decrypted, often it will be useful to store the document in a more accessible form such as in the form of a conventional word processor document, spread sheet, etc. In this case, after the initial decryption, there is essentially no way to subsequently authenticate a document. Thus, for instance, after a word processor document is generated and stored in decrypted or plain text form, the document may not again be accessed for a long time (e.g. years). The next time the document is accessed, because of the passage of time, it may be desirable to re-authenticate. The '567 reference does not facilitate re-authentication.

Second, it is often advantageous to generate a hard copy (i.e. paper) of a digital document for more conventional storage or conveyance to another party. Again, the '567 patent facilitates a first authentication by visual comparison but thereafter authentication is impossible. For example, after a paper document with a digital signature picture is generated, the paper document may be stored in a conventional binder-type file for a long time (e.g. 5 years). Thereafter, the paper document may be retrieved for review. When retrieved there is no way to authenticate the document. This problem is exacerbated by the fact that many documents are copied and copies of documents are copied and, as with an original paper document which is digitally signed there is no way to authenticate a copy.

Thus, it would be advantageous to have an information gathering system for remotely gathering information, reviewing and approving information, identifying who generated information and identifying who approved information prior to storing the information. In addition, it would be advantageous if such a system facilitated easy downloading of the information from an information gathering device to a browser for ultimate transmission to a server for storage or processing. Moreover, it would be advantageous if such a system could be used with a conventional Intranet and did not require a dedicated clearing house server or specialized server software. Furthermore, it would be advantageous to have a system which can authenticate either a hard copy or a digitally stored document by simply analyzing information provided on the document.

Many devices and software programs have been developed to improve the security of computers and computer networks. Securing computers and networks is essential to protect confidential information, to prevent fraud, and to ensure that

computers are not compromised by amateur hackers for their entertainment or by terrorists intent on disrupting or endangering public safety.

The public has seen the effects of insecure computer systems in recent years including the mass release of customer credit card numbers, the use of computers by hackers to launch denial of service attacks, and outright theft from e-commerce sites. These and other events threaten to undermine the public's interest in using computers for conducting a variety of online business activities referred to as e-commerce.

Today and for the last thirty years the most prevalent form of security is the use of software to request from a person who wants to use a computer his user name and password. This information is typically sent to a remote security server, which uses the unique user name to look up the corresponding password for that person. Then the entered password is compared with the stored password, when there is a match the person is grated access to the computer, if not they are denied access.

Unfortunately, user name and password schemes can often be overcome by hackers attempting to guess common passwords, e.g. "xxx", "123", blanks spaces, and the default password for many systems "password". In an attempt to fortify passwords, computer users are sometimes required to use long password strings (e.g. at least 8 characters), to use passwords that combine letters with numbers and/or punctuation marks, to change their password every month or so, and to prevent the reuse of a prior password for a year or longer. However, the security improvements are often illusionary; as password get longer, more complicated, or change frequently users tend to write them down, as they can't remember them. The users then leave the written password in a place that is all to often easily found, e.g. taped to the underside of keyboard, in their desk drawer, or other common location.

Another problem with complicated or changing passwords is that users who do not write them down frequently forget them. This results in their not being able to use their computers, which forces them to call the computer system help desk for assistance in recalling their password or resetting their password to allow the user to enter another new complicated password, which they probably will also forget or write down. The user now can continue to work, but the computer help desk staff is thus conditioned to expect a large number of users to forget their passwords. This allows a hacker or other person to attempt to impersonate one of the computer users to gain password information, after all the help desk cannot really verify the identity of the person calling by telephone.

Passwords are also disliked by those users who need to use computers for very short periods throughout the day, forcing them to enter the user name and password (e.g. this may require 15 seconds) in order to view one value or measurement (e.g. this may only take 3 seconds) and then log off. Nurses, physicians, and many factory workers have this problem; effectively spending more time logging on and off of a computer than the time they spend using it. Furthermore for very busy environments, the constant authentication and reauthentication of users can create a drain on network bandwidth and strain the security server.

Once the user has properly entered a password he is typically admonished to logout when leaving the workstation environment to prevent unauthorized access. The system may automatically log a user off after a predetermined period of inactivity. For users who must access the system frequently but intermittently, short inactivity periods for automatic logout will be a source of constant inconvenience. Alternatively, if long inactivity periods are used, another user may inadvertently use the terminal under the previous person's security authorization.

To improve the security of computer systems a number of other technologies have been developed, but are they used in relatively low numbers. One of the most common technologies includes the use of a biometric indicia (fingerprint, iris image, voice, facial image, etc.) that is measured or sensed and sent to a remote security server. The server compares the indicia against a database of indicia for registered users. To speed the process up and to make it more specific, the user is usually requested to enter a user name. Now the server only has to compare the measured or imaged indicia against the stored indicia corresponding to the entered username. In some cases the user may be further asked to enter a password creating what is sometimes referred to as a two factor authentication system.

However, these systems can take a long time to determine if there is a match or not and none of them are perfect. Each tolerates a level of false positives in order to ensure the level of false negatives, which irritate the user by rejecting them, are kept to a minimum. Furthermore these systems can be confused by biometric indicia changes (laryngitis for voice imagers, finger cuts or trauma for fingerprint readers, or shaving facial hair for face detectors). In some environments it is not easy to measure the biometric indicia, for example fingerprints for workers wearing protective gloves (e.g. nurses, those exposed to environmental extremes) or facial features for workers wearing hats or masks (e.g. when the temperature is extremely cold).

In situations where computers users frequently use a computer for a period of time, leave it for a while, and then later user it or another again, biometric indicia measurements can be a substantial drain on the users' time. They spend more time being authenticated than using the computer.

Other technologies used include smart cards with or without proximity detectors and electronic token generators. A smart card can be inserted into a reader attached to a computer, which reads a special code (e.g. time varying codes) and sends that to the security server often with a user name and password, also creating a two factor user authentication. When the user is finished working at the computer they must be careful to remove the smart card otherwise anyone else can use the computer. When a smart card can be detected by wireless proximity means, the user gains access as mentioned but by leaving the computer they can be logged off the computer when the card can no longer be detected. This prevents anyone else form using the computer without authenticating himself. In some cases smart cards are used with biometric indicia to create a three factor user authentication. While smart cards can provide a higher level of security they are at least as time consuming as passwords for workers who use computers for short periods of time, frequently throughout the day.

Electronic token generators are typically calculators that compute time varying codes that are presented to a user via a LCD screen. The user who wants to access a computer uses a terminal to enter their user name, the current code, and sometimes a password as well. This is received by a security server, which compares the code with an algorithm that is unique for the specific user to determine if the user and the entered code match. Token generators are particularly disliked when the user must access computer terminals frequently throughout the day as they must examine the token and enter the long numeric value properly.

Another restricted access system involves the use of user-specific password-generating devices. Typically, a user seek-

ing access to a secure system is presented a code or instruction on a system terminal screen. The user enters the code or the information demanded by the instruction, via manual entry or optical coupling, into his own password generating device. The password generating device then calculates a second code based upon the user's input and an encryption algorithm stored by the device, and displays this second code to the user for entry into the computer terminal or workstation. After the user enters the second code, the computer terminal or workstation then performs a verification check on it to confirm its creation by the password calculator of an authorized user of the computer terminal or workstation. If confirmed, the user is granted access in accordance with the user's system access privileges.

Yet another restricted access system requires a user to insert an authorization card, e.g. a PCMCIA card, into a computer card reader to authorize access and to authenticate information entered at the computer terminal with the users digital signature. One potential weakness of such a system is that a hidden program could present documents for signature without the proper control of the user. Another weakness with these implementations is the relatively high risk that an authorized user will forget to or fail to remove his card in the card reader before he leaves the terminal—a risk that is particularly acute for a nurse or doctor who may have to leave a terminal in emergency situations to attend to a patient's care. Also, the loss of the card will result in a significant inconvenience to the owner and the system administrator.

Lemelson, in U.S. Pat. Nos. 5,202,929 and 5,548,660, discloses an access control system utilizing detection devices such as speech recognition equipment and fingerprint scanners to analyze one or more physical characteristics of a person attempting access to a computer. The system also incorporates physical presence sensors such as motion detectors and limit switches embedded in seat cushions to track the presence of an authorized user so as to prevent continued access to the system when the authorized user leaves or is absent. This system is primarily directed to accessing desktop computer terminals on a sensitive computer network and is not easily adaptable, however, for restricting access to laptops, portable instruments, medical equipment such as respirators, or electronically-controlled medication dispensers. Moreover, the implementation of the Lemelson invention requires a significant amount of detection equipment and analysis software, which may not be adaptable to the cost, space, and portability requirements of many devices for which restricted access and auditing control is desired.

Users and system owners need improved user authentication systems that do not impede the workflow, yet maintain a higher level of security and to do not slow down security servers with constant reauthentications.

BRIEF SUMMARY OF THE INVENTION

The present invention relates to a limited access system for a computer network with a multitude of users. More particularly, the present invention relates to a limited access system providing automatic log-on and log-out for network users by means of coded communications between transceiver devices worn by network users and transceiver devices connected to computer terminals on the network. It also facilitates rapid secondary log on to a computer network by the user provided the secondary log on attempt is within a time range of an initial successful log on.

This invention uses an electronic device to assist computer systems authenticate users. The device may be a smart card with electrical contacts, a wireless proximity identification badge conveniently worn by a user, a PDA, cellular phone, or other acceptable forms. The device is used to assist with the authentication and reauthentication of users to computer systems. In some cases it is also used to authenticate users to computers, to automatically log users off computers upon their departure, and track which users are accessing each computer terminal in a network.

In an initial or basic version, the user has an electronic security device and authenticates himself according to the standard computer security protocol, e.g. a user name and password, biometric indicia, or by using codes in the electronic device itself. When the user has been granted access to the computer terminal a reauthentication code is transferred to the electronic device by a security server or by the local computer terminal. This code includes a time component and may also include a location component. The code is transferred by inserting the device into a reader/writer attached to the computer terminal or via a wireless link when the device is addressed using an identifier associated with the user and owner of the device. The user uses the computer as normal and logs off the computer when they leave.

It should also be noted that the electronic security device can be used to assist in logging the user off the terminal. When the electronic security device is a smart card the user may be logged off by removing it from the reader/writer. When the electronic security device has wireless communication that has a limited range (e.g. 3 m or less) it can be used to log the user off when he moves from the computer terminal beyond the limited range. To do this the computer terminal transmits signals addressed to the device on a periodic basis, which in turn transmits a response signal back to the computer terminal. When the user leaves the area near the computer workstation (e.g. within 3 m) the response signals are not longer received by the computer terminal, which then logs the user off (although a short period of absence may be accepted before the user is logged off). Alternately the security device may periodically or continuously transmit a signal identifying itself with a limited range. Once the user has logged onto the computer terminal the terminal receives signals from the device that it can correlate to the user. When the signals are no longer received for a period of time the computer terminal logs the user off.

When the user returns to any terminal they may insert their smart card into the reader/writer, which in turn reads the reauthentication code. The local terminal can examine the reauthentication code previously recorded in the smart card. The time component of the code is examined to see if the current time is within a time range defined by the time component. If it is the user is allowed to use the computer terminal without having to enter his password or provide a biometric indicia, if not the user must log into the computer system as mentioned before.

When the electronic device has wireless communication it can be used to log the user onto the computer system. This can be done by pressing an activation button on the device, which then transmits the reauthentication code and other user information as needed within a limited range. A nearby terminal with a wireless receiver will receive the code and again compare the time component to determine if the current time is within a range defined by the time component. Alternately the electronic device may continuously broadcast a user identifier and the code on a continuous basis to any terminal the user is near. Provided no one else is using the computer terminal, the user will be logged in if the time component is within the time range. A further alternate is for the user to press a key on the keyboard of the computer terminal, which in turn transmits a signal to the users electronic device requesting a user

identifier be provided and the code. Again the time component of the code is compared to determine if it is within a time range. In an alternate configuration the computer terminal or computer network maintains the reauthentication code used to the period of time during which the user can be re-logged onto the terminal or computer system without being requested to reauthenticate himself.

In some cases the security device can use a timer to determine a time period in which it can be used to log a user onto a computer terminal by transmitting a log on code. In this case a reauthentication code is not needed. Once a user has been successfully logged onto a computer they can leave the terminal of computer system be logged off of at least have the computer be placed in a suspended state so that it is not readily accessible by others, and then when they return within the time period they can be logged on or given access to the computer without having to reauthenticate themselves to the computer manually. In this case the time period can be governed by the computer terminal.

There are other variations possible, but in each case the user is identified and a time component is provided that the computer terminal can recognize. The user is granted access to the computer terminal without having to enter additional information or request a reauthentication by the security server. It should be noted that there can be concern that the electronic device might be lost or stolen and then another person (an unauthorized one) will use the device to gain access to a computer terminal of the computer system. To prevent this the time range for automatically being re-logged in can be adjusted from a few minutes to perhaps several hours based on the goals of the computer security planners. A smart card or a PDA is easily left behind without notice and therefore they may have a shorter time range defined, while an electronic identification badge is typically worn all day without removal and therefore is less likely to be lost and may be granted a longer time range.

When the reauthentication code includes a location component it can be used to define a portion of the entire computer system that the user previously logged onto. If the code received, read, or obtained from a computer network by a computer terminal for a specific security device doesn't include a location component that is the same as the computer terminal, the code will be ignored and the user if they want to use the computer system will have to log in to the system using the standard log process (e.g. user name and password). In other cases the location component is used to define neighborhoods of terminals within a computer system. These terminals are usually within a common physical area or department. The computer terminal after receiving the location component may further compare it to determine if it specifies the same neighborhood as the current terminal. If so the user is logged on to the computer system, if not the user must log on as usual. When the user attempts to use a computer terminal that is not in the same neighborhood as indicated by the location component, the reauthentication code in the electronic device or in a computer network (e.g. a security server) can be erased. This will force the user to log in, even if he returns to a terminal in the previous neighborhood.

Using the methods defined above, a user who is authenticated (by logging on normally) can use any terminal within a neighborhood for a period of time without having to be reauthenticated. Yet if the time period is exceeded or if the user attempts to use the terminal in a different neighborhood, they will be required to authenticate themselves again. This provides an increased ease in user access to computer terminals while still providing each terminal a level of security that can be tuned by the computer security planners and is referred to as the neighborhood roam feature.

In some situations it will be desirable for part of the reauthentication code (e.g. a user identifier) received by the computer terminal to be transferred to the security system along with a terminal identifier (e.g. Ethernet address). The security system can maintain a list of users who are currently using terminals. When a user leaves a terminal and is automatically logged off, as described above, a message is sent to the security server that the user is no longer using the terminal. In this manner the security server maintains a list of which user is using each terminal.

When the electronic security device is used to provide automated log on to terminals via the transmitted reauthentication code there is a concern that someone can misplace the device and an unauthorized person would try to use a terminal using the reauthentication code. Once missing the user who is associated with the electronic security device may be unaware they no longer have it. This allows another person to use it as long as the time component is within a defined time range and the neighborhood component matches that of a computer terminal.

However, once the user notices that they cannot locate the electronic security device; he places a call to the computer security staff telling them that his device (e.g. an identity or other badge) is missing. The staff can then make an entry in the security system that if the user's device is attempted to be used to gain access to the computer system that it should be denied and that other nearby staff should be notified (e.g. by e-mail, pager, or phone) to question the individual attempting to use it.

However the person who has the device may already been used it to be logged on to a terminal by the reauthentication code (assuming the user has not yet noticed the device is missing). In this case once the user identifies the missing device to the computer staff, whom will enter information about the device into security system. The system will determine that the electronic security device is already being used by someone to access computer resources. The security system will send a message to the computer terminal indicating that the terminal is to immediately log the person off the terminal and erase any information on its display. Again a message can be sent to nearby staff that the person at that terminal should be questioned. In some cases the computer terminal will activate an alarm to draw attention to the unauthorized use of the terminal and erase the reauthentication code.

A further benefit to the use of an electronic security device is that it can be used to detect trusted computer systems. Before a user attempts to log onto a computer system, the security device in the form of a smart card is inserted in to a reader/writer or as a wireless device is brought within the vicinity of a computer terminal. The computer terminal is queried for or automatically provides information identifying the computer system and/or the terminal. The security device will have been preprogrammed with a list of trusted computer system identifiers. The received computer system identifier is compared to the list of trusted site identifiers, if there is a match the user is allowed to log onto the computer system as usual, if not they are denied access and the electronic security device may provide an alert as a message displayed o the computer terminal screen or by activating an audio or visual indicator that is part of the security device. In this manner the user is prevented from attempting to provide their user name, password, or biometric indicia to systems that are not registered with the badge, systems that might have been under the

control of hackers who may attempt to gains knowledge of the user's log on identification or measured biometric indicia.

In some cases the electronic security device can include an address of one or more trusted computer systems or servers. The user can be provided a list of these systems when using a terminal that may not otherwise be part of a trusted network (e.g. a public terminal). The user by selecting a system, can then be directed to via the Internet or other communication channel to the selected system. To enhance security critical portions of or all communication with the system is encrypted by the electronic security device; creating a personal "tunnel" or virtual private network. The computer system may be required to provide identity information to the electronic security device, allowing the security device, as above, to determine if it is communicating with a trusted system in the trusted system identifiers list.

As discussed above another benefit to the use of an electronic security device is that it can be used to help provide a user's user name and password (a password that may be too long and complicated for anyone to remember, e.g. "ai8&weMd2F3!mH,kqw7<whz%F9") to a security system. This can be done by using the security device as inserting a smart card in a reader/writer or bringing a wireless device within range of a computer terminal. The electronic security device can send a message to the computer terminal that is presented on the screen of the terminal asking the user to provide the answer to a challenge question. The user enters the answer, which is verified by either the computer terminal or by the electronic security device against a user defined answer stored in the device. If there is a match the user's user name and password are sent by the security device to the security system for authentication.

The challenge question may simply request the user enter a password as a response, or the challenge question may refer to a fact that only the user is likely to know. An example is "What is the name of your favorite TWWOO character?" where the user knows that TWWOO refers to the book the "The Wonderful Wizard of OZ" and the character's name is "Glinda". To further increase security, the user can define several challenge questions and answers that are randomly presented when the user attempts to us the electronic device to assist the user log onto a computer system.

However, an unauthorized person may find a misplaced security device and attempt to use it to access a computer system. Assuming the real user has defined challenge questions and answers that are not obvious the person will have to guess several times to enter a correct answer. To prevent this type of brute force cracking, the electronic security device can be programmed to accept only a limited number (e.g. 4) of incorrect answers or failures to enter an answer at all after being requested. After the limit has been exceeded the device performs a security function. The first time this occurs (which may be within multiple repeated entries or accumulated over an hour) the function can be to deactivate the device for 5 minutes and present an error message on the screen Should the user continue to enter incorrect answers the function may be to erase portions of the security device's memory, e.g. the challenge questions and answers or definitions that are related to the computer system identified by the computer terminal so that the security device will no longer interact with the terminal.

In some cases the terminal will send a message identifying the electronic security device (e.g. by generic serial number or the user's real name), as well as the identity of the terminal, to the security system. The system can mark the identified electronic security device as questionable and before the security device is used to assist the user log on again, it may require the person using it to present themselves to trusted staff to determine that the errors in entering correct answers were mistakes as opposed to hacking attempts.

A similar process can be used when the electronic security device is able to measure and compare a biometric indicia prior to assisting a user log onto to a computer system. For example when the security device is able to read the fingerprint of the user and an incorrect fingerprint is presented multiple times, the electronic security device may perform a security function.

The inventive identifier has several advantages over prior art indicia identification systems. First, because the inventive identifier is personal to a single user, the identifier's memory need only store finger print characteristics for a single user. For this reason minimal memory is required. In addition because only one print has to be interrogated, a relatively simple processor can be used to interrogate a finger print and identify a user.

Second, the inventive identifier or security device keeps personal information secret while still facilitating user identification. In many conventional person interrogating systems which identify body indicia, a person's body indicia has to be "given up" to an interrogation system which is not controlled by the person. For example, to enter a building, an interrogation system may require a person to place her thumb on a finger print reader which identifies her print characteristic and then compares her characteristic to characteristics of prints associated with all people who are authorized to enter the facility. In this case the person's print would have previously had to have been provided to the system so that a comparison could be made. Providing personal indicia is viewed as intrusive by many persons and therefore is objectionable.

With one embodiment of the inventive indicia identifier, all indicia identification occurs on a security device (e.g. a badge, credit card, cell phone, or PDA) which is controlled by the device owner at all times and therefore control of personal indicia is never forfeited. With another embodiment of the invention a user's indicia is provided to an external interrogation system only for interrogation purposes and is thereafter erased from the systems memory. According to this embodiment, for example, a user's fingerprint characteristics may be stored in an electronic security device memory, e.g. a smart card or the like. To gain access to a computer network via terminal an interrogation must occur. To this end, an interrogation system includes a processor which can receive information from the electronic security device and which is linked to a print reader. During an interrogating process the person first enables print characteristic transfer from the electronic security device to the processor. Next the user places her thumb on the print reader which provides print characteristics to the processor. Thereafter the processor compares the prints (i.e. from the reader and the electronic security device) and allows access where the prints are identical but blocks access where the prints are different. Then the processor erases the prints from memory and may indicate so for the user's peace of mind.

The invention also includes a method and apparatus for checking authenticity of a digital or hardcopy document using only content provided on the document. To this end, assuming a document exists in a computer memory and can be displayed for approval on a computer display. A user may examine the document and, if the user approves the document, the user may indicate approval (e.g. via a key or icon selection). When approval is given, the computer performs two tasks. First, the computer provides some form of user or personal identifier to the document in a designated approval field or space. The identifier may take any of several different

forms and may include a signature picture of the person who approved the document or a personal watermark. This first task results in a "signed" document. Second, the computer uses document content and uses a personal key which belongs to the approver to compute encryption codes, hash code, etc. The encryption code is then used to modify the identifier which is indicative of signed document content. The modified identifier is appended to the document, making it a signed document. When the document is stored modifier identifier is included therewith and may be displayed when printed when it is in the form of a signature picture. In some cases the identifier provided is the encryption code calculated in part by the document content and a private key provided by the security device.

Subsequently, the content of a signed document can be authenticated as having been singed by a specific security device. When a signature picture is used that is modified in part by the original content the document, the signature picture or watermark can be read from the document and decrypted using a public key which belongs to the person whose signature appears on the document (supposedly the original approver). At the end of the decryption process, the resulting document should match the original document content and can be compared either visually or automatically to authenticate the signature and the document content. When encryption codes are stored with the document instead of a modified signature picture, the encryption coding process can be reversed using a public key corresponding to the private key of a specific security device to determine that the document was signed by the person associated with the specific security device.

These and other objects, advantages and aspects of the invention will become apparent from the following description. In the description, reference is made to the accompanying drawings which form a part hereof, and in which there is shown a preferred embodiment of the invention. Such embodiment does not necessarily represent the full scope of the invention and reference is made therefore, to the claims herein for interpreting the scope of the invention.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

FIG. **1** is a perspective view of a security badge capable of communicating with computer terminals and a plurality of smart devices;

FIG. **2** is a perspective view of a wrist bracelet to be worn by patients or other persons to provide identification through wireless communication with security badges or other smart devices;

FIG. **3** is a plan view of a computer terminal or workstation being operated by a system user where access is conditioned upon communications between the security badge and the computer terminal;

FIG. **4** is a plan view of a hospital patient room equipped with a variety of computerized monitoring, treatment, and information devices;

FIG. **5** is a perspective view of a medical container equipped with an electromechanical locking device controlled by communications through transceiver components;

FIG. **6** is a block diagram of various electrical components which are incorporated within an exemplary ICD;

FIG. **7** is a block diagram of a computer network according to the present invention, including a plurality of workstations and databases for data record retrieval and storage and a security verification system;

FIG. **8** presents the base memory contents of a security badge;

FIG. **9** presents the contents of the information transferred from a wrist bracelet according to the present invention to a security badge;

FIG. **10** presents the contents of the information transferred from a medical container according to the present invention to a security badge;

FIG. **11** presents the contents of a digital message record incorporating a dictated message and other information corresponding to the dictated message;

FIG. **12** is a list of information transferred from a patient monitoring or therapeutic device to a security badge;

FIG. **13**A is a textual representation of a URL address of medical dispensation record formed in part from the patient's identification number and a time stamp;

FIG. **13**B is a graphical representation of a medical dispensation record with HTML codes for displaying the information in a network browser;

FIG. **13**C is a graphical representation of the record of FIG. **13**B as it would be viewed by a system user through a network browser;

FIG. **14**A is a graphical representation of a medical administration record with HTML codes for displaying the information in a network browser;

FIG. **14**B is a continuation of the graphical representation of a medical administration record of FIG. **14**A;

FIG. **14**C is a graphical representation of the record of FIGS. **14**A and **14**B as it would be viewed by a system user through a network browser;

FIGS. **15**A-**15**F are a functional flow chart showing the steps a computer terminal executes in logging on a system user using a security badge for identification;

FIGS. **16**A-**16**F are a functional flow chart showing the steps a security badge executes in logging on to a computer system, sending data, or signing a document;

FIGS. **17**A-**17**C are a functional flow chart of the steps a security badge executes in establishing an association with a patient and acquiring data from other computerized devices;

FIG. **18** is a function flow chart of the steps a security badge follows to record and generate addresses for dictated messages;

FIG. **19** is a block diagram illustrating the general components of a smart device according to the present invention;

FIG. **20** is a perspective view of another embodiment of an ICD according to the present invention;

FIG. **21** is a perspective view of a video capable ICD according to the present invention;

FIG. **22** is an exemplary screen view used to implement the present invention;

FIG. **23** is a perspective view of a preferred embodiment of the badge illustrated in FIG. **1**;

FIG. **24** is a screen view illustrating an initial screen according to the present invention;

FIG. **25** is a flow chart illustrating a portion of a digital signing process according to the present invention;

FIG. **26** is a flow chart illustrating a portion of a digital signing process according to the present invention;

FIG. **27** is a portion of an authentication method according to the present invention;

FIG. **28** is a second portion of an authentication method according to the present invention;

FIG. **29** is a view of an exemplary digital signature picture;

FIG. **30** is a schematic view of an exemplary digitally signed and watermarked document according to the present invention,

FIG. **31** is a perspective view of an alternate embodiment of the electronic security device now in the form of a smart card;

FIG. **32** is an electronic schematic of a smart card;

FIG. **33** is a list of the user identification information stored in the electronic security device;

FIG. **34** is a list of the computer system information stored in the electronic security device;

FIG. **35** is a schematic view of the computing network for an enterprise;

FIG. **36** is a schematic view of a computer terminal attached to computer network;

FIG. **37** is a list of information about a computer system stored in a security server;

FIG. **38** is a list of terminals that are part of the computer network;

FIG. **39** is a list of electronic security devices that are registered with the computer network;

FIG. **40** is a list of users that are registered in a computer system;

FIG. **41** is a list of information stored in a computer terminal;

FIG. **42** is a flow chart showing how an electronic security device can verify that a computer system is recognized;

FIG. **43** is a flow chart showing how a reauthentication code can be used to authenticate a user to a computer terminal;

FIG. **44** is a flow chart showing how a user authenticates himself to a security server;

FIG. **45** is a flow chart showing how an electronic security device can be used to authenticate a user;

FIG. **46** is a flow chart further showing how an electronic security device can be used to authenticate a user;

FIG. **47** is a flow chart further showing how an electronic security device can be used to authenticate a user;

FIG. **48** is a flow chart showing how a computer terminal monitors for the presence of an electronic security device to maintain access for the user;

FIG. **49** is a flow chart showing how a security system can determine that a user who was authenticated by electronic security device should be logged off;

FIG. **50** is a flow chart showing how a computer terminal can detect that a user is no longer present at a terminal;

FIG. **51** is a flow chart showing how a reauthentication code can be dynamically updated; and

FIG. **52** is a flow chart showing the steps performed as part of a security function.

DETAILED DESCRIPTION OF THE INVENTION

The present invention may be adapted for use in a wide variety of applications and is suitable for any environment in which numerous data records having one or multiple forms and/or formats are to be collected, stored, archived, retrieved, or translated. By way of illustration and not by way of limitation, unless indicated otherwise, the preferred embodiment is presented in the context of a medical facility environment in which typically there are numerous computer systems in use by various physicians (e.g. doctors, nurses, administrators, etc.) in several related hospitals, and each physician often desires to have access to patient records created by that physician or by other physicians who practice at one of the related hospitals. Throughout this specification, identical numbers represent similar components and symbols.

I. Hardware

Referring to FIG. **7**, a simplified and exemplary embodiment of a system used with the present invention is illustrated as an electronic system referred to as computer network system **194**. System **194** includes a plurality of personal computers or computer terminals comprising workstations **60** and **60'** (designated "Workstation 1" and "Workstation M"), which may be located in patient rooms, at nurse stations, in doctor offices and administrative offices, a plurality of network devices including databases **158** and **162** (designated "Database 1" and "Database N") and servers including an Admit, Discharge, and Transfer (ADT) system or server **166**, at least one laboratory system or server **170**, various bedside treatment devices **116** and **116'** such as ventilators and IV infusion pumps, patient monitoring devices **80** and **80'**, a pharmacy system or server **186**, a security verification system or server **168**, a billing system or server **171**, a patient historical records system or server **173** and a unit dose medication dispenser **150**.

For the most part, system **194** components communicate with each other via a communication network **190** which may comprise a combination of local and wide area networks, using ethernet, serial line, token ring, wireless, or other communication standards. Communication network **190** may also be arranged so as to be part of the Internet or as an individual Intranet. The functions performed by the various components of the preferred embodiment of system **194** may be divided among multiple computer systems or consolidated into fewer components.

Each of system servers **186**, **166**, **173**, **168** and **170** has access to one or more databases **158**, **162** for storing information including text and/or audio and visual data. As illustrated, some patient monitoring devices (i.e. **80**) and treatment devices (i.e. **116**) are hardwire linked to network **190** so that data from devices **116** and **80** can be provided directly to network **190**. However, there are other monitoring devices **80'** and treatment devices **116'** which stand alone and apart from network **190** which, although capable of generating data, are not hardwired to network **190** to facilitate information interchange.

Referring to FIG. **3**, an exemplary terminal **60** includes a computer **101**, a display **103**, an interactive device **105** and an input device **64**. Computer **101** includes a processor **107**, a random access memory **109** and an audible alarm **111**. Processor **107** is linked to memory **109**, alarm **111**, input device **64**, display **103**, and device **105**. In addition, processor **107** is linked to network **190** for two-way communication with other components of system **194** (see FIG. **7**). Device **105** is illustrated as a keyboard but could be any of several different devices including a mouse or other similar pointing device.

A commercially available Internet browser **115** or similar display, entry and retrieval program using standardized formatting instructions is loaded onto processor **107**. For the purpose of simplifying this explanation, while any type of entry, retrieval and display software may be used to implement the present invention, it will be assumed that browser **115** is a standard Internet browser. Generally, browser **115** operates as an interface mechanism between a physician and the servers (e.g. **186**, **173** . . .) of system **194**. To this end, browser **115** configures various screens on display **103** providing information such as instructions, hyperlinks and blanks which facilitate interaction between a physician and the servers. Typically, where information is to be provided by a physician (e.g., through selection of a hyperlink or entry via device **105**), a target server address for reception of the information is provided.

The target server address will typically take one of two basic forms. First, the target address may simply indicate a data base address on one of data bases **158**-**162** for storing received information. Second, the target address may specify a specific system **194** server and, when a server receives

information, the server may determine how to proceed (i.e. process or store the received information).

Input device **64** is a transceiver which is capable of two-way communication with other devices described hereinafter. While device **64** may be equipped for wired communication, preferably, device **64** is capable of any of several different types of wireless communication. Because of its low cost, energy efficiency, minimally regulated status, and standardization by the Infrared Data Association (IrDA), infrared transmitter and receiver components supporting serial infrared communications links comprise the preferred transceiver **64**. A variety of infrared communications devices, such as Hewlett Packard's HSDL-1001 transceiver components, may be used to implement the preferred communication means. Alternatively, other communication means (e.g. acoustic, radio frequency, or electromagnetic coupling) may be supported.

Referring to FIGS. **3** and **7**, dispenser **150** may take any of several different forms but preferably is a terminal like terminal **60** including a processor **107**, a browser **115**, a memory **101**, a specifier transmitter or output device **64**, and an indicator **111**. In addition, other useful functionality is provided by processor **107**, for example, timing, counting, indicator and display control and so on. Dispenser **150** is in communication with pharmacy server **186**. Thus, server **186** provides screen configuration information as well as server target addresses to dispenser **150** for interaction with a pharmacist who is responsible for dispensing drugs. In addition to dispensing drugs, dispenser **150** may also dispense target address information and browser configuration information to other system devices used for remote information collection and may perform some information tracking tasks described in more detail below.

In addition to the devices, systems, and servers identified above, the inventive system includes a series of other electronic devices which cooperate to remotely gather information within a medical facility and provide information to system **194** for storage and manipulation.

Referring to FIG. **1**, a mobile information collecting device (ICD) is illustrated in one embodiment as a security badge **10** which may be clipped to a physician's clothing or worn by chain around a physician's neck. While this embodiment implements the invention in the context of an identification badge, the invention could be instantiated in other shapes, such as a ring, a personalized pointing device or a small hand held computer. In keeping with its preferred resemblance to a typical identification badge, ICD **10** is affixed with identification text **12** and graphic display **16**. ICD **10** incorporates a wireless communication means or transceiver **14** (i.e., a receiver/transmitter) which operates as both a data collector and an output device, an audible alerting device **20**, an activation button **18**, a microphone and audio digitizer **22**, and a dictation button **26**. ICD **10** may also incorporate additional electronic identification means such as a magnetic strip (the general location illustrated at **30**) and may also incorporate a small key pad (not illustrated) for entering additional information.

Referring also to FIG. **6**, ICD **10** comprises a processor **250** which is linked to each of a battery **252**, a real-time clock **254**, a memory element **262**, audible alerting device **20**, transceiver **14**, activation button **18**, microphone **22** and dictation button **26**. Display **16** of ICD **10** may be any of a variety of forms, including but not limited to a photograph, a light emitting diode array, a liquid crystal panel, and an active-matrix display. In addition, ICD **10** may include a display **258** such as a light emitting diode array, an LCD screen, or a passive or active matrix screen, which is linked to processor **250**.

Referring to FIG. **8**, exemplary information **300** which may be stored in memory element **262** is illustrated. Information **300** includes both "base contents" and "optional information". The base contents comprises the minimum information which should be stored in a personalized ICD such as identification ICD **10** and includes a physician's password or private/public digital security key information which can be used to log onto a computer terminal to provide information to, or review information thereon. The optional information includes other information which is descriptive of a badge owner including a user identifier such as a name, identification number, occupation, privileges and so on.

While personalized ICDs are preferred, the invention also contemplates other types of ICDs which are not personalized and can therefore be used by any facility personnel to collect information for entry into a facility computer system. In this case, however, prior to entering information into the system, it is contemplated that a physician would log on to a computer terminal in a more conventional manner via system **168** which would identify the physician for security purposes. For example, the physician might manually enter a personal identification number to gain access to the computer terminal for information entry and retrieval.

ICD **10** is to be used with a plurality of different "smart devices" for remotely collecting information. In addition to remotely collecting information, inventive ICD **10** is equipped to provide information packets to terminal input devices **64** which are formatted and addressed according to uniform standards in order to minimize the need for human intervention in categorizing and archiving patient records. Information packets are formatted and addressed according to conventions, such as Java or a markup language supporting interactive display by browser **115**. While any standard format (e.g. HTML, Java . . .) may be supported and it is contemplated that the present invention may be used with any computer language format, hereinafter, in the interest of simplifying this explanation, the invention will be described with reference to the HTML format only.

By formatting information packets in HTML format a receiving computer terminal **60** does not need additional programming or input to display or manipulate information in an information packet. In a preferred embodiment, formatting and addressing of information packets is done partially or entirely by ICD **10** itself, using time stamps, patient identification information, and the information or contents **300** (FIG. **8**) incorporated in memory element **262** (FIG. **6**) of ICD **10**. In this manner all the information required to display information packet information and to send the information to an appropriate database or server is included in the information packet transferred from ICD **10**. An exemplary information packet is described in more detail below.

Referring to FIG. **19**, an exemplary smart device **75** generally includes a processor **77**, a memory **79** linked to processor **77** and either a transmitter or a transceiver **81** (i.e. a receiver/transmitter). In addition, each smart device **75** may also include one or more activation buttons **83**, some type of indicator (e.g. a light **85** or audible alarm in the form of a speaker **87**) and a display **88**. Smart devices like device **75** collect, generate, and/or are provided information which is assembled into information segments to be transmitted to ICD **10** for collection. Many smart devices **75** are contemplated by the present invention, however, in the interest of simplifying this explanation, only a small number of smart devices are described. Hereinafter when specific smart device

components are referenced, the specific components will be referenced by the same numbers used in FIG. **19** followed by one or more "'" indicating components associated with specific devices as described hereinafter.

Referring now to FIG. **2**, one smart device is a patient identification bracelet **40**. An exemplary bracelet **40** is described in U.S. patent application Ser. No. 09/007,290, which is entitled "Identification Bracelet With Electronic Information", which was filed by the present inventor and is incorporated herein by reference. Bracelet **40** includes a flexible and extendible band **44**, a securing clasp **48**, a processing device **75'** and a wireless communication means in the form of transceiver **81'**. Bracelet **40** is similar to existing bracelets used to identify patients in hospitals, with the exception of the processing device **75'** which includes transceiver **81'**. Textual information (not illustrated) is typically affixed to band **44**. Transceiver **81'** is preferably similar to transceiver **14** of ICD **10** so that transceivers **81'** and **14** can communicate back and forth. Like general device **75** (see FIG. **19**), device **75'** includes a processor and a memory element linked to the processor (not illustrated).

Referring also to FIG. **9**, exemplary patient identification information **320** to be stored in the memory of device **75'** is illustrated and includes, at a minimum, a patient identification number identifying the patient who wears bracelet **40**. In addition, the identification information **320** may also include other descriptive information as indicated.

Referring to FIG. **5**, another smart device is a medical container **200**. U.S. patent application Ser. No. 08/955,475, entitled "System And Apparatus For Administering Prescribed Medication To A Patient", which was filed by the present inventor and is incorporated herein by reference, describes an exemplary medical container. Exemplary container **200**, which may be used to transport and provide auditing and limited access for medications, blood or tissue samples, or other inventory, includes a lid **204**, a securing latch **232**, a latch release button **228**, and an electronic identification or processing device **75"**. Textual identification **208** may be attached to lid **204**. Processing device **75"**, like general smart device **75** (see FIG. **19**) includes a processor which is linked to a memory, a battery, a transceiver **81"**, an activation button **83"** and an audible alerting device **87"**.

Referring also to FIG. **10**, exemplary information **340** which might be stored in the memory associated with processing device **75"** is illustrated. Once again the information is divided into a minimum amount of information which should be stored and optional information. In the case of a drug to be administered, the minimum information includes medication name and medication quantity. Optional information may include, among other things, the name of a patient for whom the drug is dispensed, the date and time at which the drug should be administered and the names of physicians authorized to administer the drug. Other information would be provided in the case of a tissue sample, a blood sample, etc.

Referring again to FIG. **5**, it is contemplated that latch **232** release may be conditioned on any of a number of different precise sequences of events. The events may include release within a time-window for treatment, the successful exchange of identification information between a physician's ICD and processing device **75"**, the successful exchange of identification information between a patient's identification bracelet processing device **75'** (see FIG. **2**) and processing device **75"** and the manual depression of the latch release button **228**. An example of a lid unlocking sequence is described in more detail below.

Referring to FIG. **4**, an exemplary patient room **104** includes a computer terminal **60**, a patient bed **88** and various other devices. The other devices include two smart devices including a patient monitor **80'** and a patient treatment device **116'**, each equipped with a wireless transceiver input device **64** which is similar to transceiver **81'** on band **40** (see FIG. **2**) and transceiver **81"** on container **200** (see FIG. **5**). Monitor **80** and device **116** are smart devices meaning that each of those devices typically include the components illustrated in FIG. **19** (i.e. in addition to a transceiver, each device includes a processor, a memory, at least one activation button and some type of output device such as an LED or computer screen for visual indication or a speaker for audio indication). In this example, it will be assumed that each of devices **80'** and **116'** are not hardwired to network **194**.

Also shown in FIG. **4** is an optional bedside communication device **96** which is equipped to communicate with wireless transceiver devices **64**. Communication device **96** may be connected to an optional patient identification display **100** equipped with wireless transceiver device **64** or to a patient identification display **120** outside of room **104**.

II. Operation of a Computer Terminal in Access Control

Generally, it is contemplated that a terminal used with an ICD **10** will be capable of, in addition to facilitating transfer of information packets from the ICD **10** to the terminal, facilitating use of other conventional computing programs (e.g. a word processor, a spread sheet, Internet access, . . .). In enabling access to any facility application, security is extremely important.

In the preferred embodiment, authentication, interrogation and data security will be illustrated through the use of conventional "public key" cryptography, such as that implemented in RSA, though other well-known techniques for authenticating a user and securing transmitted data may be employed. In implementing public key cryptography, the security badges and computer terminals are equipped with "private key rings" of one or more private keys and a "public key ring" of one or more public keys. Depending upon their sophistication and the sensitivity of the information they contain, other smart devices in a medical facility, such as monitoring devices or medical instruments, may also be equipped with cryptographic means. The private keys of each ICD **10** are never transmitted or otherwise made accessible outside the ICD **10**. For strong compression, each public and private key would typically be at least 128 bytes long. Today, the preferred implementation for smart card encryption capabilities utilizes the Advanced RISC Microprocessor (ARM), such as the ARM **6**, the ARM **710**, or a variety of customized chips integrating the ARM technology, such as the Mykronics Capstone or VLSI's VMS **210**. A variety of other processors, including the Intel x86 processor, would also be suitable.

FIGS. **15A-15F** describe the operation of a computer terminal **60** (FIG. **3**) in interrogating, establishing and monitoring access by a physician wearing an ICD **10** (FIG. **1**). Access is established by providing a substantially unobstructed signal path between the physical wireless communication means **14** (preferably comprising infrared transmitter and receiver components (see FIG. **1**)) of the ICD **10** and the wireless transceiver device **64** of the computer terminal **60**. The establishment of an unobstructed signal path is facilitated by having the ICD **10** worn on, or attached to, the front of the physician attempting to log on the computer terminal **60**. While it is not necessary that the ICD **10** be worn by or attached to the clothing of the physician, securing the ICD **10** to the physician minimizes the probability that it will be lost by the physician.

Commencing with FIG. **15A**, in step **600** the computer terminal **60** transmits an interrogation signal, which is fashioned from a private key of the security verification system

168 (FIG. 7) of the computer network 194, a large random number, and other identification information unique to the security verification system 168. Provided a substantially unobstructed signal path exists between the wireless transceiver device 64 (FIG. 3) of the computer terminal 60 and the wireless communication means 14 (FIG. 1) of an ICD 10, the ICD 10 will intercept, process, and be operable to return a part of the interrogation signal in a re-encrypted form (according to the operation of the ICD 10 set forth in FIGS. 16A-16F, infra).

In step 604, the computer terminal 60 waits for a period sufficient to allow an ICD 10 to receive, process, re-encrypt, and re-transmit the interrogation signal. If no return response is received, in step 608 the computer terminal 60 waits for a predetermined period of time and, returning to step 600, transmits another interrogation signal. If a return response is received, in step 612 the format of the return response is evaluated. If the format is unrecognized, in step 608 the computer terminal 60 waits for a predetermined period of time and, returning to step 600, transmits another interrogation signal.

If a return response of a recognized format is received by the computer terminal 60, in step 616 it is decrypted or authenticated using the public key of the ICD 10 which returned the response. In a public key cryptographic system, encryption with a private key uniquely identifies the physician possessing that key (assuming the private key has not been stolen) because an encrypted message can only be decoded using the public key matching the physician's private key. Accordingly, the security verification system 168, which stores the public keys of each ICD 10 given access privileges to the computer network, attempts to decrypt the re-encrypted interrogation signal using the public keys it retains.

There are at least two ways in which the decryption procedure may be carried out. In one procedure, the security verification system 168 attempts to decrypt the response signal, one public key at a time, until either a successful decryption is achieved or all the public keys stored by the security verification system 168 fail. Preferably, however, the identification information will have been appended to the encrypted portion of the return response purporting to identify the ICD 10. The security verification system 168 then attempts to decrypt the return response using the public key corresponding to the appended identification information. A successful decryption identifies the ICD 10 that originated the return response. If the decryption is successful, a verification algorithm is used to compare the decrypted return response to the original, pre-encrypted interrogation signal.

It would, of course, be possible to program the computer terminal 60 itself to perform some or all the functions of the security verification system 168. A physically separate security verification system 168, however, will safeguard the computer network 194's private keys and the list of public keys of valid system users, preventing appropriation of the keys by one breaking into the computer terminal 60 itself.

As an additional precaution, the ICD 10 may be programmed to detect and eject interrogation signals that are short and probabilistically non-random. In other word, if an ICD received one or a series of consecutive interrogation signals which were not recognized as being in a valid form, the ICD 10 would reject the signal and fail to respond. This rejection process would frustrate a cryptanalyst's attempt to derive an ICD 10's private key by interrogating the ICD 10 with short messages and intercepting the re-encrypted response. This precaution is especially justified if the ICD 10 is adapted to communicate with devices and computer terminals foreign to the computer network 194 and its security verification system 168. This precaution may also limit the damage that could be imposed were a private key of the security verification system 168 compromised.

In step 620, if the decryption and verification failed to identify an ICD 10 having access privileges to the computer terminal 60, then the operation proceeds again-to step 608, where the computer terminal 60 waits for a predetermined period of time and, returning to step 600, transmits another interrogation signal.

Because an ICD 10 may be misplaced by or stolen from a physician, additional security measures are warranted. The security verification system 168 may be programmed to require that a physician manually enter a password at the beginning of each day. Alternatively, the system could require manual password entry at random times throughout the day, even while the physician is logged on, flagging possible theft and unauthorized use of the ICD 10 should the proper password not be detected. Further, a switch may be incorporated onto the ICD 10 to force it into a mode requiring password entry. More elaborate means, including voice identification or a fingerprint or retinal scan, could also be incorporated into the ICD 10 or at computer terminals 60 to reinforce such security. One example of a fingerprint interrogating ICD and its advantages is described in detail below. It is to be expected, however, that should a physician be dispossessed of an ICD 10, that he or she immediately notify the system security administrator to deactivate the access privileges of the ICD 10.

Provided an ICD 10 having access privileges to the computer terminal 60 has been identified, in step 624 the security verification system 168 determines whether or not to require the entry of a password to enable log on by the physician. This procedure provides a safeguard should the ICD 10 be stolen, deterring unauthorized log on attempts with the threat that the security verification system 168 will detect the breach and apprehend the violator.

If password entry is required, then in step 632 the computer terminal 60 prompts the physician for a password. Information that is entered may not only be processed by the computer terminal 60, but also transmitted to the ICD 10 in encrypted form in order to reset a flag maintained by the ICD 10 indicating that password entry is required. In step 636, the password is analyzed. If the wrong password has been entered, in step 640 a counter is incremented. If the wrong password was entered less than three consecutive times (step 640), the security verification system 168 returns to step 632 and again prompts the physician to enter the password. After three failed attempts (step 640), however, in step 644, the security verification system 168 disables recognition of the ICD 10, records the location of the failed attempt, and notifies the system administration to alert it to a possible attempted breach of the system. Other processes may be performed in the event of a failed interrogation. For example, where data is to be provided to a terminal after a successful interrogation, the terminal may block reception of transmitted data after a failed interrogation or series of interrogations.

If within the first three attempts, the correct password is entered, the operation advances to step 648, logging the physician onto the computer terminal 60 and providing access to program features and databases in accordance with the access privileges of physician. In step 652, the computer terminal queries the ICD 10 for the existence of data records to transfer to the computer network 194 and causes the ICD 10 to transmit them, if any, to the computer terminal 60 for database storage, in accordance with the operation detailed in FIGS. 16A-16F. This query for data records or information packets

may be automatic or may simply be a function which periodically queries for records as described in more detail below.

After completion of the data transfer by the ICD **10** to the computer terminal **60** or, in the event no data is transferred but another terminal application (e.g. a wordprocessor) is employed by the physician, if warranted, the computer terminal **60** will continue to periodically poll the ICD **10** with recommitment signals. These recommitment signals may be specifically addressed to the physician's ICD **10** and may incorporate a different random number with each polling. Further, these recommitment signals may be encrypted with the ICD **10**'s public key stored by the security verification system **168**, instead of or in addition to encryption by the security verification system's private key, so that they may only be intelligibly decrypted by the ICD **10** itself, using its own exclusively-guarded private key. By periodically polling the ICD **10**, the user input and output devices of the computer terminal **60**, including the monitor, keyboard, and mouse, can be disabled if the computer terminal ceases receiving response signals from the ICD **10**. A physician may also be automatically logged out by means of periodic polling.

This process of periodic polling is illustrated in steps **656** through **692** of FIGS. **15**C-**15**E. The computer terminal waits for a predetermined interval in step **656**, transmits a recommitment signal in step **660**, and probes for a response signal in step **664**. If there is a recommitment response signal, in step **668** its content is evaluated. If the content of the recommitment response signal is accepted, the operation proceeds to step **696**, discussed infra. If either there is no recommitment response signal in step **664**, or if the content of the recommitment response signal is rejected in step **668**, an idle/invalid link counter (not illustrated) maintained by the security verification system **168** and whose initial value relative to the log on event was zero, is incremented in step **672**.

The idle/invalid link counter permits the physician to temporarily turn away from the transceiver device **64** of the computer terminal **60** or to otherwise interfere with the signal path. However, if the computer terminal **60** does not receive a recommitment response signal after several requests, the display of the computer terminal **60** is blanked, input from any keyboard or pointing device may be ignored, and other processing activities may be suspended. The computer terminal **60**, however, continues to transmit recommitment signals. Should the physician's ICD **10** respond within a second period of time, the display will be restored to its previous condition and the keyboard, pointing device, and processor will resume normal operation. If the ICD **10**, however, does not transmit a correct recommitment response signal during the second period of time, the physician is automatically logged off the computer network **194**. When the user is logged off the computer system, a software program may also be used to remove any temporary files that have been stored on disk or in RAM memory, e.g. the cache file used by the network browser program. Furthermore, access by the computer terminal **60** to the computer network **194** may be terminated with the exception of the link between the computer terminal **60** and the security verification system **168**, which may be preserved to determine if a new user is attempting to use the computer terminal **60** to log onto the computer network **194**. In this manner a physician's access to the computer network **194** is restricted while logged off and enlarged while logged on.

This computer terminal access security operation is described more particularly in steps **676** through **692** of FIGS. **15**D-**15**E. The value of the idle/invalid link counter is compared in step **676** to a predetermined disable I/O limit. If that value does not exceed the disable I/O limit, the periodic polling continues with step **656**. If and when the value of the idle/invalid link counter does exceed the disable I/O limit, in step **684**, the input and output devices of the computer terminal **60** are disabled, if they have not been previously disabled (step **680**). In step **688**, the value of the idle/invalid link counter is compared to a predetermined logout limit. Periodic polling is continued in step **656** if the value of the idle/invalid link counter does not exceed the logout limit. If and when this value is exceeded, in step **692** the physician is logged off the computer terminal **60** and information stored in memory or cache on the computer terminal by the user is overwritten.

If the content of the recommitment response signal is valid (step **668**), in step **696** the security verification system **168** processes the signal through a verification algorithm, attempting to decrypt the signal with public keys and comparing the decrypted output with the original recommitment signal. If the decrypted output matches the original recommitment signal (step **700**), then in step **704** the computer network **194** recognizes that the physician is still using the computer system. The idle/invalid link counter is reset and the display and other input and output functions of the computer terminal **60**, if disabled, are restored. If the decrypted output does not match the original recommitment signal (step **700**), then in step **708** the computer network **194** recognizes that another physician is nearby. If the value of the idle/invalid link counter exceeds a third limit (step **712**), then the original physician is logged off, memory cache and temporary work space utilized by the original physician or applications executed by or through the original physician is deleted and/or overwritten, and the new physician is logged on to the computer terminal. If the value of the idle/invalid link counter has not yet exceeded a third limit (step **712**), then the new physician is recognized but not logged onto the terminal, for the original system user has not been logged off for a sufficient period of time.

While the preferred embodiment is described above wherein a terminal initiates an interrogation process, the invention is not meant to be so limited and indeed includes systems wherein an ICD may initiate an interrogation either when an ICD is near a terminal (e.g. in the case where an ICD transmits interrogation signals at regular and frequent intervals) or when an initiation button is pressed on the ICD.

III. Operation of an ICD in Access Control

FIGS. **16**A-**16**F describe the operation of an ICD **10** (FIG. **1**) in responding to interrogation and recommitment signals transmitted by a proximately located computer terminal **60** (FIG. **3**). In order to conserve power, the ICD **10** is preferably capable of alternating between sleep and wake states. During a sleep state, the ICD **10** is not responsive to signals transmitted by computer terminals **60** and other proximate smart devices, and may be essentially "invisible" to such devices. This alternating sleep/wake cycle is described in steps **724** through **732**. In step **724**, the ICD **10** maintains a wake state in which it is capable of receiving and transmitting signals through its wireless communication means **14**. If in step **728**, the time allotted for the wake state has expired and no signal has been received via the wireless communication means **14** of the ICD **10**, then in step **732** the ICD is powered down for the allotted duration of its sleep state, before cycling back to the wake state of step **724**.

If a signal is received during its wake state, however, the alternating sleep and wake-cycle is suspended in order to process and respond to the signal. In step **736**, the ICD **10** processes and identifies the signal. If the signal is identified as a nonspecifically addressed signal (step **740**) or as being addressed to the instant ICD **10** processing the signal (step

742), then further evaluation of the signal is performed, beginning with step **760**, discussed infra.

A signal that is neither nonspecifically addressed (step **740**) nor specifically addressed (step **742**) to the instant ICD **10** is regarded as being extrinsically addressed to a second ICD **10**. This situation may arise when two system users **68** with two security badges **10** are in the vicinity of the same computer terminal **60**, one of them being logged onto the computer terminal **60**. In step **744**, the extrinsically addressed signal is evaluated to determine whether or not it is of a nature seeking an identification signal from the second ICD **10**. If not, the instant ICD **10** ignores the extrinsically addressed signal and retires to wake state **724**. If, however, the extrinsically addressed signal is of a nature requesting an identification signal, in step **752** the instant ICD **10** pauses to permit the second ICD **10** to transmit its identification signal. In step **756**, the ICD **10** then transmits its own identification signal to the computer terminal **60** to indicate its presence, retiring afterward to wake state **724**. This may allow the security verification system **168** to temporarily blank the screen to prevent unauthorized access to data by one physician through the access privileges of another physician. Alternatively, after repeated failures by the computer terminal **60** to receive a response signal from the second ICD **10**, the second physician may be logged out and the instant physician logged in.

In the event that the signal was either nonspecifically addressed (step **740**) or specifically addressed to the instant ICD **10** (step **742**), the operation advances to step **760**, where the signal is further evaluated to determine whether it is an interrogation or recommitment signal, in which case it would have been encrypted by a private key of the security verification system **168**. If in step **760** it is identified as an interrogation or recommitment signal, then in step **764**, a key ID tag appended to the signal is used to locate the public key stored in the memory element **262** (FIG. **6**) of the ICD **10**, with which it decrypts the signal.

In step **768**, the decrypted signal is evaluated for information positively or probabilistically identifying the security verification system **168** as the source of the signal. This step implements the precaution of programming the ICD **10** to detect and reject interrogation signals that are too short or probabilistically non-random. If the decrypted signal is not distinguishable as originating from the security verification system **168**, then in step **772**, the ICD **10** stores and transmits an invalid message code, retiring to wake state **724**. If the decrypted signal is recognized as originating from the security verification system **168** (step **768**), then in step **774**, the signal or a portion thereof is re-encrypted using the private key of the ICD **10** and transmitted, in step **776**, to the computer terminal **60**. Following this transmission, the ICD **10** retires to wake state **724**.

Turning back to step **760**, if the signal is not identified as an interrogation-or recommitment signal, in step **784** the signal is evaluated to determine whether it is prompting the ICD **10** to transmit stored data to the computer terminal **60**, in which case in step **788** the data is transmitted before the ICD **10** retires to wake state **724**. If the signal was not identified as a prompt for data transfer (step **784**), then in step **794** the signal is evaluated to determine whether it is prompting the ICD **10** to delete specified data, in which case in step **796** the specified data is deleted before the ICD **10** retires to wake state **724**.

If the signal was not identified as a request to delete specified data (step **792**), then in step **800**, the signal is evaluated to determine whether it is prompting the ICD **10** to digitally sign a document or data record using its private key. If the signal is not identified as a request to digitally sign a document, the signal is treated as an unspecified command, upon which the ICD **10** takes no action, instead retiring to wake state **724**. If the signal is identified as requesting a digital signature (step **800**), in step **804** the computer terminal **60** or the ICD **10**, by means of its audible alerting device **20**, prompts the physician to depress the activation button **18**. In step **808** the ICD **10** waits for the physician to respond for a limited time period. In step **812**, if the activation button **18** has not been depressed before the expiration of this limited time period, then in step **816** the ICD **10** returns a signal indicating that the signature has not been provided, retiring then to wake state **724**. In this manner a digital signature will not be provided without the affirmative agreement and action of the physician. If in step **812**, the activation button **18** had been depressed within the limited time period, in step **820** the document, a message digest or an information packet is encrypted in whole or in part and transmitted to the computer terminal **60**, the ICD **10** afterward retiring to wake state **724**.

Though not illustrated, the activation button **18** may be pressed for several seconds in order to suspend automatic log on access to a computer terminal **60** without being prompted to enter a password. The ICD **10** may emit an audible sound to indicate that automatic log on has been suspended.

In addition, while the preferred embodiment is described above wherein a terminal initiates an interrogation process, it is also possible in other embodiments to initiate an interrogation via the ICD either every time an ICD is proximate a terminal or when an earmarked ICD button is pressed.

IV. Browser Initiation

It is contemplated that the inventive ICD/smart device system will be used with conventional computer terminal hardware which can be employed to run other useful software programs. To this end, when a physician nears a terminal and the terminal and the physician's ICD **10** perform an interrogation, the physician will simply be logged onto the terminal and ICD information packets may or may not be automatically transferred to the terminal, depending on how the terminal is configured. In a preferred embodiment, after a successful interrogation, a terminal automatically queries an ICD **10** to retrieve information packets for display. In another embodiment, after a successful interrogation, a physician is given the option to use any terminal capabilities which the physician is authorized to use. For example, in addition to downloading information from the physician's ICD to the terminal, the physician may wish to use a wordprocessor or a spreadsheet, access the Internet, access e-mail and so on. In this embodiment, upon accessing a terminal, the physician is given the option to select any of several different applications. Instead of automatically querying an ICD **10** for information packets to transmit packets, a physician must press activation button **18** (see FIG. **1**) at which point packets are transmitted.

In either of the above embodiments (i.e. automatic and manual packet transfer), when not using a terminal to display packet information, the terminal must be useable for other applications.

To enable a terminal to facilitate various applications and still be ready to receive ICD **10** data, preferably, a split screen is maintained by the terminal. Referring to FIG. **22**, an exemplary split screen **523** is illustrated. Screen **523** includes an upper window **525** and a lower window **527**. Although illustrated as relatively large, in reality, lower window **527** is extremely small (e.g. a single line) so that a selected application can take essentially full advantage of entire screen area **523**. Generally, a selected application (e.g. a word processor) runs in window **525**.

Exemplary HTML code for controlling window **525** is indicated in box **901**. Lines **903** and **905** indicate that the information from www.abc.com and from address

l:swap.htm, respectively, should be displayed in windows **525** and **527**, respectively, wherein "l" corresponds to the address location associated with the input device and acts as a device similar to a disk drive. In window **527** code segment **529** is provided at a time 1 prior to information being provided at address l:swap.htm, Segment **529** includes a "Refresh" command **907** and a command "url=l:swap.htm". Refresh command **907** indicates that window **527** should be refreshed periodically (e.g. every 3 seconds) with data stored at address l:swap.htm. Where no data is stored at address l:swap.htm, window **527** remains relatively small (e.g. a single line at the bottom of the screen). However, upon a refresh cycle, when information has been provided at l:swap.htm, window **527** is automatically expanded such that the information can be displayed therein.

When an information packet is received from an ICD **10**, either through automatic query or pressing button **18**, the packet is stored at l:swap.htm which emulates a disk drive and segment **529** is the code sample in the file.

Thus, after an ICD **10** first establishes communication with a terminal, until information packet transmission to the terminal, a physician can use any of several different terminal applications in window **525**. However, once an information packet is received, code line **909** expand and refresh window **527** with a screen which is configured via the received information packets.

For example, assume a physician's ICD **10** includes three patient information packets which the physician is to review via a terminal. Prior to receiving the packets, however, the physician would like to review data on ABC Corporation which is accessible via the Internet. When the physician is proximate a terminal, the terminal and ICD **10** perform an interrogation process and, after a successful interrogation, the terminal allows the physician to access the terminal. In the first embodiment (i.e. automatic packet query), the input device automatically retrieves the ten packets from the ICD **10** and stores the packets on disk address l. The next time (e.g. within 3 seconds) screen **532** is refreshed, the browser displays a screen configured accordingly to the packets stored at address l:swap.htm.

Referring to FIG. **24**, an exemplary HTML code segment **911** which may be provided at a time 2 to address l:swap.htm via an ICD **10** and a resulting terminal screen **499** are illustrated. Segment **911** expands window **527** and reduces window **525** and provides three different types of information including a summary phrase **501**, separate record or information unit summaries in a table **913** and interaction icons **503** and **505**. Phrase **501** summarizes table **913** information and in the example indicates there are three records to review. Table **913** presents the records to review in summary form. The interaction icons include REVIEW and STORE icons **503**, **505**, respectively.

Either of icons **503** or **505** may be selected using a mouse controlled cursor (not illustrated). Because the physician wishes to first use the Internet to access ABC Corporation data, the physician selects STORE icon **505** which stores the packets on a terminal or network memory device for later review. Thereafter, screen **523** (see FIG. **22**) is redisplayed, including expanded window **525** and reduced window **527** (see FIG. **22**). Window **527** waits for additional packets on drive **1**. In window **525** a personal menu of icons representing applications for the accessing physician is provided, one of the selectable icons corresponding to the physician's Internet account. The physician selects the Internet icon, reviews ABC Corporation data and can then return to an application which allows review of the stored packets.

Referring to FIGS. **1** and **22**, in the second embodiment where packets are not transmitted until button **10** is pressed, when a physician gains access to a terminal, screen **523** is initially displayed, the physician's personal menu of application icons displayed in window **525**. In this case, the physician selects the Internet icon, reviews the ABC Corporation information and then closes the Internet application.

At any time while the physician maintains access to the terminal, the physician may press button **18** to transmit information packets to the terminal. When button **18** is pressed, packets are sequentially stored to and at l:swap.htm and then provided to the terminal. Upon the next refresh cycle (e.g. 3 seconds), an initial screen (see FIG. **23**) characterizing the packets and providing options is provided.

V. Interrogating ICD

Referring now to FIGS. **1** and **23**, a preferred embodiment of the ICD badge **10** is identified as ICD **401**. ICD **401** is essentially identical to ICD **10** (FIG. **1**) having the same internal components, an alarm indicator, a speaker, an audio digitizer, a transceiver, a visual indicator (e.g. picture, text, etc.) and so on. However, ICD **401** is different than ICD **10** in that the activation mechanism is different.

FIG. **23** is a perspective view of ICD **401** showing, generally, the back side of ICD **401**, the front side of ICD **401** appearing as illustrated in FIG. **1**. Instead of having a conventional activation button (**26** in FIG. **1**), ICD **401** includes an interrogating activation button **403** which includes a finger print pad **405** which is approximately the size of a thumb. Pad **405** is capable of discerning the characteristics of a fingerprint when a thumb is pressed thereon. Various systems for discerning fingerprint characteristics have been provided in the prior art and therefore will not be explained here in detail. Suffice it to say that any method for discerning characteristics may be used here which can be implemented in a relatively small electronic package. Pad **405** is linked to the ICD processor (see FIG. **6**) and provides print characteristics to the processor for interrogation.

Because each ICD **401** is an identification badge, each ICD **401** is uniquely associated with a single physician. Therefore, when an ICD **401** is initially provided to the physician, the physician commissions the ICD **401** by placing the physicians thumb on pad **405** a first time. During a commissioning protocol, the first time a thumb is placed on pad **405**, the ICD processor discerns fingerprint characteristics and stores the discerned characteristics in an ICD memory (see FIG. **6**). In addition to storing fingerprint characteristics, the ICD processor is equipped with code for comparing fingerprint characteristics and based on the comparison, for either allowing ICD functions to be performed or disabling ICD **401**.

To this end, prior to ICD **401** being used for any information gathering, transmitting, generating or interrogating purposes, a physician must place her thumb on pad **405** pressing button **403**. With her thumb on pad **405**, the ICD processor again discerns fingerprint characteristics and compares the discerned characteristics with the stored characteristics. Where the discerned and stored characteristics are essentially identical, ICD **401** is enabled. Upon a match ICD **401** may either be programmed to be enabled for one transaction or a certain number (e.g. 10) of transactions or, in the alternative, may be enabled for a specific time period or, where ICD **401** is used to perform a transaction within a specific time window, may remain enabled for a subsequent period.

Where the discerned fingerprint characteristics do no match the stored characteristics, ICD **401** may do any of several different things. First, ICD **401** may simply disable itself until an authorized facility administrator resets the ICD **401** for another identification attempt. Second, ICD **401** may

allow several (e.g. 3 or 4) attempts to generate a match and only after several failed attempts disable itself. Moreover, when ICD **401** disables itself, ICD **401** may either cause an audible or a visual signal indicating a mismatch and may continue to cause the signal to alert passersby that an unauthorized person attempted to use the ICD **401**.

ICD **401** is uniquely advantageous for a number of reasons. First, ICD **401** ensures that only a specific physician associated with ICD **401** can use ICD **401** for collecting, generating, and transmitting information and for interrogating other smart devices. This is particularly important, as will become clear below, in instances where successful interrogation enables a physician to perform some procedure or to administer some drug. For example, one example explained in more detail below allows a physician to open a drug container (see FIG. **5**) only after a successful interrogation is completed between the container and an ICD **401**. The interrogation is meant to ensure that the user of ICD **401** is authorized to administer the drug inside the container. While the interrogation provides one level of security, there is no way to ensure that a physician's ICD **401** will not be misplaced or stolen in an attempt to mismedicate a patient. With ICD **401**, even if the ICD **401** is stolen, a would be mismedicator could not open a drug container unless the physicians fingerprint could also be duplicated.

Second, while other systems for identifying personnel via fingerprint or other biometric indicia are prevalent in the prior art, many such systems require that users "give up" control of their indicia by providing the indicia to a system administrator. For example, a security system for restricting access to an office building may include a security server and a plurality of fingerprint pads located at building entrances and perhaps at other doors located throughout the building. The security server has access to a memory storage device where fingerprint characteristics corresponding to each person who has authority to access the building are stored. To enter a building, a person places her thumb on a pad, the pad discerns fingerprint characteristics which are provided to the server and the server compares the characteristics to all sets of fingerprint characteristics which correspond to personnel who have authority to access the building through the specific door. Where discerned characteristics match a stored characteristic set, the building allows entry. If the discerned and stored characteristics do not match, the building restricts entry.

Unfortunately, with the system described above, each of the people whose fingerprint characteristics are to be examined during an access attempt must agree to provide their fingerprint characteristics to the security server to enable comparison. While providing such biometric indicia is not difficult, many people object to giving and only grudgingly give, such information as they feel that type of information is private. Clearly, if every building a person entered would have to have personal biometric indicia, peoples biometric information would be virtually everywhere.

Another problem with such a system is that, like a door handle, many (e.g. hundreds and even thousands) people may be placing their thumbs on a single fingerprint thumb pad every day. Such access to the pad not only seems unsanitary but in fact is unsanitary as germs are spread via the pad.

With the inventive ICD **401**, all personal biometric indicia remains personal and does not have to be "given up" to some administrative server. This is because ICD **401** and not some amorphous server, performs the interrogation and enables ICD **401** to operate. Thus, personal biometric indicia is never accessible by a device outside a physician's own ICD which the physician controls to at all times.

In addition, with ICD **401** only the physician who "owns" ICD **401** will be placing her thumb on pad **405** unless some mistake is made. Thus, ICD **401** is relatively sanitary.

Another advantage of ICD **401** is that, because ICD **401** is only useable by a single physician, only a single set of fingerprint characteristics have to be stored by the ICD processor and discerned characteristics during an interrogation need only be compared to a single set of stored characteristics. These advantages cut down both on required memory and processor time necessary to complete an interrogation which means that ICD **401** need only have a relatively simple processor.

It might also be noted that while the fingerprint pad activation button has been described in the context of ICD **401**, clearly this aspect of the present invention could be used in many other technical areas. For example, in the case of a building entry security system as described above, a smart card may be provided which is similar to ICD **401** except that, upon enablement, the card may only be able to unlock a door. In this case, to open a locked door, first, a user places her thumb on a smart card fingerprint pad similar to pad **405** (see FIG. **23**). The pad discerns print characteristics and provides those characteristics to a card processor. The processor compares the characteristics to a stored characteristic set corresponding to the card owner. Only if the stored and discerned characteristics are essentially identical will the card be enabled to unlock the door. When the card is enabled, rather than indicating the fingerprint characteristics to the security server, the card sends out an identification signal to a receiver (e.g. RF or infra-red) which provides the identification signal to the server. The server then compares the identification signal to stored valid identification signals to determine if the received signal corresponds to a person who is authorized to open the door. The door is only opened if a match occurs. In this manner a security system which uses personal biometric indicia can be provided without requiring users to give up control of their indicia.

Moreover, the fingerprint pad activation button could also be used in the context of a credit card to enable or disable a credit card on the basis of a simple fingerprint check as described above with respect to the access card. To this end, to charge a purchase, a user places a thumb on a pad, a comparison is performed and, only when a match occurs is a purchase authorized.

While the inventive pad activation button has been described above in the context of a fingerprint pad, the invention is not meant to be so limited and any other recognizable biometric indicia or uniquely personal biomedical indicia could be used to activate a properly configured activation button. For example, a retinal scanner, voice recognition identifier skin texture identifier, etc., could be used to activate a button and so on.

VI. Operation of an ICD in Collecting Data

FIGS. **17**A through **17**C describe the operation of an ICD **10** in gathering and exchanging data with smart devices with which ICD **10** is in communicable range. This operation is described particularly, but not by way of limitation, in the context of a hospital, where the exchange of information between ICD **10** and a plurality of smart devices assigned to various patients and distributed throughout the hospital may be limited by the access privileges corresponding to patients whom or with whom a physician is authorized to diagnose, treat, or interact. Referring again to FIG. **4**, a single hospital room **104** (FIG. **4**) may include a number of smart devices, including a computer terminal or workstation **60**, a patient identification display **100**, a bedside communication device **96**, a patient treatment device **116'**, and a patient monitor **80'**,

each of which may communicate with the ICD **10** or, in some circumstances, with each other.

Generally, smart devices like bracelet **40** (see FIG. **2**) or container **200** (see FIG. **5**) include information about a patient or a medical event and/or generate information about a medical event, the included or generated information being stored as one or more information segments in respective device memories. When a physician decides to collect information from a smart device, the physician establishes communication between the device and the physician's ICD **10** and causes the smart device to transmit stored information segments to ICD **10**. For the purpose of this explanation, the term "data record" is used to describe a grouping of information which is to be transferred among system devices and may include a simple information segment or a more complex construct such as an information packet referenced above and described in more detail below.

When ICD **10** receives one or more information segments, ICD **10** recognizes the nature of the segments and stores related segments as an information unit in HTML format. In addition, ICD **10** may also generate other information segments which can be added to received segments to provide enhanced information units. Exemplary additional segments may include a time and date stamp generated by badge processor **250** (see FIG. **6**) and physician identifying information (where available).

Moreover, ICD **10** also provides two other types of information. First, ICD **10** includes an address specifier (i.e. the ICD processor) which provides a server target address for each information unit formed. The target address specifies a specific server or database address to which the information unit should be sent for storage or processing on system **194** (see FIG. **7**). Second, ICD **10** also provides browser formatting information which indicates how browser **115** should present information in an associated information unit on display **103**.

For each information unit browser **10** assembles an information packet which includes the information segments in each unit, an associated server address and relevant configuration information. Importantly, each information packet assembled by an ICD **10** is in HTML format so that the packet can be received by a conventional browser **115** for display.

Subsequently, after a physician has gained access to a terminal **60** (see FIG. **3**), the physician causes information packets assembled by the physician's ICD **10** to be transmitted to the terminal **60** via an input device **64**. The packets are received and read by browser **115**. Browser **115** displays information unit information in the format indicated by the configuration information and stores the relevant server target address.

In addition to indicating how information unit information is to be configured on display **103**, configuration information may also provide on-screen tools for modifying some or all of the unit information displayed. For example, where displayed information specifies a medication dose which was supposedly delivered to a patient, while the displayed dose may indicate the dose dispensed by a pharmacy, upon administration, a physician may have elected to modify the dose. In cases where such modifications can be anticipated, the configuration information provides a tool (e.g. a pull down window) for modifying the displayed dose prior to storing the unit information.

Moreover, the configuration information may also facilitate hyper links to additional information which is related to displayed information. For example, again, in the case where a medication is dispensed, displayed information will typically include the dispensing physician's name. In this case, the configuration information highlights the physician's name **464** and provides a hyperlink address "behind" the physician's name to a biography site specifying information about the physician. Similarly, a patient's name or identification number may be linked to a medical history record for the patient via hyperlink **445**.

After a physician reviews and perhaps modifies displayed information packet information, the physician approves the information by selecting an approval icon **476** on display **103**. When icon **476** is selected, browser **115** causes an "electronic signature" to be attached to the approved information in a manner described in more detail below. Thereafter, browser **115** sends the approved information to the server target address for storage and/or processing.

In the preferred embodiment, data exchange between an ICD **10** and a smart device associated with a particular patient is conditioned upon, and must be preceded by, establishing an "association" between a physician using an ICD **10** and the patient with whom a smart device is associated. Preferably, an association is digitally recorded by the ICD **10** in the form of information uniquely identifying the patient, the smart device and/or the ICD **10** itself, and the time and date of the association. This information may later be appended to information packets exchanged with smart devices and computer terminals **60**, providing information packets with a complete audit trail. Further, smart devices and ICDs **10** themselves may also digitally record associations in a similar fashion.

Referring to FIGS. **1** and **17**A, at step **824**, a physician attempts to initiate a communication link or exchange information with a smart device by placing the physician's ICD **10** proximate a smart device and pressing ICD activation button **18** (FIG. **1**). Depending on the sophistication of ICD **10** and the smart device and the sensitivity of the information to be exchanged, the communication established with the smart device may or may not utilize public key cryptography. While link initialization may be automated rather than user-initiated, making the links user-initiated allows ICD **10** to conserve energy and prevents unnecessary link initialization with devices with which a physician is not concerned. Alternatively, the smart devices may be individually and manually enabled to communicate through the use of activation switches incorporated in the smart devices. Provided that the signal path between an ICD **10** and a smart device is substantially unobstructed and short enough that signal transmissions are not excessively attenuated, a communications link is established.

In step **828**, ICD **10** evaluates the existence, if any, of an association between the ICD **10** and any patient (not necessarily the particular patient to which the linked smart device is directed). An association exists if ICD **10** has most recently been used with a smart device which is associated with a patient. In this case, ICD **10** stores information specifying a specific patient. For the purposes of this explanation it will be assumed that the identifying information comprises a patient's identification number which, if an association exists, is stored as an identification information segment by ICD **10**. Thus, to determine if an association exists, ICD **10** determines if an identification information segment is occupied. If there is no association, in step **832** ICD **10** transmits to the smart device its own identification information and a request for information to be returned. If there is an association, in step **836** ICD **10** transmits its own identification information, patient identification information (of the patient with whom ICD **10** is associated), and a request for data to be returned.

Steps **832** and **836** are each followed by step **840**, in which ICD **10** waits for a predetermined time period for a response

from the linked smart device. If no response is received within the predetermined time period (step **848**), then in step **852** ICD **10** emits a first audible sound to alert the physician that no response was received from the smart device. In step **856** the operation initiated by the physician in step **824** is terminated. If instead a smart device transmits a response in the form of a recognizable information segment which is received before the predetermined time period elapses (step **848**), then referring also to FIG. **17**B, in step **860** the data record or information segment contained in the response signal is stored. In addition, referring also to FIG. **6**, processor **250** identifies the time and date via clock **254** at which the information was received and stores a time stamp as a second information segment, combined with the received information segment, as an information unit.

One type of information segment or data record which may be transmitted to an ICD **10** is a patient identification record. An exemplary record is illustrated in FIG. **9** and includes an identification number, name and distinguishing characteristics. All or only a small part of the information illustrated may be included in a transmitted record but at least the identification number is transmitted.

If the data record or information segment stored in step **860** is a patient identification record (step **864**), and if ICD **10** is already associated with the patient indicated by the record (step **868**), then in step **876** ICD **10** emits a second audible sound readily distinguishable to the human ear from the first audible sound of step **852**, signaling to the physician that ICD **10** is associated with the patient and that the exchange of information was successful.

If the data record or information segment recorded in step **860** is a patient identification record (step **864**), but ICD **10** is not associated with any patient (steps **868** and **872**), then in step **874** ICD **10** records the patient's identification number in the identification information segment to establish an association and in step **876** emits said second audible sound.

If the information segment recorded in step **860** is a patient identification record (step **864**) identifying a first patient, but ICD **10** is associated with a second patient (steps **868** and **872**), then in step **878** the association with said second patient is closed and a new association is established by recording the first patient's identification number in the identification information segment. In step **880** ICD **10** emits said second audible sound twice to indicate the closure of a previous association and the initiation of the current association.

If the data record information segment recorded in step **860** is not a patient identification record (step **864**) but if ICD **10** is already associated with a patient (step **888**), then in step **892** the data record is modified. In this regard, the received information segment is combined with the current identification information segment (i.e. the segment which identifies the patient with which ICD **10** is currently associated) and perhaps other information segments to form an information unit (i.e. an enhanced data record). The other information segments may include a time stamp segment, a physician segment and so on. The information segment received and other information segments which identify both the physician and the patient (i.e. the identifying information previously recorded in establishing the current association between ICD **10** and patient) are combined to form an information unit. Further, the ICD **10** emits said second audible sound to indicate the successful transaction.

If the data record or information segment recorded in step **860** is not a patient identification record (step **864**) and if ICD **10** is not currently associated with a patient (step **888**), then in step **896** the data record is modified to include identification information attributable to the physician to which ICD **10** is assigned. To this end, the received information segment is combined with a physician information segment which identifies the physician and perhaps other information segments (e.g. a time stamp) to form an information unit. Further, the ICD **10** emits said second audible sound to indicate the successful transaction.

Although not illustrated by flow chart, association of ICD **10** with a patient may be manually terminated by depressing activation button **18** for a few seconds, after which ICD **10** emits an audible sound to indicate that the association has been terminated. An association with a patient may also be automatically terminated after a sufficient period of inactivity with respect to ICD **10**.

FIGS. **14**A and **14**B illustrates an exemplary HTML coded information packet **440** which corresponds to a medication dispensation event and which is provided by an ICD **10**. Packet **440** may be provided in any of several different ways.

First, packet **440** may be constructed by ICD **10** as ICD **10** receives certain types of information. In this case, ICD **10** is provided with packet configuring software which recognizes information segment type and thereafter tailors a specific packet for the received segment.

Second, packet **440** may be constructed primarily by some other network device and provided to ICD **10**. For example, referring again to FIG. **7**, dose dispenser **150** dispenses medication for administration. The type of information generated during administration is often very similar (e.g. time, date, type, dose, patient ID, physician ID, etc.). In this case, dispenser **150** may provide a general packet format to a medication container (see FIG. **5**) which is in turn provided to ICD **10** when a drug is administered.

Third, a smart device (e.g. an IV pump) may provide a general packet format including target address along with data provided to an ICD **10**.

In FIGS. **14**A and **14**B, packet **440** includes a target address field **444** which specifies a server address to which packet information is to ultimately be delivered. The exemplary target address includes a hospital name, an event type ("mediation") an event specifier ("given"), a patient identification number ("987654321"), an event date and an event time. Packet **440** also includes a report type indicator **448**, a field **452** for indicating that patient ID has been verified and format medication quantity fields and **456** and **460** indicating how much of the dispensed medicines was administered. To this end, fields **456** and **460** are set up so that, initially, each format field **456**, **460** causes the medicine dose dispensed to be displayed. In addition, fields **456** and **460** provide interaction tools for modifying the displayed dose to reflect actual administered doses. Thus, field **456**, which corresponds to Penicillin dose, allows a physician to modify an initially displayed dose of 2 capsules by selecting either 1.5, 1, 0.5 or none as the actual administered dose. Similarly, field **460**, which corresponds to Tylenol dose, allows choices of 1, 0.5 and none to identify administered dose.

Packet **440** also includes a physician identification field **464**, and a date and time field **468** indicating time of medication administration. Packet **440** further includes a dispenser identification field **468** indicating the physician who dispensed the specific medication, the date and time of the dispension and so on. Hidden fields **472** which incorporate information to be transmitted along with information to be displayed but concealed from view through the browser display, may also be added. Information appropriately concealed may include initial quantities of medication dispensed, which information may be compared with the amount actually administered. Packet **440** further includes an approve field **476** which specifies configuration of an APPROVAL icon on

display **103**. The APPROVAL icon allows a physician to approve of information displayed via browser **115**. When field **476** is displayed and an associated icon is selected via browser **115**, information in packet **440** is transmitted for storage to a database **158** or **162** at the server target address indicated in field **444**.

Referring also to FIG. **14**C, an exemplary browser screen **480** which corresponds to packet **440** is illustrated. Screen **480** includes a plurality of elements which indicate all information associated with a drug administration event. The elements, which correspond to identically marked fields in packet **440** (see FIGS. **14**A and **14**B), include an identification element **445**, a report type element **448**, an ID verification element **453**, modifiable dose elements **456** and **460**, an administrating physician identification element **464** including date/time **469**, a dispensing physician identification element **468**, and approval icon **476**. When formatted data packet **440** is transmitted to a terminal **60**, the ICD **10** may be programmed to emulate a file structure device, wherein the open file command of the browser **480** may be used to request data from the ICD **10**.

Thus, generally, ICD **10** formats an information packet (i.e., in the present example, a medication administration record) for delivery to network system **194** via a computer work station **60** which includes three types of information. The three information types include general information (including, perhaps identification information) to be stored, a target server address (i.e. a target address field) at which the general information is to be stored and browser screen configuration information (i.e. format fields) indicating how the general information to be stored should displayed for review, modification and approval by a physician.

In addition to receiving information from a smart device, ICD **10** is also capable of receiving dictation for storage in one or more information units for delivery to system **194**. Referring to FIGS. **1** and **18**, while observing or treating a patient, a physician may, in step **900**, press dictation button **26** and dictate messages (step **904**) into microphone **22** of ICD **10**. Digitizing circuitry incorporated in processing circuitry **260** (FIG. **6**) digitizes the message (step **904**), which is recorded as a message record or dictation information segment in memory element **262**. If ICD **10** is associated with a patient at the time the dictation is recorded (step **908**), then in step **912** patient identification information and a time stamp are incorporated into the message record. To this end, ICD **10** combines the identification information segment, the time segment and the dictation information segment into an information unit. Further, in step **912** a database address or server target address is formulated for the information unit using the time stamp, the dictation data type and patient identification information. Further, in step **912** the ICD **10** emits said second audible sound. If the ICD **10** is not associated with a patient at the time the dictation is recorded (step **908**), then in step **916** a time stamp segment is added to the dictation information segment to form an information unit. Further, in step **916** the dictation data type and time stamp are combined to form a partial database address for the information unit. Further, in step **916** the ICD **10** emits said second audible sound.

Dictation information is treated like any other gathered information in the sense that ICD **10** formulates an information packet including a segment associated with the collected information. The only difference is that the collected information is digital audio. It is contemplated that when a packet includes a dictation segment, ICD **10** will construct a packet including a field which will provide a "Dictation" icon associated with the dictation segment, the icon being displayed when the packet information is reviewed via browser **115**. When the dictation icon is selected, the dictation associated therewith is replayed via terminal **60** for physician review. In addition, other icons for controlling dictation review (i.e. fast forward, reverse, stop, pause, etc.) may be configured via packet configuration information.

In addition, it is contemplated that in many instances both statistical information and audio dictation may be collected during a single patient visit. In this case, ICD **10** may do one of two things. First, ICD **10** may formulate a single message packet which includes all collected information and appropriate browser configuration information. In addition, in this case, if appropriate, ICD **10** may be programmed to, generate more than a single target address for all of the packet information or, different target addresses for the various types of packet information. For example, while a dictation segment should be transmitted to a transcription server for conversion to text (either manually or automatically by voice recognition software), medication administration information should be provided to the pharmacy server for logging and to determine if proper administration occurred. Either all information could be provided to both the transcription and pharmacy servers or only relevant information may be provided to the respective servers.

Second, where more than a single type of information is collected during a single patient visit, ICD **10** could be programmed to formulate two separate information packets for delivery to a terminal **60**, a separate packet corresponding to each information type. For instance, in the example above, one packet may be formulated for dictation while a second packet is formulated for statistical information. While various packet schemes are possible, the preferred scheme provides only a single information packet for each patient visit which would include all types of information collected. This scheme has the advantage of maintaining a complete record for each patient visit which can be stored in a patient's historical records to memorialize all aspects of this visit. Then, if specific servers require specific collected information (e.g. dictation, administration, administering physician, etc.), a central server can determine which information should be sent to each specific server.

In addition to generating specific information packets for transmission to browser **115**, ICD **10** is preferably programmed to construct an initial screen packet. The initial screen packet, like other information packets is formatted in a conventional language such as HTML so that, when received by browser **115**, browser **115** can display packet information as specified. The initial screen packet will typically include information which summarizes other packets to be transmitted to a terminal **60** and configuration information. For example, where ten information packets are to be transmitted to a terminal **60**, the summary information may simply indicate "There are 10 patient records to review." The configuration information indicates how the summary information should be displayed, may provide instructions and typically provides icons for physician interaction. Exemplary icons include a "REVIEW" icon and a "STORE" icon. An exemplary initial screen **499** is illustrated in FIG. **24** and includes a prompt phase **501** and icons **503** and **505**.

Referring to FIG. **3** when ICD information packets are transmitted to a terminal **60**, the initial screen packet is also transmitted. The input device **64** receives all packets, distinguishes the initial screen packet from other packets, stores the other packets in RAM **109** and provides the initial screen packet to browser **115** for display. Browser **115** displays an

initial screen (see FIG. **24**) corresponding to the initial screen packet providing interaction icons REVIEW **503** and STORE **505**.

If REVIEW icon **503** is selected, browser **115** accesses the first packet in RAM **262** and displays associated information as configured by the packet. After review of the first packet browser **115** displays record packet information and so on. If STORE icon **505** is selected, browser **115** stores the initial screen packet along with associated other information packets in RAM **109** (or some other suitable storage location) for later review and approval.

Other aspects, not included in FIGS. **17**A through **17**C, may be involved in communicating with or between certain smart devices. In one embodiment, the presence of a physician in proximity to a patient enables communication between the patient's wrist bracelet **40** (FIG. **2**) and the physician's ICD **10**. The communication link may be initiated by pressing the activation button **18** on the ICD **10** and/or an activation button (not illustrated) on the wrist bracelet **40**, provided there is a complete signal path between the ICD **10** and the wrist bracelet **40**. Once a communication link is established, ICD **10** identifies the patient and records the establishment of an association with that patient. ICD **10** may also request and receive additional information stored by the wrist bracelet **40**, providing a beep, vibration or other sensational signal to indicate a successful transmission or to alert a physician. The wrist bracelet **40** may also record in its own memory the staff identification information and current date and time from the ICD **10** to provide an audit trail of the physicians who have associated themselves with the patient. If communication and association is established with another wrist bracelet **40** or, if not, after a preset period of time has elapsed, the ICD **10** regards the association to have terminated and alerts the physician to this fact with another beep, vibration or other sensational means of communication.

In another embodiment, the wireless communication means **52** of wrist bracelet **40** (FIG. **2**) may utilize alternate communication means, such as magnetic coupling or low power radio transmission, rather than the preferred infrared means of the ICD **10**. Similady, the bedside communication device **96** (FIG. **4**) of a patient bed **88** may also utilize alternate communication means. Further, the communication range of wrist bracelets **40** or other smart devices may be limited in order to prevent two devices from receiving the same request. Instead of communicating directly with the ICD **10**, the wrist bracelet **40** may communicate with patient identification display **100** directly or indirectly via communication with the communication means of a bedside communication device **96**. A patient identification display **100** may also have transceiver device **64** compatible with the communication means **14** of the ICD **10**. The smart devices may be arranged and implemented so that the patient identification display retrieves the patient identification information from the wrist bracelet **40** and electronically displays it. The patient identification display **100** may be programmed to cease displaying the patient identification information if the patient bedside device **96** no longer senses the presence of the patient. Patient chairs may be similarly equipped with smart devices to sense the presence of a patient and to convey such information to a patient identification display **100**. Further, in order to establish an association with a patient, the ICD **10** may be required to establish a communication link with the patient identification display **100** instead of or in addition to the wrist bracelet **40**, which patient identification display **100** would in turn transmit the patient identification information to the ICD **10**. This would permit the transfer of patient identification information without the possible necessity of disrupting the patient in order to establish a communication link with the patient's wrist bracelet **40**.

If a new patient comes to occupy the patient room **104** or the patient bed **80**, the patient identification display **100** obtains the new patient identification information from the wrist bracelet **40** worn by the patient and may be structured to transmit that information to the Admit, Discharge and Transfer System **166** (FIG. **7**) of the computer network **194**. Alternatively, the patient identification display **100** could display a request for input indicating whether or not the new patient is to be marked as having been transferred to the instant patient room **104**. A patient monitoring device **80** (FIG. **4**) or bedside treatment device **178** (FIG. **7**) may reject a data exchange request from an ICD **10** if the physician wearing the ICD **10** is not authorized or cleared to diagnose or administer treatment to the patient. FIG. **12** illustrates the contents of the monitoring or treatment device information **380** that the bedside treatment device or patient monitoring device **80** may transmit to the ICD **10** if the data exchange is authorized. As part of a double-audit function, the monitoring device **80** or the bedside treatment device **178** would itself record any data transaction made with an ICD **10**.

VII. Electronic Signature

Hereinafter, while information units and information packets as described above are still contemplated, other types of information such as word processor documents, spread sheets and the like are also contemplated and all such information types will be collectively referred to as documents.

An extremely important aspect of the present invention is that a physician's identity is added to collected information or documents prior to long term storage or transmission to a server for further processing. By adding a physician's identity, the system creates proverbial "ownership" of the document (i.e. information collected).

Taking this "ownership" one step further, according to another aspect of the invention, the information approval process which must be performed prior to long term document storage or transmission to a server requires a physician to take "responsibility" for approved documents. To this end, the present invention contemplates a digital signature procedure whereby, when a physician approves a document, the physician's identity and, also preferably, an indication of the content of the document approved, are added to the approved document. This type of approval system helps ensure that documents are accurate. This is because, if a physician knows approved documents are to be recorded and attributed to the approving physician, the physician will be more careful to ensure document accuracy.

In one embodiment a simple text phrase is provided in a document approval field. For example, upon approval the phrase, "Dr. Smith approved this document on Tuesday, Aug. 25, 1998 at 10:30 AM", may be added to the document.

The physician's identity may be determined in any of several different manners. For example, as a physician's ICD **10** must gain access to a terminal to review document information, the physician's ICD **10** may, during the interrogation process, provide an indicator of the physician's identification. In the alternative, each time an approval icon is selected the terminal may send a message to the physician's ICD **10** requiring a physician's digital signature. When the message is received the ICD **10** transmits the physician's digital signature in encrypted form. In this case, when a terminal receives the encrypted digital signature the terminal deciphers the encryption and correlates a physician with the digital signature.

In another embodiment, when a physician logs onto a terminal in a conventional manner (e.g. entering a password)

via a keyboard), the terminal may identify the physician and subsequently add the physician's identity to each document approved by the physician.

While a simple text phrase indicating approval suffices to convey that a specific individual approved a document at a specific time, such text phrases are relatively impersonal and therefore have relatively little value in terms of creating a "feeling" of responsibility for approved documents. Therefore, preferably, instead of providing an impersonal text phrase to indicate approval, a picture of a physician's actual scripted signature (i.e. a signature picture) may be digitized and stored in an ICD memory, the signature picture provided to the terminal for insertion in the approval field along with the time and date of approval. The signature has traditionally been an indicator of responsibility and therefore indicates the import of the approval process to the approving physicians.

Unfortunately, even where a digital signature picture is provided, it is possible for an unscrupulous physician or some other unscrupulous person who has access to a stored document to effectively electronically modify the approval field by, for example, copying a physician's digital signature picture from one approval field into another. While such copying may be accomplished electronically by cutting a signature picture from one digital document to another, such copying or forgery may also be accomplished after a digital document has been printed out in paper document form. For example, after a digital document is printed, a physician's signature may be clipped out of a first document, taped on a second document and copied via a high quality copier thereby rendering a document which was seemingly signed by the physician.

To ensure authentic signatures on documents, the present invention further includes an electronic "watermarking" procedure. A watermark is a mark which is difficult to reproduce and which is "laid over" some other information generally for the purpose of identification and indicating authenticity of the underlying information. For example, often a watermark will be provided on paper currency, the mark appearing like a water stain across a portion of the paper, hence the term "watermark". Watermarks have also been used to mark copyrighted material, the marks subsequently used to identify any copies of the copyrighted material.

Unlike currency watermarks, electronic watermarks and differences there between often are difficult to perceive via the human eye. Instead, electronic marks include pixels within a displayed picture which have specific and known characteristics. For example, one electronic mark on a screen display may include modified white pixels where every 10th white pixel which appears within the picture is slightly grey. While the specific color is slightly different than other white pixels, the difference is not detectible by the human eye. Instead, a computer is required to identify the pixilated watermark. In this case, if an electronically marked screen is electronically copied, suitable software running on a computer can be used to analyze the copy and detect the electronic watermark (e.g. the unique pixel intensities). In addition, where an electronically marked document is printed out, the watermark should be reproduced as a printed mark which can be used for subsequent authentication. Moreover, where a printed document including a mark is copied using a high quality copier the mark should be reproducible and thereafter useable to authenticate.

In addition to unique pixel shading, electronic marks can be provided by providing different pixel intensities, pixel intensity or shading designs, a uniquely configured pixel bar adjacent a graphic design and so on.

Like a digital picture, a physician's digital signature picture includes perhaps thousands of pixels. Unique signature picture pixel characteristics can be provided which can be used to identify authentic signature pictures. Unfortunately, as with a screen, a copied signature picture will often include the watermark pixels and therefore an authentic signature picture, as opposed to an electronically or manually (i.e. physical cut and tape) copied signature picture, may be difficult to identify.

To overcome the problem of accurately copied watermarked digital signature pictures, the present invention includes a content varying watermark which is generated as a function of the content of a document to which a signature is applied.

Generally, according to the present invention, in addition to storing a physician's signature picture, an ICD memory also stores a standard watermark (SM) which corresponds to the physician and a program for modifying the standard watermark SM as a function of document content (DC). When a document is to be electronically signed, the document is transmitted to the physician's ICD **10**. The ICD **10** recognizes the requirement for signature, retrieves the standard mark, mark modifying program and signature picture, isolates document content, modifies the standard mark as a function of the document content, places the modified mark on the scripted signature picture or on the document itself, places the marked signature picture on the document in an approval field and retransmits the "signed" document to the terminal. The modified mark MM can be expressed as:

$$MM=SM+f(DC)$$

wherein f indicates a function. Other equations for identifying the modified mark MM may be used. For example, mark MM may be a function of both the standard mark SM and document content DC (i.e. MM=f(SM, DC)) or may be a function of both standard mark SM and a different function of document content DC (i.e. MM=f'(SM, f(DC))), etc. An example of how this aspect of the invention operates is instructive.

In this example, it will be assumed that a physician is currently logged onto a terminal, has download various documents to the terminal for review and now wishes to approve a document prior to long term storage.

Referring specifically to FIG. **25**, when a physician selects an approve icon to approve a previously reviewed document, at block **601** the terminal determines if a watermarked signature is required for the document to indicate approval. Where a watermarked signature is required, at block **603** the terminal transmits the content of the document to be "signed" to the physician's ICD **10** along with a simple instruction indicating that a digital signature is required.

Referring also to FIG. **26**, when the ICD **10** receives the document and instruction at block **650**, ICD **10** recognizes the instruction and ICD control passes to block **652**. In some cases a document may include minimal information and therefore it might be difficult to generate a distinct and difficult to decipher watermark MM. Therefore, although not a requirement of the invention, it is contemplated that, in one preferred embodiment, there will be a minimum or threshold document content (TDC) requirement which indicates the minimum amount of content required to generate a mark MM. Where the document content DC is less than the requirement TDC, additional information, either random or meaningful, is added to content DC prior to modifying the standard mark. Meaningful data may include the current time or date.

The additional information is not necessary to understand the meaning of the document. Therefore, it is contemplated that the additional data would typically be added to the docu-

ment in some non-visual manner. For example, the additional data may be added as some hidden text in a hidden note field or the like. On the other hand, the additional data may be added as a visual bar having varying pixel intensities. The important aspect of the additional data is that the additional data enables a secure content specific watermark to be generated which is not easily subjected to decryption.

Referring again to FIG. **26**, at block **652**, ICD **10** compares the document content DC with the threshold requirement TDC. The comparison may be as simple as comparing the number of words or characters in the DC to a corresponding threshold number TDC. Where the DC exceeds the TDC, control passes to block **656**. Where DC is less than the threshold requirement TDC control passes to block **654**.

At block **654** ICD **10** adds additional text or numbers to the DC thereby generating a new document content. As indicated above, the additional data is preferably, although not necessarily, added so that it will not appear on the document when the document is displayed.

At block **656** ICD **10** retrieves the ICD user's scripted digital signature picture and applies the signature picture to an appropriate and designated location (i.e. the approval field) on the document. At block **656** ICD **10** retrieves the standard graphic mark from the ICD memory and modifies the standard mark SM as a function of the document content DC (e.g. the original document plus any additional data added plus the digital signature picture) to generate a modified mark MM. At block **659** ICD **10** applied the modified mark MM to the scripted digital signature picture generating a watermarked signature picture.

At block **660** ICD **10** replaces the digital signature picture on the document with the watermarked signature picture and at block **662** ICD **10** transmits the "signed" document back to the terminal.

Referring again to FIG. **25**, after having transmitted a document to an ICD at block **603** the terminal awaits return of a signed document at block **605**. When a document is received by the terminal control passes to block **607**. At block **607** the terminal determines if the received document was signed. At block **609**, where the document has not been signed for some reason, the terminal indicates failure to sign. At block **611**, where the document has been signed the terminal stores the signed document. In addition, to facilitate the "feeling" of ownership and responsibility for the signed document, the terminal may display the document with the physician's scripted digital signature picture thereon.

To allow a physician to confirm that approval occurred it is contemplated that, according to at least one embodiment of the invention, after a terminal displays a document including a signature picture, and prior to storing the document to long term storage or transmitting the document to a server for further processing, the terminal may provide a "STORE" icon which, when selected, stores or transmits the document including the signature picture. When the STORE icon is selected the document is transmitted.

When an approved document is accessed at a subsequent time, if there is any doubt that a signature picture is authentic, the physician's ICD **10** which was supposedly used to generate the signature picture can be used during an authentication process to re-generate the suspect document. Then, the suspect and regenerated documents can be compared to determine if the suspect document is authentic. Where the documents are dissimilar, an electronic forgery has been identified and the suspect document is identified as a forgery.

To confirm authentic approval, it is contemplated that, software which allows a physician to retrieve and review stored information units will provide some authentication functions while each physician's ICD will facilitate other required functions. For instance, in one exemplary embodiment the retrieval/review terminal software is capable of scanning in a watermarked scripted signature picture from a hardcopy of a document, scanning in an entire document including a watermarked signature picture, or selecting a signature picture from a document displayed on a screen. In addition, the software can magnify a digital signature and digitize the signature and watermark and can transmit the signature to an ICD along with a command requesting signature authentication. Moreover, the software also enables the terminal to receive a document from an ICD for display. The software may also enable split windows so that a suspect document and a regenerated document can be viewed side-by-side to facilitate visual authentication. Furthermore, the software may be able to perform document comparison to identify document discrepancies.

To authenticate, the ICD is able to receive a watermarked signature from a terminal, remove the standard graphic watermark from the watermarked signature, generate a regenerated document from the remaining marked signature and transmit the regenerated document to the terminal for examination. An example of how a signature is authenticated is instructive.

After a physician gains access to a terminal via an ICD-terminal interrogation, the physician selects a review software application which allows the physician to select and examine one or more documents which were previously approved and stored on a server in the manner described above. After selecting the review application, the physician selects one document (e.g. patient record or check, etc.) to examine and, referring to FIG. **27**, at block **701**, the software displays the selected document, in HTML format as earlier stored. As part of the stored document, the software displays a digital and watermarked signature picture purportedly representing the signature of the physician who approved the document. The date and time of approval may or may not also be displayed. In addition, the software also provides an "AUTHENTICATE" icon adjacent the digital signature picture. It will be assumed that the reviewing physician is the physician who purportedly originally approved the document being examined and that the physician's scripted signature picture, standard watermark and mark modifying program, all stored on the physician's ICD, remain the same.

While the physician is reviewing the document, the physician notices something which the physician cannot remember approving. For example, while the document may indicate that eight capsules of drug A were administered to a patient the physician may clearly remember that only two capsules of another drug B were administered. While the physician recognizes that she may have made a mistake, the physician nonetheless would like to authenticate the document.

Referring again to FIG. **27**, to authenticate the document, at block **703** the physician selects the AUTHENTICATE icon and the software recognizes the selection. At block **705** the software identifies the watermarked digital signature picture and isolates that portion of the displayed document. Next, at block **707** the terminal transmits an authenticate request to the ICD along with the watermarked signature picture. At decision block **709** the terminal waits to receive a re-generated document from the ICD **10**.

Referring also to FIG. **28**, at block **801** the ICD receives the authenticate request and the watermarked signature picture. At block **803** the ICD retrieves the standard watermark and the physician's digital signature picture from its memory. At block **805** ICD **10** removes the standard watermark from the watermarked signature picture thereby generating a watermark which specifically corresponds to document content. At

block **807** ICD **10** expands the remaining content watermark into a re-generated document. The re-generated document includes the document which was originally approved by the specific instance of the physician's digital signature picture and may include additional data if additional data was added to the approved document during standard watermark modification. At block **809** the ICD transmits the re-generated document to the terminal.

Referring again to FIG. **27**, at block **709** when the regenerated document is received, control passes to block **711** where the terminal displays both the suspect and re-generated documents side-by-side for comparison. The physician should then be able to visually compare documents to determine if the documents are identical.

If desired, the terminal software can be equipped to itself compare documents to determine similarity. To this end, at block **713**, the software compares the suspect and re-generated documents. In addition to comparing visual document information (e.g. text, graphics, data, etc.), the terminal software can also compare any additional data which was added to an original document to the additional data in the regenerated document. Thus, even hidden or visually meaningless (e.g. a bar having varying pixel intensities) random information can be used to authenticate an associated document.

Clearly, facilitating document comparison via software is advantageous for several reasons. First, as indicated above, random data comparison ensures a more thorough comparison. Second, presumably software comparison would be much faster than visual manual comparison. Third, for long documents such as a mortgage, contract, historical medical record, etc., software could compare every aspect and all document information to identify even a single document change.

Referring again to FIG. **27**, where an original and a regenerated document are identical, the terminal indicates authentication at block **715**. Where the documents are even slightly different the terminal indicates "no match" at block **717** signaling that the signature on the suspect document was not provided by the physician.

In another embodiment of the invention public key encryption (PKE) may be used with a digitally watermarked signed document to authenticate the document in the absence of a physician's ICD. A conventional PKE system is described in U.S. Pat. No. 5,689,567 (hereinafter "the '562 patent") which has been referenced above and which is incorporated herein by reference. Generally, in a PKE system each system user has both a "secret key" and a "public key" for encryption purposes. To effectively mark a document for authentication purposes a mark (i.e. bar graph or seal, etc) is generated by subjecting document content to the secret key. Thereafter the mark is applied to the document and can be stored or printed out on hard copy. To authenticate a marked document, if the document is a hard copy, the document is scanned into a computer to generate a digital document. After scanning or if the original document to be authenticated is a digital document, the mark is lifted from the digital document and used to regenerate a document corresponding to the mark using the public key of the person who supposedly approved the document via the mark. To this end, in a hospital facility, for example, all physician public keys may be stored on an Intranet and may be accessible for authentication purposes.

After the public key corresponding to the physician who supposedly approved the document is used to expand the mark into a re-generated document, the original and regenerated documents are compared to authenticate. This type of PKE system can clearly be used with the present invention to generate documents from watermarks for authentication purposes.

Also, in accordance with the '567 patent, a hashing method can be used to encrypt, decrypt and authenticate a document. To this end, according to the present invention, after a standard mark (e.g. a signature picture) is added to a document, document content or a representative portion thereof may first be hashed using a hashing code and generating an initial document hash. Thereafter, the initial hash may be encrypted using a private encryption key to generate a watermark which is applied to the document.

In this case, to authenticate, a watermark is identified on a document and is decrypted using a public encryption key to generate a re-generated hash. Next, a private key is used to again hash the document content generating a document hash. The document and re-generated hashes are thereafter compared to authenticate.

It should be appreciated that while the inventive time dependent electronic watermark described herein is extremely advantageous in the medical records area to authenticate an approval indication, clearly, this invention can be used in any application where a digital approval must be provided. For example, where bills are paid by electronic check, a users digital time dependent watermark can be provided on the electronic check, the mark generated in the manner described above. Similarly, a digital time dependent watermark could be provided when a credit card number is used to purchase something over the Internet. In either of these two applications, instead of generating the watermark using an ICD, a terminal itself could be used to generate the mark and apply the mark to a terminal stored digital signature.

Referring to FIG. **29**, an exemplary signature picture **949** is illustrated and includes a scripted signature picture **953** and pre-water marked border **951**.

Referring also to FIG. **30**, a watermarked signature picture **955** applied to an exemplary document **957** in a designated approval field (phantom identified by numeral **959**) is illustrated. Picture **955** includes the signature picture **953** inside a watermarked boarder **622** digitally signed document **620** according to the present invention is illustrated. The exemplary document **957** is a digital prescription which includes information which one would expect to find on a prescription. The information includes a prescribing physicians name and address **961**, a patient's name and address **963**, and a prescription order **965** including medication prescribed, amount and required administration frequency. In this case, using a prescription software program, a physician fills in the information on the document **957** via a terminal. Assuming the information is accurate the physician then request a signature from the physician's ICD **10** at which point the content of document **620** is transmitted to the ICD **10**.

Referring again to FIG. **26**, when the physician's ICD **10** receives the document, assuming the document content DC is less than the threshold requirement TDC, ICD **10** adds random text/numbers to the DC. Thereafter, at block **656** the physician's digital signature picture is added to the document, at block **658** the modified mark is generated, at blocks **659** and **660** the modified mark is used to modify the digital signature picture and at block **662** the document **957**, with the watermarked signature picture, is transmitted back to the terminal for review and if signed properly, for further transmission to other network storage or processing devices.

After digitally "signing" the document **957**, the signed document is displayed and then transmitted to a server. Thereafter, when the prescription is filled, the signed document can be electronically returned to the physician stamped "filled".

Then, to authenticate the prescription the authenticate process described above can be performed.

In addition, it should be recognized that while a signature block is very personnel to a user and therefore is preferred in the present invention to convey a feeling of responsibility for the document to which the block is ascribed, any type of personal identifier which can be pictorially represented may be marked using a content dependent electronic watermark. For example, even a single horizontal line could be watermarked. Moreover, other types of information could be marked with time dependent watermarks for authentication purposes. For example, a video clip could be so watermarked, an audio clip could be so watermarked and so on. Furthermore, an electronic watermark can take any of several different forms such as, for instance, providing the background to a signature field or indeed providing the background for an entire document. In the case where the mark comprises the entire document background the entire background would have to be used during authentication to re-generate the document.

Moreover, while the watermarking procedure has been described as one wherein an entire document content is used to generate a mark, in the alternative a document digest may be used instead. For example, referring again to FIG. **29**, a digest may simply include information filled in on a check such as issues, date, amount and signature where a digest is used to generate a watermark, comparison to authenticate compares only digest information, not an entire document.

While the approval/authentication concepts of the present invention were described above in the context of an ICD, the invention should not be so limited and is meant to cover other embodiments. The most general aspect of the approval/authentication concepts is that a document which has been approved by someone can be authenticated by using the document content. Other examples of how this general concept can be implemented are helpful to understanding the full import of this invention.

For example, according to another embodiment of the invention, a physician's terminal may be equipped with both a scanner and a printer and, where the terminal is personal to the physician, the terminal may share the physician's private secret encryption key, the physician's public encryption key accessible, via a LAN or the like, to other facility personnel.

In this case, if the physician has a hardcopy paper document which she would like to endorse, the physician may sign the paper document via a pen and a handwritten signature. Then the signed document is scanned into the computer via the scanner. Thereafter, it is envisioned that the computer retrieves the physician's private key, applies the private key to the document content (including the signature) to generate a watermark and then applies the watermark to a digital representation of the document. Thereafter, the digital representation may be printed out including the watermark or, in the alternative, the originally hand signed document may be provided to the printer input and run through the printer to add the watermark to the originally signed document. In effect, the printer would only print out the watermark which would be applied to the signed document.

Subsequently, to authenticate the document the watermark is identified on the document and scanned back into a terminal, the public key corresponding to the physician's signature which appears on the document is retrieved and is used to decrypt the watermark thereby generating a complete copy of the document which could either be examined on a computer display or printed out on hard copy for comparison to the original document.

According to yet another embodiment of the invention, a physician's terminal may be equipped with a digital signature pad for providing a digital signature. Digital signature pads are well-known and have been extensively used in the credit card industry to digitally record purchaser's signatures. A typical pad includes a flat sensing surface which senses the position of a pen tip as the tip is moved along the surface and generates a position signal indicating tip position. The position signal is provided to a computer which thereafter generates a "picture" of the pen tip movement. Where the pen is used to script a signature, the picture generated by the computer is the scripted signature. In this case, it will also be assumed that the physician's private key is stored on a private terminal and public key is generally available.

In this case, assuming a document is displayed on a computer display screen which a physician would like to approve, it is envisioned that the physician selects an approve icon on the display. Thereafter, the computer terminal requests the physician to hand script a signature on the digital pad. As the physician hand scripts the signature on the pad, the computer provides a digital representation of the signature in an approval field on the displayed document.

After the signature is completed, the computer retrieves the physician's private key, encrypts the signed document using the private key and thereby generates a watermark and applies the watermark to the displayed document, the mark remaining with the document when stored or printed out. Authentication in this example is the same as in the previous examples.

VIII. EXAMPLES

A few examples of how the present invention is intended to operate are instructive and aid in an understanding of why the invention is extremely advantageous. In each of the first four examples below, it will be assumed that both Penicillin and Tylenol are to be administered to a single patient within a facility within a specific time period and in specific doses by one of several authorized physicians. The patient is wearing an electronic identification bracelet like bracelet **40** of FIG. **2** which has, in its memory, at least some and perhaps all of the information which is illustrated in FIG. **9**.

A. Example 1

In a first example, it will be assumed that a physician's ICD **10** is relatively complex so that the ICD **10** itself is capable of recognizing different types of received information, building a server target address for the received information and providing configuration information for displaying the received information via a browser screen on a display **103**. Initially, referring also to FIG. **6**, it will be assumed ICD **10** includes a physician identifying segment in memory **262** which identifies the physician associated with the ICD **10**.

In this case, initially, it will be assumed that two Penicillin capsules and a single Tylenol capsule are dispensed into a container like container **200** illustrated in FIG. **5**. In addition, referring to FIG. **10**, a programming device such as dose dispenser **150** (see FIG. **7**) provides a dispensation to processing device **75"**, device **75"** storing received information in its memory. Moreover, dose dispenser **150** also generates a dispensation address for storing record **340**. An exemplary dispensation record address **400** is illustrated in FIG. **13**. Address **400** includes a field indicating the facility at which dispensation occurred (e.g. "St. Mary, Springfield"), a descriptor field (e.g. "medication"), an event field (e.g. "dispensed"), a patient ID field (e.g. "987654321"), a date field

(e.g. "May 19, 1996") and a time field (e.g. "13:42"). All of the fields in address **400** are generated by dispenser **150**.

As the physician makes her rounds, the physician eventually visits the patient for which the Penicillin and Tylenol were dispensed. After an abbreviated examination, the physician elects to administer half (i.e. 1 capsule) of the dispensed Penicillin and the entire dose of dispensed Tylenol (i.e. 1 capsule) to the patient. To administer the drugs the physician must first gain access to the Penicillin and Tylenol by unlocking container lid **204**. In this example, it will be assumed that processing device **75"** maintains lid **204** locked until a specific set of information is received by device **75"** which matches information stored in the memory of device **75"**. Specifically, both patient identifying information which matches similar information in FIG. **10** and physician identifying information which matches similar information in FIG. **10** must be received by device **75"**.

Thus, to gain access to the contents of container **200**, the physician places container **200** proximate the patient's bracelet **40** and causes the patient's bracelet to transmit patient identifying information (e.g. the patient identification number) to transceiver **81"** on device **75"**. In this example this is accomplished by pressing an activation button (not illustrated) on device **75'** in FIG. **2**. A short time thereafter, the physician places container **200** proximate ICD **10** and causes ICD **10** to transmit physician identifying information to transceiver **81"** by pressing button **18**.

When device **75"** receives the patient and physician identifying information, device **75"** compares the received information with similar information stored in the memory of device **75"**. Where the received and stored information is not identical, device **75"** maintains lid **204** locked and may indicate a mismatch by generating an audible sound via device **87"**. However, if the received and stored information is identical, device **75"** allows lid **204** to be opened by pressing button **228**. Device **87"** may generate a different audible sound indicating the match. Audible alerting device **87"** may also serve to remind a physician when it is time to administer the enclosed treatment.

In addition to facilitating opening of lid **204**, when button **228** is pressed device **75"** transmits all of the information illustrated in FIG. **10** as an information segment to ICD **10**. This transmission can be in any form which is recognizable by ICD **10**. When ICD **10** receives the information segment, ICD **10** does several things. First, referring also to FIG. **6**, processor **250** identifies the time at which the information segment was received and hence the time at which lid **204** was opened via clock **254**, processor **250** storing the identified time as a time stamp segment. Here, it is assumed that medicine administered to the patient is administered a short time after lid **204** is opened and therefore, administration time is indicated by the time stamp segment. Second, processor **250** recognizes the received information segment as a medication administration record and therefore automatically formats the received information and the time stamp segment as an information packet like the medication administration packet illustrated in FIGS. **14**A and **14**B.

In addition, ICD **10** uses received information to formulate a target address.

To this end, in FIGS. **14**A and **14**B, an exemplary target address is identified by numeral **444**. Address **444** includes a facility field which indicates the same facility as the dispensing facility (i.e. St. Mary, Springfield, see also FIG. **13**A), a descriptor field (i.e. medication), an event field (i.e. "given"), a patient ID field (i.e. "987654321") and date and time fields (i.e. "May 19, 1996" and "13:42", respectively).

After lid **204** is opened, the physician removes a single Penicillin capsule and the Tylenol capsule leaving the second Penicillin capsule in container **200** and administers the removed capsules to the patient. The physician recloses lid **200** which again locks and is routed back to the pharmacy for reinventory. If desired, the physician may make a manual note indicating that only one Penicillin was administered (e.g. via dictation).

After the physician completes her rounds, it will be assumed that the physician's ICD **10** includes ten information packets, each of which is similar to packet **440** in that each packet includes configuration information, a specific target address and some description information which describes a medical event (e.g. patient identifier, physician identifier, medication identifier, administration date/time, medication amount, etc.). In addition to the ten information packets, it is assumed ICD **10** forms an initial screen packet which summarizes ten information packets and provides interaction icons to facilitate physician review of the information packets. Referring to FIGS. **1** and **3**, to transfer the initial screen packet and the information packets to system **194**, the physician first gains access to a terminal **60** in one of the manners indicated above which is supported by the terminal **60**. For example, the physician may position her badge proximate input device **64**, at which time device **64** and terminal **60** generally interrogate ICD **10** to determine if the physician associated therewith is authorized to access the terminal **60**.

After the physician gains access to terminal **60**, the physician again positions ICD **10** proximate input device **64** and causes ICD **10** to transmit all ten information packets to terminal **60** via device **64**. When the packets are received, browser **115** initially displays an initial screen which is configured in accordance with the instructions provided in the initial screen packet. To this end, the initial screen indicates the number of information packets received and also displays the interaction icons. The interactive icons are assumed to be REVIEW and STORE icons.

It is contemplated that a first physician might collect information packets via a first ICD **10** and a second physician might access a terminal **60** via a second ICD **10** to review, modify and approve descriptive information in information packets associated with the first ICD **10**. Thus, after gaining terminal access via the second ICD **10**, the information packets in the first ICD **10** are transmitted to the terminal **60** for review. In this regard, the terminal **60** may, after being accessed and receiving information packets, either allow the second physician to review, modify and approve the packets or may block the second physician from one or all of the review, modifying and/or approval abilities.

In most cases, it does not make sense for a physician who did not perform an examination to review, modify and approve information packets as the second physician likely would not know the specifics of an examination. For example, in the present case where a first physician elected to administer only one of two dispensed Penicillin capsules, the second physician would have no way of knowing that the first physician changed the prescription. Thus, if the second physician approved the information packet which indicates two Penicillin capsules were administered, the stored data would be erroneous.

To determine if a terminal accessing physician is the same physician who acquired information packets, the terminal **60**, when accessed stored an accessing physician identifier. Then, when information packets are received from a second physician's ICD **10**, terminal **60** identifies the administering physician associated with the packets (e.g. the physician associated with the second ICD) and stores an administering

physician identifier. Next, terminal **60** compares the accessing and administering physician identifiers, where the accessing and administering physician identifiers are identical, terminal **60** allows information packet review as described hereinafter.

However, where the accessing and administering physician identifiers are not identical, terminal **60** may do one of several things first. First, terminal **60** may simply indicate that the accessing physician cannot review, modify or approve the information packets and thereafter may terminate access to the terminal **60**.

Second, terminal **60** may allow the accessing physician to review the information packets but may not facilitate modification and approval functionality. Restricting the accessing physician in either of these first two way goes a long way to ensure that information transmitted to long term storage truly reflects an associated medical event.

Third, terminal **60** may add the accessing physician identifier to the descriptive information in the information packet and thereafter allow the accessing physician full review, edit and approve abilities. Then, when the descriptive information is stored, the accessing physician identifier is included therewith so that a complete audit trail for each information packet is formed. In addition, if desired, terminal **60** may also maintain an unmodified information packet for storage with each information packet which is modified by an accessing physician who is not an administering physician. In this manner, if modified descriptive information is erroneous, a record of unmodified descriptive information can still be accessed for review.

Continuing, assuming the physician elects to review the descriptive information in the information packets and is authorized to review, modify and approve packets, the physician selects the REVIEW icon. It will be assumed that the initial packet to review is the medication administration packet described above. When the physician selects the packet, browser **115** configures the browser screen as indicated by the configuration information stored in the packet and displays the descriptive information. In addition, browser **115** displays hyperlinks in instances when the configuration information so instructs and displays a hyperlink for the APPROVAL icon which indicates the target address. Thereafter, the physician can modify displayed information and then approve the information by selecting the APPROVAL icon.

In the present example, the physician consults her hand written notes and confirms that only half of the dispensed Penicillin was administered. Because the physician changed the amount of Penicillin administered to the patient from two capsules to one, the physician must modify the penicillin dose which is displayed. To do this the physician selects the dose amount which causes a pull down menu to open up providing the physician with other options (e.g. 1.5 capsules, 1 capsule, etc.) The physician selects one of the other options (i.e. in this case 1) and the menu closes as the dose amount is modified.

When the APPROVAL icon is selected, browser **115** transmits the approved information and associated hidden information to the server target address associated with the APPROVAL icon. After the first packet information has been approved, preferably the browser automatically presents the information in the next consecutive information packet via display **103**. Again, the physician can quickly review the information, modify the information if necessary and approve the information for storage.

Thus, it should be appreciated that, using the inventive ICD **10** to collect information, configure browser screens and provide server target addresses for collected information streamlines the information gathering process and also streamlines the process of downloading information from such a device to a terminal for viewing, modification and approval.

In addition, by adding physician identification information to an information packet a record of medical administration information is formed. Moreover, by requiring an authorized physician to approve descriptive information which characterizes a medical event and identifying the approving physician in the descriptive information prior to long term storage, not only is the information review process easier and therefore more likely to be completed, the review process figuratively assumes "ownership" of approved data to the approving physician, thereby adding import to the approval process. In addition, by adding approving physician identification to the descriptive information or by adding a physician's watermarked digital signature to record, a complete audit trail for descriptive information is provided.

B. Example 2

In this second example, it will be assumed that a physician's ICD **10** is relatively simple in that the ICD **10** cannot itself formulate target server addresses or HTML configuration information and cannot generate most descriptive information (e.g. date and time stamp segments). Instead, in this example, address, configuration and most descriptive information is provided to ICD **10** by other system devices.

In this example, like the preceding example, it will be assumed that two Penicillin capsules and a single Tylenol capsule are dispensed into a container like container **200**. However, in this case, in addition to providing the information illustrated in FIG. **10**, dose dispenser **150** includes a specifier apparatus (see **64** in FIG. **3**) which also provides a server target address and browser screen configuration information in HTML code to container device **75"** (see FIG. **5**). For example, referring again to FIGS. **14**A and **14**B, in this example, virtually all of the HTML code illustrated, including format field information, would be provided by dispenser **150** except for descriptive portions of some fields. Thus, for example, in field **444**, the portion which reads "given" along with the patient identification number, date and time, would not be provided. Similarly, in field **452**, verification "YES" would not be provided. Moreover, the administering physician in field **464** would not be provided.

To form the incomplete packet, dispenser **150** may be equipped with special software for generating appropriate HTML code or, in the alternative, dispenser **150** may be linked to a server for generating the HTML code. Referring to FIG. **7**, in the present example, it is advantageous if dispenser **150** is linked to pharmacy server **186** for receiving pharmacy information related to ordered prescriptions. In addition, by being linked to the pharmacy server **186**, when ICD **10** returns information to server **186** after dispensation and approval, dispenser **150** may access the returned information to confirm dispensation and if dispensation did not occur or a prescription was changed, dispenser **150** may indicate so via an alarm or some form of quality control reporting.

As in the previous example, when Penicillin and Tylenol are placed inside container **200**, container **200** is positioned proximate a transceiver associated with dispenser **150** and dispensation information is transmitted to container device **75"** via the dispenser specifier apparatus or output device **64** (see FIG. **3**). In this case, however, transmitted information includes the entire packet **440**, less the descriptive information (e.g. receiving patient i.d., date, time, administering physician, etc.).

Again, it is assumed that when the physician visits the patient for whom the Penicillin and Tylenol were dispensed, the physician elects to administer only one capsule each of Penicillin and Tylenol. Once again, to gain access to the capsules, the physician performs a specific procedure to open lid **204** whereby device **75"** receives patient and physician identifying information, compares the information to similar information stored in the memory of device **75"** and facilitates unlocking of lid **204** only when there is a precise information match.

In addition, if a precise information match occurs, referring again to FIGS. **14**A and **14**B, device **75"** fills in various blank portions of packet **440** including verification field **452**. It is assumed that when lid **204** is unlocked, drugs therein are administered to the patient associated with the patient identification number which was received by device **75"**. Therefore, device **75"** fills in the patient identification number in field **444** further defining the target address. It is also assumed that the physician who opens lid **204** administers the drugs and therefore physician identifying information is filled in field **464**.

After lid **204** is unlocked, when a physician presses button **228** to open lid **204**, device **75"** identifies the current date and time and provides that information both in the target address (in field **444**) and in field **468** (i.e. the time stamp). At this point packet **440** is complete as illustrated in FIGS. **14**A and **14**B.

Assuming device **75"** is proximate the physician's ICD **10**, once packet **440** is complete, device **75"** transmits entire complete packet **440**, including HTML code specifying target addresses and screen configuration, to ICD **10**. When ICD **10** successfully receives an information packet, ICD **10** may generate an audible signal or a visual signal (e.g. activate an LED to indicate successful reception. ICD **10** simply stores packet **440** until caused to transmit packet **440** to a terminal **60** for review, modification and approval.

The remainder of this example, is similar to the example above. Thus, after her rounds, the physician accesses a terminal and downloads information packets to a browser for review, modification and approval prior to storage.

This second example is advantageous because ICD **10** and other smart devices (e.g. container **200**) need not be able to facilitate complex computations and formatting procedures. Instead, ICD **10** and smart devices, at most, must fill in a few descriptive fields and basically act as information storage buffers. In addition, this second example is advantageous because a dispenser **150** can specify a target address for returned information and how information which is returned to a terminal should be configured for review. This should facilitate a more flexible system. Moreover, the ICD **10** and other smart devices are relatively inexpensive as less remote computing power is required.

In addition, in this second example, as indicated above, dispenser **150** can close the information loop by tracking information returned to the pharmacy server **186** via ICD **10** and comparing that information to prescriptions which were to be administered. To this end, in addition to including the components illustrated in FIG. **3**, the dispenser processor also includes a clock (not illustrated). In addition to indicating medication to be dispensed each prescription includes a prescribed administration period such as "between 2-3 PM" which is accessed by the dispenser **150** processor for each drug dispensed. When the drug is dispensed, the processor identifies the required administration period. For each prescription, at the end of the administration period or at the end of some predetermined reporting period (e.g. 2 hours) following the end of an administration period, the dispenser processor retrieves any data corresponding to a specific prescription which was returned by an ICD and also recognizes the absence of such data.

Where no data for a specific prescription has been provided by an ICD, the dispenser **150** may do any of several different things. First, the dispenser **150** may indicate via a dispenser display (see **103** in FIG. **3**) that administration potentially was not performed. In addition, dispenser **150** may also periodically generate an audible "chirp" via indicator (i.e. alarm) **111**. In the alternative, some other indicating mechanism such as an e-mail or pager signal may be generated to inform a physician or attending nurse of a potential mismedication. Still further, the dispenser processor may simply generate a record indicating possible mismedication. Subsequently, if ICD prescription data for the specific prescription is provided the indications may be automatically halted.

At the end of a prescribed administration or reporting period, if data for a specific prescription has been provided the dispenser **150** may retrieve the data and compare the data to the original prescription. In the present case where the administered medication was modified and therefore does not match the prescription exactly, it is contemplated that dispenser **150** generates a prescription/administration (P/A) quality control modification report indicating that the drugs administered were in fact different than those prescribed. In addition the P/A report may also indicate matching prescriptions and administrations.

The dispenser reports may be provided to an attending pharmacist for daily or weekly review or to a physician for review or indeed to an administrator or the like to track administration efficiency and accuracy.

C. Example 3

In this third example, it will be assumed that an ICD **10** is a hybrid of the ICDs in the above examples in that each ICD has less computing ability than the ICDs in the first example and more computing ability than the ICDs in the second example. In this example, it will be assumed that some of the HTML code for configuring a browser and providing browser addresses is provided to ICD **10** and that ICD **10** generates the remainder of required information and at least some of the descriptive information.

In this example, like the preceding examples, it is assumed that two Penicillin capsules and a single Tylenol capsule are dispensed into a container like container **200**. In this example, dispenser **150** provides an HTML dispensation information packet in HTML to device **75"** which includes information for configuring browser **115** screens to indicate dispensation information. To this end, referring to FIG. **13**B, an exemplary dispensation information packet **404** is illustrated. Referring also to FIG. **13**C, a browser screen **412** which corresponds to packet **404** is illustrated including hypertext links **416** and **420**, respectively, to a patient's demographic record and the bibliographic record of the physician who dispensed the medication. Packet **404** is formatted according to HTML and uniform resource locator—(URL) conventions. FIG. **13**C illustrates the medication dispensation record **404** as it is displayed by a browser **412**, FIG. **13**A illustrates the URL **400** generated for the medication dispensation record **404** which identifies the location at which it is or will be stored.

In this example, prior to dispensing a dose to a container **200**, a physician reviews dispensation information via screen **412**. If dispensation information is correct, the physician approves the information and packet **404** is transmitted to container **200**.

Again, it is assumed that when the physician visits the patient for whom the Penicillin and Tylenol were dispensed, the physician elects to administer only one capsule each of Penicillin and Tylenol. Once again, to gain access to the capsules, the physician performs a specific procedure to open lid **204** whereby device **75"** receives patient and physician identifying information, compares the information to similar information stored in the memory of device **75"** and facilitates unlocking of lid **204** only when there is a precise information match.

As in the first example, when button **18** on ICD **10** is pressed, ICD **10** identifies the time and date and stores that information as an time stamp segment for placement in a subsequently formed information packet.

After lid **204** is unlocked, when a physician presses button **228** to open lid **204**, assuming device **75"** is proximate the physician's ICD **10**, device **75"** transmits packet **404** (i.e. the HTML dispensation information packet in FIG. **13**B) to ICD **10**. When ICD **10** receives packet **404**, ICD **10** modifies packet **404** by adding descriptive information, additional browser screen formatting information, formulating a specific target address and providing configuration information for interaction icons as indicated above, thereby generating a completed information packet like exemplary packet **440** in FIGS. **14**A and **14**B.

The remainder of this example, is similar to the examples above. Thus, after her rounds, the physician accesses a terminal and downloads information packets to a browser for review, modification and approval prior to storage.

D. Example 4

In this fourth example, it will be assumed that all smart devices and the ICD **10** are extremely simple in that none of the devices is capable of formulating or storing complex and complete screen configuration information. Instead, it is assumed that target address and minimal configuration information is provided to the smart devices and ICD **10** by other system devices and that the smart devices and ICD **10** simply provide descriptive information during a patient visit. In this example, to facilitate information review, a simple software package is provided on each terminal **60** which receives the minimal configuration information, correlates the minimal configuration information with a more detailed configuration format, and provides the detailed format for browser configuration control.

In this example, as in the second example above, dose dispenser **150** provides a server target address and browser server configuration information to a smart container device **75"** when Penicillin and Tylenol are dispensed into a container **200**. However, unlike in the second example where screen configuration information is provided in HTML code, in this example a simple configuration indicator code is provided which can later be expanded into more detailed HTML code for configuration. For example, the simple configuration indicator may be as simple as a single character or number. In this case, assuming there are only ten possible screen configurations for viewing descriptive information packet information, each of the ten possible configurations is associated with a different number indicator 0 through 9. In the present example, it will be assumed that a screen configuration for reviewing descriptive information in a medication administration information packet is identified by number indicator 4. In this case, in addition to receiving a target address upon medicine dispensation, container device **75"** also receives indicator 4 which is stored for later transmission to ICD **10**.

When lid **204** is unlocked so that the physician can administer the medicine therein, device **75"** identifies descriptive information and provides the descriptive information, target address and screen configuration number indicator (i.e. "4") to ICD **10**. ICD **10** stores the received information as a packet until caused to transmit the packet to a terminal **60**.

In addition to storing the described information packets, it is also assumed ICD **10** also generates a dynamic initial screen indicator to provide dynamic information to browser **115** for display via the initial screen. To this end, it has been recognized that generally the initial screen will often include essentially the same information. For example, a typical initial screen will often only include an indicator to identify the number of files to be reviewed and perhaps a small number of indicators indicating the types of files to be reviewed (e.g. billing, dispersion, monitored information, dictation, etc.). Assuming a simple initial screen which only displays the number of files to review and icons to select review or store options, the dynamic initial screen indicator is simply a number. Assuming 10 files are stored in an ICD after a physician makes her rounds, the screen indicator is 10.

After the physician completes her rounds, the physician gains access to a terminal **60** in the manner described above. After the physician gains access and activates ICD **10** to transmit stored data to a terminal **60**, ICD **10** transmits the initial screen indicator (e.g. 10) and the information packets.

When the transmitted information is received, terminal processor **107** performs several functions. First, processor **107** dissects each information packet thereby identifying, with respect to each packet, a target address, descriptive information and the screen configuration number indicator. Processor **107** uses the number indicator to identify a screen configuration for displaying associated descriptive information and forms an HTML packet like **440** (see FIGS. **14**A and **14**B) for each received packet, filling in descriptive information where appropriate. Each HTML packet is then stored in RAM **109**.

Second, processor **107** identifies the initial screen indicator and fills in an appropriate field in an initial screen configuration. Then the initial screen is configured to enable a physician to review the descriptive information packet information. In the present example, because the initial screen indicator is 10 (e.g. there are 10 files to be reviewed), the initial screen indicates "There are 10 files to review" and provides REVIEW and STORE icons.

The remainder of this example is similar to the examples above. Thus, the physician can review, modify and approve information in each file stored in RAM **109**.

This embodiment is advantageous in that most of the formatting capability can be provided in a terminal **60** as opposed to an ICD **10** as other smart devices. This is advantageous as it is contemplated that, in a typical facility, there will be many more ICDs and smart devices than there will be terminals **60**. Nevertheless, consistent with the present invention, this embodiment still has the advantage of specifying target addresses via an ICD **10**, instead of a server and specifying browser screen configuration albeit in an abbreviated format.

E. Example 5

In this fifth example, instead of interacting with a smart container **200**, referring to FIGS. **1** and **4**, it will be assumed that a smart IV treatment device **116'** which, in addition to including an IV pump and proper patient linkage hardware, includes the hardware illustrated in FIG. **19**, is provided in a patient's room **104**. In addition, it will be assumed that the

patient has been linked to the IV pump for several days and that a physician visits the patient's room to monitor patient condition and generate a report every 4 hours. Thus, a new patient record is generated every four hours.

In this example, as in the second example above, it will be assumed that ICD **10** is relatively simple in that most data is collected from IV device **116'**, and not generated. To this end, in addition to providing a dispensation information segment record indicating medicine dispersion since the most recent data acquisition (e.g. four hours earlier), device **116'** also generates a target address for the dispensation record and browser screen configuration information indicating how a browser screen should be configured for data review. The dispensation information segment and address are assembled into an HTML information packet which includes several incomplete descriptive fields including a patient ID field, a time and date field and a physician ID field.

When a physician visits the patient linked to device **116'**, the physician establishes a patient association with ICD **10** as indicated above, the patient association stored as a packet identification segment. After the patient association has been established, the physician causes device **116'** to transmit the incomplete packet to ICD **10**.

When the incomplete information packet is received, if the time is not already identified in the received information, ICD **10** identifies the time and date of reception. ICD **10** places the time and date of reception, patient identifying information indicating the patient who received the IV medication (i.e. patient identified in the patient identification segment) and physician identifying information indicating the physician with whom ICD **10** is associated, in appropriate information packet fields thereby completing an HTML packet similar to packet **440** illustrated in FIGS. **14**A and **14**B.

A typical IV packet might include a period indicator which indicates the monitored time period (e.g. previous four hours) which corresponds to the dynamic data in the packet and a delivery rate field which indicates the rate of medicine delivered by IV device **116'**. Where the delivery rate changed over the most recently monitored time period, the delivery rate field may include several medicine rate indicators which are each correlated with a delivery period over which the specific rate was provided. In the alternative, the rates may be provided in other forms such as a graph of rate versus time. In addition, the IV packet will also include a medication field indicating the medication dispensed via the IV, the physician who authorized the medication, the patient name and so on. Further more, the IV packet will also include a physician identifying field indicating the physician who acquired the IV packet.

As in the previous examples, when a physician completes her rounds, the physician gains access to a terminal **60** and transfers information packets, including the IV packet, to the terminal browser **115**. Once again, the receiving browser identifies initial screen configuration information indicating the number of files transmitted to terminal **60** and displays the initial screen, including REVIEW and STORE icons.

Assuming the physician selects the REVIEW icon, terminal **60** displays the first information packet in the associated configuration format. As above, the IV information is displayed for review, in a format which is specially configured to display IV information. Although editing tools for modifying displayed IV information may be provided, such tools probably would not be provided as the IV information simply reports actual medicine administration and could not have been modified by a physician arriving for a visit after administration occurred. An APPROVAL icon allows the physician to approve the IV information for storage at the target address.

While this smart IV example is relatively simple, this example illustrates that the invention may be used with any type of smart device to remotely collect data and generate an ultimate target address and screen configuration data. The important aspect of a smart device is that the device can monitor some quantifiable information which is associated with a patient and which is advantageous to collect and store for later retrieval.

F. Example 6

Referring again to FIG. **1**, in this sixth example of how the present invention might operate it will be assumed that a physician's ICD **10** is equipped to receive audio information (e.g. voice) via digitizer **22** when dictation button **26** is pressed. Thus, during a patient visit, a physician may use ICD **10** to take audio notes.

To this end, at the beginning of a patient visit, a physician's ICD **10** identifies the patient by communicating with the patient's bracelet **40** (see FIG. **2**) and, after forming a patient association, stores patient identifying information as a patient identification segment. In addition, ICD **10** also stores a physician identification segment indicating the physician associated with the ICD. When the physician wants to form an audio note, the physician presses button **26** and thereafter speaks in the vicinity of digitizer **22**.

When button **26** is pressed, ICD **10** recognizes that audio information is to be received and performs several different functions. First, ICD **10** automatically generates a target address for audio information to be received. The target address specifies a server used by a facility transcription pool. The transcription pool server is where all digital dictation is stored which is then transcribed either manually by facility personnel or automatically by transcription software. For the purpose of the present invention it will be assumed that transcription is manual.

In addition to generating the target address, ICD **10** identifies the time and date which are stored together as a time stamp segment. Moreover, ICD **10** automatically generates an incomplete audio information packet including browser screen configuration information and time, patient identifying and physician identifying fields and fills in the time and identifying fields with information from the time stamp, patient identifying and physician identifying segments. The only field which is not completed in this example is an audio dictation field which is to receive the digital audio information upon reception. In addition to generating the packet described above, the ICD **10** may also generate browser formatting information to formulate specific types of templates to be filled in by a member of the transcription pool. For example, the templates could include a template for a typical patient visit, a template for a prescription to be filled and so on. After the audio information packet is formed, ICD **10** stands ready to receive audio information via digitizer **22**.

With button **26** pressed, when the physician speaks within the vicinity of digitizer **22**, digitizer **22** receives the dictation, digitizes the dictation and stores the digitized information in the audio dictation field. At the end of the dictation, the physician stops pressing button **26**. In the example, if, prior to ICD **10** forming a new patient association, the physician again presses button **26** to dictate again, the subsequent dictation is stored in sequence at the end of the audio dictation field. Once a new patient association is formed, when button **26** is pressed, a new audio information packet is generated.

In the case of an audio information packet, among other things, the configuration information will configure a browser screen which identifies time and date of dictation, dictating

physician and patient visited. In addition, the configuration information may also provide interaction icons to allow a reviewing physician to play back and perhaps edit dictation. For example, interaction icons may include "PLAY", "STOP", "REWIND", "ERASE", "FAST FORWARD" and so on.

After a physician completes her rounds, as in the previous examples the physician gains access to a terminal **60** and transmits an initial screen configuration packet and other information packets, including the audio information packet described above, to the terminal **60**. Browser **115** receives all the packets, stores the information packets and configures the initial browser screen as instructed by the initial screen configuration packet.

As the physician reviews the information packets, eventually the physician selects the above audio information packet for review. When the audio information packet is selected, browser **115** displays the descriptive information in the audio information packet including the interaction icons. The physician can review the audio information packet via the icons and, if necessary, may correct the dictation via some suitable means (not illustrated).

A second dictation facilitating ICD **201** is illustrated in FIG. **20**. ICD **201** is similar to a conventional digital dictaphone in that ICD **201** is a hand held device including an audio digitizer **203**, a speaker **205** and conventional editing buttons, "Play" **207**, "Record" **209**, "Reverse" **211**, "Fast Forward" **213** and "Stop" **215**. In addition, however, ICD **201** includes a transceiver **217**, target address specifying or indicating buttons "Pharmacy" **219**, "Billing" **221**, "Personal" **223** and "Transcription" **225**, a processor **250** (see FIG. **6**) which is capable of configuring target addresses and screen configuration information and is capable of generating some descriptive information (e.g. physician identifying information, time and date, etc.). An optional screen **231** for viewing either collected data or a target address may also be provided.

With an ICD like ICD **201**, it is envisioned that, by selecting one of the specifying buttons **219**, **221223** or **225**, a physician can generally select the target address for subsequent dictation. In addition, as with a conventional dictation device, by providing editing buttons on ICD **201**, a physician can correct dictation immediately if desired.

When a physician stops to visit a patient during her rounds and would like to dictate a note which should be provided to a specific facility department, the physician first selects an appropriate department for receiving the note. For example, if the note is for the pharmacy to prescribe a specific medicine for a patient at a specific time, the physician presses button **219**. When button **219** is pressed, ICD **201** generates an incomplete audio information packet which specifies, in appropriate fields, a visited patient, a visiting physician, time and date and a target address which specifies the pharmacy server. Once again, the only field which is not filled is the audio information field. Thereafter, the physician uses editing buttons **207**, **204**, **211** and **215** to dictate an intended note which is digitally recorded in the audio information field.

After her rounds, the physician accesses a terminal, transmits information packets and edits and approves the packets. With respect to the audio information packet targeting the pharmacy server address, when the audio information is approved, instead of going to the transcription pool, the information is transmitted to the pharmacy server.

In the alternative, ICD **10** may be configured such that more than a single server address can be selected by consecutively pressing more than one button **219**, **221**, **223** or **225** or, so that all dictation, in addition to being provided to the selected server, is also provided to the transcription pool server (or some other server for that matter).

G. Example 7

In this seventh embodiment of the present invention, in addition to collecting audio information and other information which is provided by other smart devices (e.g. patient ID number, dispensed drug type and amount, etc.) an ICD is equipped to collect video information. To this end, referring to FIG. **21**, an exemplary video equipped ICD **301** includes a main body housing **303** in which a processor and other already described hardware (see FIG. **6**) is housed. Most importantly, the other hardware includes a clock and a memory (both audio, video and other information) in which user identification information is stored. In addition, ICD **301** includes conventional video editing buttons "Play" **305**, "Record" **307**, "Reverse" **309**, "Fast Forward" **311** and "Stop" **313** which are linked to the ICD processor to facilitate recording, reviewing and erasing of video and audio information.

Moreover, ICD **301** also includes a video lens **315**, a video viewer **317** which is pivotally attached to housing **303** and an audio digitizer (e.g. digital microphone) **319** for detecting audio signals. As with all ICDs described herein, ICD **301** also includes a transceiver **321** which can both receive information from smart devices and transmit information to smart devices and to a terminal. In addition, other data collecting devices may be provided such as a bar code reader **323**.

Furthermore, ICD **301** also includes a toggle button **325**. It is envisioned that, as with the audio ICD illustrated in and described with reference to FIG. **20**, ICD **301** may be used to select a specific facility department to which collected data (e.g. video and audio) should be provided. In this example, the capabilities of viewer **317** are used in conjunction with toggle button **325** to select specific target facility departments. To this end, it is envisioned that where no other server is selected, a facility video archive department and associated server are selected as a default target for the purposes of generating a target address for collected information. Thus, if a user does not select a different target server, ICD **301** generates a target address specifying the archive server.

To select a different target server, a user looks into viewer **317**. At the bottom of a displayed screen, a server indicator is displayed, the currently selected target server specified thereat. Thus, initially the server indicator indicates "Archive Server". To select a different target server, the user depresses button **325** once which causes the target server to change and causes the server indicator to also change accordingly. For example, pressing button **325** once may change the server indicator from "Archive Server" to "Pharmacy Server". By pressing button **325** a second time the server indicator observable through viewer **317** again changes to indicate another possible target server (e.g. "Billing Server"). Where there are five possible servers, any of the five servers can be selected by releasing button **325** once the desired server is indicated by the server indicator. To return to the initial default "Archive Server", the user simply scrolls through the server choices and, after the last choice has been displayed, the next time button **325** is pressed, the default server is again selected.

In addition, it is envisioned that, in addition to enabling selection of a specific target server, one choice provided by toggle switch **325** should be "No server" so that while information can be collected, no server has to be selected during data collection. Then, if the user desires, the user may, while reviewing a video clip via viewer **317**, select any portion of the clip for delivery to a specific server.

Two examples of how ICD **301** might operate are provided hereinafter. In a first example, in a medical facility, when a physician makes her rounds and visits a patient, ICD **301** can be used as described above with respect to the preceding examples to establish an association with a specific patient through any of several different interrogation protocols. After association has been established, ICD **301** begins to build a conventional target server address using the physician's ID information, patient ID information, time and date (from the ICD clock, not illustrated). In addition, if IV information or drug dispensing information is collected, that information is automatically formatted for subsequent delivery to a terminal for viewing and further delivery to an appropriate server address indicated by the target address.

Assuming some peculiar visible symptoms are observed, the physician can use ICD **301** to record video of the symptoms for archiving and subsequent diagnosis. For example, if a physician observes a rash about a patient's elbow which the physician does not recognize as a symptom of the patient's known condition, the physician can collect a video clip to illustrate the rash. While collecting the clip, the physician can dictate an audio note explaining the rash.

Prior to collecting the clip, the physician uses toggle button **325** to scroll through target server choices. Initially it will be assumed the physician simply selects "No server" using button **325** and the server indicator.

After the physician completes the examination, the physician may review the video clip via viewer **317**. If the physician determines that the clip may be useful, the physician may, prior to reviewing the clip again, use button **324** to select a target server. It will be assumed the physician selects a personal archive server as the target server so that the physician can review the clipping later with the aid of medical references in her office. Then, with a target server selected, it is envisioned that any video reviewed will be earmarked for building a target server address. Thus, if a clip is 10 seconds long, the physician may only review a 4 second clip, thereby selecting the 4 second clip for delivery to the target server.

In addition, if desired, by selecting another server via button **325** and reviewing the clip again, the physician can select a second server for building yet another target address for the clip.

After her rounds, the physician accesses a terminal, transmits information packets, including or not including video, depending on what the physician selected, and edits and approves the packets. In this regard, in addition to including the typical HTML formatting information indicated above with respect to the other examples, the packets including video clips provide icons and a viewing window to enable the physician to observe and perhaps edit earmarked video clips prior to storage to a server.

In a second example of how video capable ICD **301** might operate, instead of being used in a medical facility, it will be assumed ICD **301** is used in a jet and maintenance facility for a major airline. In this example, the ICD user is a maintenance technician. It will also be assumed that many jet components include unique bar codes for identifying component parts. For example, a right wing rudder may include a bar code identifying the rudder as a right wing rudder. In addition, the code for a particular jet's right wing rudder may indicate the specific rudder components instead of simply a right wing rudder. For example, the code may indicate "right wing rudder #8821475" so that the specific rudder and its history can be tracked.

In addition, each jet will typically be equipped with a jet specific bar code. While the bar codes may be provided on separate jet components, more typically, a maintenance technician will have a bar code binder or notebook which, for a particular jet, lists all components and the component specific bar codes. Thus, the binder would include an entry "right wind rudder #8821475" which corresponds to the specific jet. During routine maintenance check-ups, the technician is required to carry ICD **301** to collect information for a maintenance report.

During a check-up the technician would first use ICD **301** to establish an association between the jet being examined and the ICD **301**. To this end, initially the technician uses ICD **301** to read the jet specifying bar code for the jet or the jet specific binder via reader **323**. When the code is read, ICD **301** stores the code and identifies the time and date. At this point ICD can already formulate a good portion of a target server address for the technicians report. As the technician examines the jet, the technician can use ICD **301** to take dictation and identify other specific components via corresponding bar codes from the binder.

When the technician observes the right rudder, it will be assumed that the technician observes a small puncture in the outside skin of the rudder. To document the puncture and subsequently order maintenance services, the technician establishes an association between the right rudder and ICD **301**. To this end, the technician locates the right rudder in the binder and uses reader **323** to read the code. The right rudder code is then stored by ICD **301**. Next, assuming the puncture is particularly dangerous the technical immediately orders maintenance to repair or replace the rudder. In addition, the technician will want to generate a video clip for archiving so that the puncture is documented for subsequent review and for use by the person who will repair/replace the rudder.

To this end, the technician can use button **325** to scroll through the possible target servers. It is assumed ICD **301** provides a "Maintenance Server" choice. The technician selects the maintenance server as the target server and then collects a video clip of the punctured rudder skin. The maintenance server selection causes ICD **301** to generate a target address specifying the maintenance server for the video clip. Audio information may be provided by the technician during the video clip. In addition, date, time, rudder information, jet identification and technician identification information is added to the video clip for identifying a target address and populating fields in an information packet.

After the examination, the technician accesses a terminal and downloads all information packets for observation. After examining the packet corresponding to the rudder puncture (including the clip), the technician approves the packet information and transmits the information to the maintenance server. Another maintenance technician reviews the video clip and other information provided therewith. Thereafter, the puncture is repaired or the rudder is replaced.

Where maintenance is required prior to flight, in addition to sending the clip to maintenance, the clip and associated information may also be earmarked for a clearance server, personnel associated therewith grounding all jets which require maintenance. In addition, all data collected may be achieved in an archive server regardless of whether or not the archive server is selected by the technician. In yet another example which is related to the previous example, an ICD similar to ICD **301** may be equipped with a lens **315** attached to a technician's head piece or helmet so that everything which is viewed by a technical is captured on video. Thereafter or, during an examination, the technician could earmark certain video clips (e.g. 5-10 seconds) for delivery to specific target server addresses while the entire video is archived on an archive server.

Importantly, it should be noted that preferably content is provided within generated addresses in the present invention. For example, where several facilities share servers, a portion of each server may be earmarked for each facility and therefore all information units or documents for a specific facility should be stored in the corresponding earmarked locations. A portion of each address preferably identifies the facility from which an associated information unit originated. Thus, the address is content specific.

Similarly, for every patient at a facility, preferably, information associated with the patient, is stored at a specific location within the portion of a server earmarked for the facility. As indicated above patient information is also provided in an address. Similar address fields are provided for physician information, type of record, time, date, etc so that virtually an entire address can specify content.

This type of content specifying address is not only intuitive but also very useful in that it makes it relatively easy to retrieve data and information units from storage. In addition, this type of addressing reduces the overall size of an information packet and information units as important content information can be stored in the address.

While a particular embodiment of the invention has been illustrated and described, it will be obvious to those skilled in the art that various changes and modifications may be made without sacrificing the advantages provided by the principle of construction disclosed herein. For example, while the invention is generally described in the context of HTML, clearly the invention is meant to be used with other conventional markup languages or with JAVA or JAVA script program codes. In addition, while the invention is described as being used with a browser, the invention could be used with any terminal which includes software which receives formatting codes and can display information as a function of such codes. Moreover, while it is preferred that full target addresses be provided by an ICD **10**, clearly minimal addresses such as a coded address could be provided to a browser wherein the browser would expand the coded minimal address into a full fledged address, the advantage being that the ICD specifies where data is to be stored, not a browser or associated server.

Additional User Authentication Embodiments

In one preferred embodiment of the present invention ICD badge **10** can be configured to only act as an electronic identification and security device and henceforth referred to as security device **10**. While it may have the data collection capabilities previously described, they are not required. As before, security device **10** can be in the form security badge or a cell p hone or PDA or other convenient shape that is typically worn or held by an employee of an enterprise, henceforth referred to as computer user. It includes identification text **12** and a photograph of the user and is used to identify the employee to others and to computer resources. Device **10** includes a processor **250** linked to memory **262**, activation button **18**, indicator **20** (e.g. a LED or speaker), wireless communication transceiver **14**, power source (e.g. a battery, photocell, or fuel cell or magnetic field induced power source), and an optional biometric indicia sensor **405** (e.g. a fingerprint sensor placed on the back of device **10**). In some cases a small key pad (e.g. buttons **207**, **209**, **211**, **213**, and **215** or others) is also provided and display **258** can be provided as a graphic display, e.g. a LCD.

An alternate embodiment of security device is shown in FIGS. **31** and **32** as smart card **1140**, which includes identification text **1112**, processor **1120**, memory **1122**, and transceiver **1130**, which may be arranged as a series of electrical contacts or as an RFID tag type antenna. Generally speaking, card **1140** is powered by an external power source **1132** via electrical contacts or by a received energy field such as magnetic, radio, or capacitive coupling. However card **1140** may also include a power source **1132** internal to card **1140** such as a battery. Bar code **1142** can also be used to identify the employee.

It should be noted that while electronic device **10** is shown as an identification badge or smart card it can take a number of forms, such as a portable digital assistant (PDA) or a cellular phone. Generally the invention will refer to device **10**, but it is to be understood that card **1140** may be substituted for device **10** in most embodiments.

FIG. **33** shows the preferred contents of memory **256** for this embodiment of electronic device **10**, now showing information **300** with new detail and expanded fields. As shown, information **300** now includes user identifier **1146** (e.g. his name or an ID number), the security device identifier **1148** (e.g. a serial number or user's name **1146**), private keys(s) **1151** used for encrypting or digitally signing information, optional biometric reference information such as biometric indicia characteristics, reference measurements or images **1152** (e.g. fingerprint image), device authentication protocol information **1153** used to authenticate a user to device **10**, and reauthorization code **1157**. Authentication protocol **1153** can take a number of forms including one or more of challenge question **1154** and answers **1155**, but it may also take other forms such as flag **1156** specifying that a biometric indicia be measured or both a challenge question **1154** and a biometric indicia measurement flag **1156**.

Typically challenge questions **1154** and corresponding answers **1155** are defined by the user, using questions whose answers will be obvious to the user, but unknown to anyone else who attempts to use device **10**. However, question **1154** may simply request a password and the answer **1155** will be a password known to the user.

Reauthorization code **1157** is shown comprised of time component **1158** with optional neighborhood component **1159**. It should be noted that additional components can be added as desired. In some cases reauthorization code **1157** is stored at server **168**, as will be explained later.

FIG. **34** shows the expanded list of trusted or registered computer system information **1160** stored in memory **262** of device **10**. For each electronic or computer system **194** the user is to access, security information **1161** is provided including trusted computer system identifier **1162** that electronic device **10** has been programmed to recognize or trust and may be in the form of a name, a URL address, an internet protocol (IP) address, or other method of identifying a computer system. For each trusted computer system identifier **1162**, an optional field indicates the neighborhoods **1163** for each computer system identifier **1162** the user can use to access system **194**. Neighborhood **1163** may be all the computer terminals **60** in computer system **194** (referred to by identifier **1162**), a group of terminals **60** within a specific physical location (e.g. the library) or terminals that may be spread across the computer system **194** that are associated with a common department or function (e.g. accounting). Neighborhood **1163** can be referred by name, codes, or addresses and a user may have access rights to several neighborhoods.

Information **1160** can include a field that specifies security software identifier **1164** that device **10** will interact with (i.e. trust). This field can specify a software identifier such as a version number, a checksum, or a verifiable software signature that is transmitted to device **10** by software in terminal **60** and/or server **168** prior to it interacting with the software in terminal **60** or computer system **194**. This prevents device **10**

from providing challenge questions or biometric indicia images or measurements to non-trusted or compromised software.

For each trusted computer system identifier **1162** there can also be stored authentication protocol **1165**. As shown computer authentication protocol information **1165** may consist of a user name **1166** and a password **1167**. However, protocol **1165** may take a number of forms, such as the requirement that a biometric indicia be measured or imaged **1168** and provided to computer system **1162** or an algorithm **1169** that computes a code or response based on the time or based on a received message and then sends the code to computer system **194** or security device identifier **1148** or combinations of the above. Authentication protocol information may also include portions of user identification **300**, e.g. device identifier **1148**. Where device authentication protocol information **1153** is used to authenticate a user to security device **10**, system authentication protocol **1165** is used to authenticate security device (and therefore its user or owner) to computer system **194**.

System authentication protocol information **1165** can consist of a user name **1166** and password **1167** (as may be requested to be provided to most log on software), an indication **1168** that a biometric indicia be measured or imaged, and/or an indication **1169** that the results of a time or message based computation be provided to computer system **194**.

For each trusted computer system identifier **1162** there may be list of specific application programs **1174** or functions the user needs or is allowed to use on computer system **194**. Program(s) **1174** can be automatically started when the user is authenticated to a computer system **194** or they can be presented as selectable icons.

For each trusted computer system identifier **1162** there may be security code **1172** used to protect neighborhood identifier **1163**, software **1164**, system authentication information **1165**, and any other information stored with identifier **1162**. The security code **1174** can take the form of a password, an encrypted code that device **10** can decrypt, or a device identifier **1148** of another device **10** belonging to a trusted computer security staff member. Trusted computer administrative security staff typically provides security code **1174** when information about their system is provided to device **10**. Thereafter security code **1174** must be provided to device **10** prior to reviewing or changing system identifier **1162**, neighborhood identifier **1163** (when provided), or protocol information **1165**. By using multiple security codes **1174** for each trusted computer system **1162**, the computer security staff members of one computer system **194** can be assured that no one can review or make changes to the settings he made. This allows device **10** to be used across multiple computer systems **194**, where each one has separate and secured settings. In some cases the user of device **10** will not have access to security codes **1172**, while in other cases they may.

FIGS. **35** and **36** shows computer system **194** comprised of computer terminals **60** linked by network **190** to security server **168** and database **1186**. Network servers (not shown) and computer resources can be added to network as needed. Terminals **60** are arranged into neighborhoods N**1**, N**2**, . . . Nn. As mentioned previously each neighborhood N may be defined by a specific physical grouping, departmental grouping, or other design choice and referred to by neighborhood identifier **1163**. A terminal **60** can be a member of two or more neighborhoods N when that definition is convenient to the users. While computer system **194** is shown comprised of several neighborhoods N, it may consist of a just a single neighborhood.

As shown in FIGS. **3** and **36** terminal **60** consists of processor **107** and memory **109** linked to interactive device **105** (e.g. a keyboard, mouse, or voice recognizer), display **103**, and transceiver **64**, which is designed to communicate with transceiver **14** of device **10**. When device **10** is card **1140** and transceiver **14** is a series of electrical contacts, cable **1197** can be used to link processor **107** to smart card interface **1198**. When desired processor **107** can be linked to biometric indicia sensor **1199** (e.g. a fingerprint scanner, palm scanner, voice imager).

As shown in FIGS. **37** to **40** it is expected that database **1186** includes information **1200** consisting of computer system identifier **1202**, computer terminal list **1230**, security device list **1240**, and user list **1250** of all users registered to use the all or part of the resources of computer system **194**. While shown as separate lists they may be combined in a single database.

Terminal list **1230** is a list of computer terminal identifiers **1232** that are attached to network **190**. These are terminals **60** that are trusted by or known to server **168**. Identifiers **1232** can be an IP address, and/or a processor serial number, and/or a unique number stored in transceiver **64**. For each terminal identifier **1232** there may also be one or more neighborhood identifiers **1163** associated with it. When desired, device identifier **1148** of security device **10** can also be stored for each terminal identifier **1232** when the user corresponding to device **10** is using the terminal **60**. When no user is using computer terminal **60** no device identifier **1148** is stored.

Device list **1240** (see FIG. **39**) consists of a list of all security devices **10** that have been registered with or trusted by computer system **194**. For each device **10** the list includes user identifier **1146**, device identifier **1148**, and system authentication protocol information **1242** (e.g. a specific user name **1244** and password **1255**) that must be provided for to computer system **194** in order to authenticate a user. However an expanded list of authentication protocol information **1242'** is also shown from which may include the use of a time varying algorithm, a biometric indicia reference measurement or image, encrypted response message, device identifier, or any of the above or others in any combination that is (are) used by security server **168** to authenticate a user.

For each device identifier **1148** there may also be stored device status **1246**. Status **1246** can be used to indicate that device **10** is in normal operation ("OK") and may be trusted or recognized when information **1242** is presented. Expanded list **1246'** shows other potential status conditions such as device **10** has been reported by the user as having been misplaced (e.g. thought to be left at home) and may include date **1248** when it was reported missing. Presumably if device **10** is not located and reported found within a period of time as being found, it will be marked as lost. Devices **10** that are reported or marked as lost may cause an alert to be presented if they are attempted to be used with computer system **194**. Device **10** can be marked as deactivated for a period of time (e.g. during a vacation) or while waiting for an event to occur (e.g. reassignment to a new user). Other status conditions are contemplated, e.g. device can only be used between 8:00 am and 6:00 pm.

User list **1250** (see FIG. **40**) is a list of users that have been registered with computer system **194**. List **1250** includes user identifier **1146**, authentication protocol **1242** that describes what information the user must provide in order to be authenticated by system **1200**, and device identifier **1148** of electronic device **10** used by that user. In some cases list **1250** will be incorporated into list **1240** or visa versa. It is generally assumed that for each register device **10** there is a corresponding user identified by identifier **1146** in user list **1250**.

Memory **109** of terminal **60** stores computer terminal information **1260** (see FIG. **41**), which includes computer terminal identifier **1232**, and optionally computer system identifier **1162**, neighborhood identifier **1234** (which differs from neighborhood identifier **1163** which is the neighborhoods that's device **10** will interact with), and when desired software identifier **1262** such as a version number, a checksum, or a verifiable software signature (which also differs from security software **1164** that device **10** is intended to interact with). It is anticipated that information **1260** may be stored in transceiver **64** or another device, should storage there be more impervious to hacking or software manipulation. Depending on the software needs of device **10** and terminal **60**, information **1260** may not need to be shared with terminal **60**. Instead portions of information **1260** can be stored in database **1186** or transceiver **64** and database **1186**.

Using of Device **10** to Identify a Trusted Computer System—(FIG. **42**)

One use of electronic device **10** is to assist users to verify that computer system **194** and/or computer terminal **60** are trusted or known to electronic device **10**.

Transceiver **14** can be under control of processor **250** to repeatedly broadcast device identifier **1148** (or other message) when it is not in communication with a specific terminal **60**. This can also be instigated by pressing activation button **18**. When the user with device **10** approaches within communication range (e.g. 3 m) of terminal **60**, transceiver **64** will receive identifier **1148**. Provided terminal **60** is not already communicating with another device **10**, it will start communicating with device **10** by transmitting computer system identifier **1162** to device **10** (Step **1301**).

Before terminal **60** transmits identifier **1202**, it can send a message to security server **168** to check that device identifier **1148** has been registered with computer system **194**. If it is not registered or its status **1246** is marked as not approved for use, no further interaction between device **10** and terminal **60** is allowed, an error message can be displayed on display **103**, and other staff in the vicinity of terminal **60** can be notified via e-mail, pager, or phone call to assist the person at terminal **60** and to possibly confiscate device **10** as necessary.

While device **10** is described as being powered on all the time, several other steps can be used to establish communication between device **10** and terminal **60**. For example, device **10** may require activation button **18** be depressed to place device **10** in an active mode, e.g. to transmit identifier **1148** is transmitted. Device **10** then stays alert waiting several seconds for a reply (e.g. trusted computer system identifier **1202**).

In other cases transceiver **64** will repeatedly broadcast a "are any devices present" status message and when device **10** comes within communication range of terminal **60**, transceiver **14** will receive the message and processor **250** will respond by transmitting device identifier **1148**. As before activation button **18** may need to be pressed for device **10** to receive the message from transceiver **64**. After receiving the message device **100** in turn transmits device identifier **1148** and receives computer system identifier **1202**. When device **10** is card **1140**, it is placed in interface **1198** allowing transceiver **14** to receive system identifier **1202**.

In each case the processes described above device **10** and computer terminal **60** interact so device **10** receives computer system identifier **1202**. Other communicated messages can be sent and received by device **10**. Identifier **1202** can be sent to device **10** first allowing device **10** to validate that system identifier **1202** matches a trusted computer system identifier **1162** in list of computer systems **1160**.

Device **10** compares computer system identifier **1202** against the list of trusted computer system identifiers **1162** stored in memory **262** (Step **1302**). If there is no match device **10** will no longer communicate with terminal **60** and indicator **20** can be activated or an error message can be sent from device **10** to processor **107**, which will present it on screen **103** (Step **1304**).

When there is a match terminal neighborhood identifier **1234** may be sent to device **10** (e.g. it may have been included with computer system identifier **1202**) (Step **1306**), which compares it to system neighborhood **1163** (Step **1308**). If there is no match device will no longer communicate with device **10** and indicator **20** can be activated or an error message can be sent from device **10** to processor **107**, which will present it on screen **103** (Step **1304**). When there is a match the user and device can proceed to a next step.

When there is a match software identifier **1262** may be sent to device **10** (e.g. it may have been included with computer system identifier **1202**) (Step **1310**). IT is compared to software identifier **1164** (Step **1312**). If there is no match device will no longer communicate with device **10** and indicator **20** can be activated or an error message can be sent from device **10** to processor **107**, which will present it on screen **103** (Step **1304**). When there is a match the user and device can proceed to a next step.

It should be noted that although neighborhoods are described as a subset of computer systems, it is possible to define systems or neighborhoods only, where each system consists of a single neighborhood or where each neighborhood consists of its own system.

Using Device **10** to Determine if the User Needs to be Authenticated—(FIG. **43**)

To determine if the user must authenticate himself, reauthentication code **1157** is retrieved (Step **1320**). A check is made to determine if code **1157** is present (Step **1322**). If code **1157** is not present, e.g. the first time the users uses computer system **194** in a day, the user must log onto computer system **194** using the standard authentication process **1340** (Step **1324**). When reauthentication code **1157** is present, time component **1158** is compared to the current time to see if is within a time range T1 retrieved (Step **1326**), for example within 4 hours. Time component **1158** is based on a time relative to a previous successful standard authentication process, e.g. it may be the time of the authentication was performed or the time the user left any terminal **60**. When time component **1158** is not with range T1, reauthentication code **1157** is erased (Step **1328**) and the user must log onto computer system **1162** using the standard authentication process **1340** retrieved (Step **1330**).

When time component **1158** is within range T1, computer system-neighborhood component **1159** is compared against computer system **1202** and neighborhood identifier **1163** of terminal **60** (Step **1332**). When component **1159** does not match computer system identifier **1202** or terminal neighborhood identifier **1163**, reauthentication code **1157** is erased (Step **1328**) and the user must log onto computer system **1162** using the standard authentication process **1340** retrieved (Step **1330**), which may be part of a system security function. In some cases an error message may be presented on display **103**. When component **1159** is matched the user is given access it computer system **194** without further authentication being necessary (step **1334**).

Other component tests can be performed to determine that both device **10** and computer system **194** recognize or trust each other, e.g. by using a third party certificate verification service.

While device **10** was described as performing the above comparisons, security server **168** or terminal **60** may perform the comparisons regarding reauthentication code **1157** and code **1157** instead of being stored in device **10** can instead be stored in database security server **168** as part of user list **1250**.

The Standard Authentication Process **1340**—(FIG. **44**)

To authenticate a user in the standard process may consist of the user entering system authentication protocol information **1242** (Step **1342**), e.g. user name **1244** and password **1245** via interactive device **105** or for device **10** to provide system authentication protocol information **1165** for a specific computer system **194**. If this is not provided within a time limit T2 (Step **1344**) the entire process is restarted (Step **1346**). When authentication protocol is provided it is transmitted to security server **168** (Step **1348**), which searches database **1186** for matching system authentication protocol information **1242**. This may be assisted by using the entered user name and searching database **1186** for a matching user name **1244** and then comparing the corresponding password **1245** stored in database **1186** against the entered password (Step **1350**) (see authentication protocol **1242**).

If there is a match the user is authenticated and logged on (Step **1352**), security server **168** records that user **1146** is using computer terminal **60** associated with terminal identifier **1232** (Step **1354**), and an appropriate reauthorization code **1157** is created and transmitted to device **10** for storage in memory **262** (step **1356**) or for storage in status **1246**.

Standard authentication process **1340** may also include requesting the user allow biometric indicia sensor **405** or **1199** to measure or image a user biometric indicia. The sensed measurements or image can be compared against all other biometric indicia measurements defined in system authentication protocol information **1242** stored in database **1186** of security server **168**, or the comparisons can be limited to those of a single user identified by an entered user name or by user identifier **1146** provided by device **10**. If there is a match the user is authenticated to computer system **194** and logged on.

Security server **168** records that the user corresponding to user name **1166** or user identify **1146** is now using terminal **60** corresponding to terminal identifier **1232**.

If there is no match between entered authentication information and system authentication protocol information **1242** a count is maintained of the number of times this occurs and a is compared against a limit (Step **1358**). If it is less than the limit (e.g. 5 tries) the user is requested again to enter authentication protocol information **1242** (step **1342**). If the limit is exceeded, a message is sent to security server **168** that the user corresponding to user identifier **1146** or user name **1166** is having trouble authenticating himself (Step **1360**), which may be part of a system security function. Server may deactivate the user's account for a period of time and present an error message for presentation on display **103**. When appropriate the manager of computer system **194** may specify that a security device **10** security function be performed to the memory **262**, e.g. erasing some or all of information **300**, especially that related to computer system **194** (see Step **1490**). The authentication process recommences at Step **1300**.

As previously described, the log on process can be conditioned by requiring that computer system **194** matches one stored in list **1160**, that the neighborhood corresponds to one defined in **1163** (when provides) and that the security software **1262** of terminal **60** matches security software **1164**.

Using Device **10** to Authenticate a User—(FIGS. **45** to **47**)

To improve the authentication process, the user may need to authenticate himself to security device **10** in order for device **10** to provide system authentication protocol information **1165** to security server **168**, which in turn authenticates the user **1380**. The user must initially provide device authentication protocol information **1153**, which may be in the form of a number of challenge questions **1154** and corresponding answers **1155**, to device **10**. To authenticate himself to device **10** challenge question **1154** can be randomly retrieved and transmitted by device **10** to terminal **60** for presentation on display **103** (step **1382**). In some cases the challenge question is presented on display **16** of security device **10**. The answer to the challenge question can be entered using an input device such as activation button **18**, a small key pad or touch screen (not shown) on security device **10**. Using a security device input device for entering the answer prevents any software in terminal **60** from secretly recording the answer. However, question **1154** (e.g. a request for a password) can be sent to terminal **60** for presentation on display **103** and the answer (e.g. a password) can be entered using input device **105**.

If there is no response within time limit T3 (e.g. 30 seconds) to the request for an answer (Step **1384**), device **10** can present an error indication by sending a message to terminal **60** for presentation on display **103** or by activating indicator **20**. This event is added to a list device **10** maintains of requests to provide a challenge question without an answer being provided in time T3 (Step **1386**). When a significant number of these events occur (Step **1388**), especially if they tend to be recent (although timing need not be a criteria) (Step **1390**) it can be evidence of an attempt to hack, guess, or otherwise defeat the authentication of the user to device **10** and a device security function is performed (e.g. see Step **1490**) (Step **1392**). Following the security function the authentication process recommences at Step **1300**.

When the user enters an answer via interactive device **105** (step **1393**) device **10** or computer terminal **60** is provided with the corresponding answer **1155**, which is compared against the user entered answer (Step **1394**). If they do not match an error message can be presented by display **103**. The message is generated by terminal **60** when processor **107** performs the comparison and is sent to terminal **60** when processor **250** performs the comparison. Next a flag is stored in memory **262** indicating this error event (step **1396**). A determination by device **10** (or by terminal **60**) is made to determine if there the number of these events has exceeded a limit (Step **1398**) especially if they tend to be recent (although timing need not be a criteria) (Step **1400**). This can be evidence of an attempt to hack, guess, or otherwise defeat the user authenticating himself to device **10** and a device security function is performed (e.g. see Step **1490**) (Step **1402**). Following the security function the authentication process recommences at Step **1300**.

It should be noted that it is preferable, but not required, that answer **1155** is not provided to terminal **60** in order to maximize the security of this information.

If there is a match, user is authenticated to device **10**, which then retrieves stored system authentication protocol information **1165** (e.g. user name **1166** and password **1167**, a time varying algorithm to compute a time based response code, or other user unique code, or a measured biometric indicia) corresponding to the computer system **194** as in list **1170**. The authentication protocol information **1165** is then sent to server **168** (Step **1404**) for comparison with system authentication protocol information **1242** (Step **1406**) for the user identified by device **10**. If there is a match the user is authenticated to computer system **194** and logged on.

Authenticating a user to device **10** using device authentication protocol information **1153** can include presenting a biometric indicia to sensor **405**, which measures or images

the indicia. Processor **250** then compares it to biometric reference information, measurements, or images **1152** stored in memory **262**. When there is a match the user is authenticated to device **10**, which then retrieves stored authentication protocol **1165** (e.g. user name **1166** and password **1167**, a time varying algorithm to compute a time based response code, or other user unique code) for corresponding to received computer identifier **1202**. System authentication protocol information **1165** sent to security server **168** for comparison with authentication protocol **1242**. If there is no match the authentication process recommences at Step **1300**.

If there is a match the user has been authenticated to computer system **194**. Any previous "no answer provided" or incorrect answers events that have been recorded can be erased (Steps **1408** and **1410**), since the user has authenticated himself to device **10**. It should be noted that Steps **1408** and **1410** can be performed prior to the user being authenticated to system **194**, as the user has at least been authenticated to device **10**.

The user is granted access to computer system **194** and logged on (Step **1412**). Security server **168** records that the user corresponding to user name **1166** is now using terminal corresponding to terminal identifier **1232** (Step **1414**). With the user authenticated to computer system **194**, computer terminal **60** now writes reauthorization code **1157** to device **10** for later use (Step **1416**). It can also be held by security server **168**. As previously stated code **1157** may include time component **1158** based on the current time of authentication and computer system and neighborhood component **1159** of the neighborhood Ni corresponding to terminal **60**.

While in the above discussion biometric indicia is measured by sensor **405** and compared by device **10** some of the process can be performed by computer terminal **60**. For example in some cases the biometric indicia is measured or imaged by sensor **1199** and transmitted by transceiver **64** to device **10**, which performs the comparison. In other cases the biometric indicia is measured by sensor **405**, which is transmitted along with biometric reference measurements **1152** to computer terminal **60** for comparison or the indicia is measured by sensor **1199** and compare to measurements **1152** by computer terminal **60**.

For optimal security it is preferable, but not required, that biometric reference measurements are not transferred to any terminal **60** or computer system **194**. Each transfer opens the possibility for others to gains access to this information.

Monitoring Security Device **10** to Detect User Departure—(FIG. **48**)

Once the user has been authenticated by computer system **194**, the user uses computer terminal **60** and the resources of computer system **194**. When the user is finished using computer terminal **60** two methods are commonly used to determine the user has left terminal **60**. First the user may take steps to indicate to software on terminal to log him off. Secondly, the user may leave terminal **60**, in which case software in terminal **60** detects that interactive device **105** remains inactive in excess of a time limit (e.g. 3 minutes) then software in terminal **60** determines the user has likely left and will log the user off.

However, the first method requires active steps be taken by the user which may delay them from other activities (e.g. a healthcare worker being called to an emergency) and the second allows the security threat of any new user who starts to use terminal **60** within the time limit complete access to computer system **194** as though they are the previous user.

After device **10** is used to authenticate a user to computer system **194** terminal **60** can start to periodically monitor that device **10** is present (Step **1430**). When device **10** is kept within range of terminal **60** (or card **1140** left inserted in reader/writer **1198** its status can be monitored (Step **1431**). This can be done by terminal **60** using transceiver **64** to broadcast an interrogation signal including device identifier **1148**. Device **10** when it receives the signal responds with a return response (see above) or status message back to terminal **60**.

Alternately device **10** may broadcast a status message identifying itself on a periodic basis to terminal **60**. A comparison is made to determine if terminal **60** has received a status message within a period of time T4 (e.g. 30 seconds) (Step **1432**). A further test can be made to determine if no message has been received within longer time limit T5 (e.g. 10 minutes). If time limit T5 has not been exceeded terminal **60** can take steps to secure itself (Step **1435**) by limiting access; for example it can secure display **103** by removing any previously shown data and replace it with a message indicating that device **10** cannot be detected and that the user is soon to be logged off terminal **60**; which may be part of a system security function. Limiting access can also include locking one or more of the terminal interactive device **105** such as a keyboard or a mouse; it can also include disabling the connection between terminal **60** and network **190** so as to limit access to computer system information, which may also be part of a system security function.

If time limit T5 is exceeded then the user access is further limited by logging him off terminal **60** (Step **1436**) and a message is sent to security server **168** that the user is no longer present (Step **1438**). In some cases the user is logged off immediately when time limit T4 has been exceeded (T5=T4). If a new user with his own electronic device **10** is sensed between T4 and T5 terminal **60** can automatically log the previous user off and proceed to allow the new user to authenticate himself to security server **168**. The previous user's device identifier **1148** is removed from list **1230** and the new user's device identifier is inserted if they are authenticated to system **194**.

When a status message is received by terminal **60** within time limit T5 the user can continue to use terminal **60** at the point they had previously being using it and any terminal security measures are removed (Step **1440**).

When terminal **60** transmits interrogation signals, device **10** receives them to determine when it is near terminal **60**. As stated before, device **10** can transmit response messages related to the interrogation signals. When device **10** has not received an interrogation signal within a period of time it can determine that it is no longer in communication with terminal **60** and erase any information about its interaction with terminal **60** in memory **262**, although reauthorization code **1157** is preferably retained. Device **10** can also switch to an inactive mode, for example a powered down or power restricted mode.

Monitoring User of Device **10** is Still Authorized to Use Computer System **194**—(FIG. **49**)

A request can be made episodically from terminal **60** to security server **168** requesting the most current user access status **1246** (Step **1450**) to determine if the user identified by user identifier **1146**, device identifier **1148**, or user name **1166** is still trusted or granted access to computer system **194**, e.g. to cancel access privileges if a user reports their badge or security device **10** stolen. In some cases security server **168** dynamically sends a message regarding the access status of the user's or device **10** to detect if it has changed. Terminal **60** determines if the user is still trusted (Step **1452**). If they are still granted access the user continues to use computer terminal **60**.

If device **10** or the person using it is no longer granted access they are logged off terminal **60** (Step **1454**), a message can be sent to nearby staff (e.g. by e-mail, pager, or phone) to recover device **10** or otherwise assist the user (Step **1456**), and a message can be sent back to server **168** that the user has been logged off. When appropriate the manager of computer system **194** may specify that a security function be performed to the memory **262**, e.g. erasing some or all of information **300**, especially that related to computer system **194** (see Step **1490**). The authentication process recommences as Step **1300**.

Monitoring Terminal **60** Inactivity—(FIG. **50**)

Even while terminal **60** is able to detect device **10** (e.g. by receiving status messages) it remains possible that the use has left his device **10** (especially likely when card **1140** is used). In this case any one who uses terminal **60** will have complete access to it. To prevent this user interface **105** can be monitored periodically for activity (Step **1460**), e.g. a lack of use or activation of interactive device **105** or other. If it remains inactive for a period longer than a time limit T6 (e.g. 3 minutes) (Step **1461**), terminal **60** can either log the user off or secure terminal **60** and present a message asking the user to reauthenticate himself in some way to device **10** (e.g. by responding to challenge question **1154**) or security server **168** (Step **1462**). If the user fails to reauthenticate himself within period of time T7 (e.g. 30 seconds) (Step **1464**), he will be logged off terminal **60** (Step **1466**).

Furthermore a message indicating that the user may have left behind device **10** can be sent to security server **168**. Server may mark status **1246** for device **10** as being left behind. A message can be sent (e.g. by e-mail, pager, or phone) to other staff near terminal **60** to secure device **10** so that it is not stolen or otherwise misused (Step **1468**).

Any reauthentication code **1157** in device **10** can be erased (step **1470**) to prevent code **1157** from being used reauthenticate a user to a terminal **60** as described above.

A message is sent to security server **168** indicating the user has been logged of because they could not reauthenticate himself even though device **10** was present. Sever **168** can maintain information about users that leave their device **10** at terminal **60**. Users that to do this repeatedly can be reminded of the importance of computer security and may have their security privileges removed. When appropriate the manager of computer system **194** may specify that a security function be performed to the memory **262**, e.g. erasing some or all of information **300**, especially that related to computer system **194** (see Step **1490**).

Reauthenticating a User who had Been Previously Authenticated—(FIG. **50**)

In some cases it is desirable to reauthenticate a user even though his device **10** broadcasts status messages that are received by terminal **60** and interactive device **105** remains active. This can be done on the basis of a time interval or random basis, e.g. has the user used terminal **60** for more than time limit T8 (Step **1474**)? For example any user who uses a terminal **60** in a specific neighborhood Ni may be asked to reauthenticate themselves every 4 hours, while in another neighborhood Nj, they are not asked to reauthenticate themselves.

Reauthentication can include answering a challenge question **1154** properly, providing a biometric indicia to device **10** or to security server **168**, or following any other authentication protocols **1153** or **1242** (Step **1462**). If the user does not reauthenticate himself within time limit T7 (Step **1464**), he will be logged off (Step **1466**), and otherwise denied access as indicated in Steps **1468** to **1472**, which are not repeated in FIG. **52**.

Episodic Updating Reauthentication Code **1157**—(FIG. **51**)

Reauthentication code **1157** was set when the user was authenticated to security server **168**. However, when a period of time is greater than time limit T9 (e.g. 60 seconds) (Step **1480**) reauthentication code **1157** can be updated or reset (Step **1482**). This ensures that should the user leave, without otherwise logging off computer system **194**, that device **10** has the most recent code **1157**. This is useful when the time range for reauthentication is set to be relatively short (e.g. 20 minutes) but is generally based on the last time a terminal **60** was used.

Security Function **1490**—(FIG. **52**)

When a user is unable to authenticate himself to device **10** or is unable to do so after trying several times device, **10** can activate a security function designed to protect computer system **194** from someone who may be trying to hack or otherwise guess answer **1155** to challenge question **1154** or attempting to provide a false biometric indicia.

The security function can take a number of different forms, one is to erase all the information about computer system **1162** corresponding to computer system identifier **1202** including authentication protocol **1165** from memory **262** (Step **1492**). In other cases device can erase or otherwise prevent from being used device authentication protocol **1153** from memory **262** (step **1494**). Additional information can also be erased. When the information is only prevented from being used it can be reset for use by transmitting a special code from terminal **60** to device **10** under the direction of the manager of computer system **194**. Presumably this code is limited in distribution or knowledge of to a few trusted computer security staff members who are required to personally verify who the user is that is attempting to use device **10**.

The security function can also include terminal **60** sending a message to server **168** that device **10** is no longer to be authenticated (Step **1496**). Additional messages (e.g. by e-mail, pager, or phone) can be sent to nearby staff asking them to assist or question the user attempting to use device **10** (Step **1498**). An alert can be presented on display **103** and indicator **20** can be activated. An appropriate status **1246** can be entered indicating that device **10** should no longer be authenticated to system **194** until an administrative staff member has spoken to the user or owner of device **10**.

Using Device **10** to Activate User Specific Programs

When a user has been authenticated to computer system **194**, device **10** may further interact with computer terminal **60**. For example device **10** can download from memory **262** to terminal **60** list of specific application programs **1172** or functions the user needs or is allowed to activate or use. This list can be a part of user information **300** (see FIG. **33**) e.g. computer system information **1160** and can differ for each computer system identifier **1162**. The programs can be indicated by a program name or target address and may further include a disk domain in which the user is to operate the program. When only one program is specified that program can be automatically activated. When more than one is specified, the user is allowed to select which one to activate or use, e.g. as displayed selectable icons.

Each program activated may further require that device **10** provide additional authentication information in addition or in duplication to that provided to computer system **194**. In this manner the user is authenticated to the selected program, perhaps using even more secure techniques than required by computer system **194**. When a program is activated additional information regarding the user may be provided, e.g. owner name **1146**, allowing the program to use this information in order to perform its function.

When the security device **10** is removed from terminal **60** and no longer communicates interrogation responses or status message, any activated programs can be notified or independently determine that the user is not longer present. The activated program can then deactivate or exit its operation. In some cases this will include saving any partial work of the user, e.g. in a folder or disk associated with the user's identity or other information **300** provided by device **10** to the program.

The list of specific programs **1172** a user is allowed to use may also be stored as part of electronic device list **1240** or user list **1250**. It is sent from security server **168** to terminal **60** upon receipt of device identifier **1148** from device **10** or the entry of user identifier **1146**.

Security Device **10** Ownership and Information **300** Knowledge—

Security device **10** can be owned either by the computer users who uses it. This is especially desirable when security device **10** is used by the user to gain access to several computer systems **194**. However, notwithstanding the above statement, security device **10** can be owned by the enterprise or company operating one of the computer systems **194**. Whichever party owns the security device **10** is referred to as the owner.

More maximal security, private key(s) **1151** and other valuable information, e.g. biometric reference measurements **1152** or portions of security information **1161**, are stored in security device **10** so that they are not accessible outside of security device **10**. This can be achieved by using a special security microprocessor for processor **260** and storing the keys in the memory of this processor. Such processors have special guards against external retrieving or detection (e.g. by scanning electron microscopes) of information stored within them. It is further preferred that private key(s) **1151** and other valuable information are not known to the computer user or the owner. The manufacturer of the security device **10** may provide private codes or key(s) **1151** at the time of manufacture in a randomized manner or distribute them in random manner so that the key(s) **1151** or other valuable information cannot be attributed to any specific security badge **10**. In some embodiments device identifier **1148** and other information such as security code **1172** can be considered to be a private code.

In some cases the security device **10** may no longer be needed by the computer user and can be reassigned to a second computer user. However, before this can be done any information **300** related to the first computer user should be erased prior to entering in any new information about the second user. This will prevent the second user from accidentally using information that may be attributed to the first computer user. To effect the erasure of information **300** the first computer user may be required to authenticate himself to the security device **10** are previously discussed. Alternately when the security device **10** owner is the enterprise, a security code such as security code **1172** or another one that is used on global basis relative to information **300** can be transmitted to security badge **10**. The security badge **10** upon recognition of this code can proceed to erase information **300**.

Using Security Device **10** to Decrypt Private Messages—

Security device **10** can be used to decrypt private messages that are only to be read by the computer user having the security device **10**. A message may be created and then encrypted using an encryption key, e.g. the public key of a public/private key encryption system or a guarded private key). The message is sent to a person with the security device **10**. The message cannot be read by anyone who intercepts the message and cannot be read by the computer user to whom it sent unless they have the security device **10** with the corresponding decryption key (e.g. the private key of a public/private encryption system or a duplicate of the guarded private key). The computer user authenticates himself to the security device **10** as previously described, the security device can then receive the encrypted message or a message digest (e.g. a hash table related to the message). The device then uses the decryption key to decrypt the message or the message digest. When the message is decrypted it can be displayed on display **16** or **258** or it can be transferred to workstation **60** for presentation on display **103**. In other cases the decrypted message digest is transferred to workstation **60** which uses the decrypted message digest to further decrypt the encrypted message for presentation on display **103**. As is common with well known encryption and decryption methods various safeguards (e.g. checksums, or other verification steps) are used to ensure that the message being decrypted has not been tampered or altered since it was created. In this manner the computer user will be able to rely on the decrypted message as being one and the same as the created message.

Prior to decrypting the message, the user will typically be presented with a notification message on display **103** or **16** or **258** requesting that they activate the security device **10** in some manner (e.g. pressing activation button **18** before the message or message digest will be decrypted. This allows the computer user to control when messages are decrypted. It can be further advantageous to require that the computer user has authenticated himself to badge within a recent time period, e.g. with in 3 minutes. In some cases the user will be asked to authenticate himself to the security device **10** before each message is decrypted.

As a convenience the computer user may indicate to or set the security device **10** to decrypt multiple message with a single activation.

Using Security Device **10** to Sign Multiple Messages—

When several documents are to be signed by the user using security device **10** they can be signed with a single operation. The documents can be presented on display **103** as a summary, e.g. in a table with a title and date for each document, or as a list of subject heading, or the first paragraph of each document can be displayed. A message is displayed on display **103** requesting the user sign the documents and the documents or representative portions of the documents are sent to security device **10**. When the user presses activation button **18** each of the documents or representative portions of the documents are digitally signed using encryption key **1151** to create digital signature information. The encrypted data is sent back to the terminal **60** and then to computer system for storage, e.g. with the respective documents when the entire document is not signed. However, the user can request that each document be presented to him prior to signing each of them as previously described.

The invention claimed is:

1. A method for use with a computer system containing information, the method comprising the steps of:

a. providing a separate portable security device for each of a plurality of computer users;

b. providing a terminal including a display screen for presenting information to computer users where the terminal is separate from the portable security devices;

c. communicating system authentication protocol information from at least one of the security devices to the computer system;

d. authenticating the at least one of the security devices with the computer system using the authentication protocol information;

e. upon successful completion of the authenticating step, initiating a first access by the computer user associated with the at least one of the security devices to the computer system via the terminal;

f. creating, sending, and storing a reauthentication code to the at least one of the security devices, where the reauthentication code is related to a time limit;

g. logging the computer user off the terminal; and

h. initiating a second access by the computer user associated with the at least one of the security devices to the computer system via the terminal by communicating the reauthentication code to the computer system from the security device and when the reauthentication code is within the time limit allowing the second access, the step of initiating the second access by the computer user to the computer system further including verifying that the reauthentication code includes a neighborhood identifier that matches a neighborhood identifier of the terminal that the computer user is attempting to use to access the computer system.

2. The method according to claim **1**, further including the step of communicating signals generated by the security device to the computer system and when the computer system fails to receive a signal from the security device after a first preset time period the system performing a system security function.

3. The method according to claim **2**, further including the step of limiting access to the computer system information as part of performing a system security function.

4. The method according to claim **3**, where the step of limiting access includes causing information presented on the terminal display to be removed from the display.

5. The method according to claim **2**, where the step of limiting access includes disabling the use of the terminal.

6. The method according to claim **3**, further including the step of further limiting access to the computer system after a second preset time period is exceeded.

7. The method according to claim **6** where the step of further limiting access includes logging a user off the computer system.

8. The method according to claim **6**, where the step of initiating either a first or second access by the computer user includes recording in a database that the computer user is using the terminal and the step of further limiting access includes removing from the database that the computer user is using the terminal.

9. The method according to claim **1**, where the reauthentication signal is validated by at least one of the terminal which is proximal to the security device and the computer system.

10. The method according to claim **9**, further including the step of comparing a time component of the reauthentication signal and the current time and determining that the current time is within a specified time limit of the time component.

11. The method according to claim **10**, including the step of when the current time is not within a specified time limit requiring the security device be authenticated with the computer system by communicating the system authentication protocol information from the security device to the computer system.

12. The method according to claim **11**, wherein prior to the step of authenticating the security device with the computer system, the method further includes the step of authenticating the computer user to the security device by the computer user providing response information to the security device selected from the list of a response to a question and a biometric indicia, and wherein the provided response information must match device authentication protocol information stored in the security device prior to authenticating the security device with the computer system.

13. The method according to claim **12** wherein, when biometric indicia is provided, the indicia is provided by the computer user using a biometric sensor in the security device to sense the indicia.

14. The method according to claim **12**, further including the step of incrementing a count in the security device when the computer user is not authenticated to the security device, the count recording the inability of the security device to authenticate the computer user.

15. The method according to claim **14**, further including the step of activating a security device security function selected from the list of (i) erasing a portion of the memory of the security device, (ii) transmitting an alert message to the computer system, and (iii) disabling the security device, when the count exceeds a limit.

16. The method according to claim **15**, including the step of storing the count in the memory of the security device.

17. The method according to claim **16**, further including the step of resetting the count to zero when the count is less than or equal to a limit and the computer user is able to authenticate himself to the security device.

18. The method according to claim **1**, further including the step of receiving a computer system identifier by the security device and positively matching the received system identifier to a trusted computer system identifier prior to authenticating the security device to the computer system.

19. A method for use with a computer system containing information, the method comprising the steps of:

a. providing a terminal including a display screen for presenting information to the computer user where the terminal is separate from the security device;

b. communicating system authentication protocol information from the security device to the computer system;

c. authenticating the security device with the computer system using the authentication protocol information;

d. upon successful completion of the authenticating step, initiating a first access by the computer user to the computer system via the terminal;

e. storing a reauthentication code in the computer system and associating the code with user identification information associated with the computer user;

f. logging the computer user off the computer system;

g. initiating a second access between the computer system and the computer user via the terminal by using the security device to communicate at least a portion of system authentication protocol information to the computer system, the computer system determining that access is to be provided by using the at least a portion of system authentication protocol information to retrieve the reauthorization code and determining that the code allows access, where the step of initiating the second access is only performed when the reauthentication code includes a neighborhood identifier that matches a neighborhood identifier of the terminal the computer user is attempting to use to access the computer system; and

h. the security device receiving a computer system identifier and positively matching the computer system identifier to a trusted computer system identifier prior to authenticating the security device with the computer system.

20. The method according to claim **19**, further including the step of communicating signals generated from the security device to the computer system and when the computer

system fails to receive a signal from the security device after a first preset time period the system performing a system security function.

21. The method according to claim **20**, where performing a system security function includes limiting access to the computer system information via the terminal.

22. The method according to claim **21**, where the step of limiting access includes causing information presented on the terminal display to be removed from the display.

23. The method according to claim **20**, where the step of limiting access includes disabling use of the terminal.

24. The method according to claim **21**, where after a second preset time period the computer system further limiting access to the computer system.

25. The method according to claim **24** where the step of further limiting access includes logging a user off the terminal.

26. The method according to claim **24**, further including the step of entering in a database that the computer user is using the terminal when access is to computer system is initiated and wherein the step of further limiting access includes removing from the database that the computer user is using the terminal.

27. The method according to claim **19**, further including the step of determining that the reauthentication code includes a time component and the step of determining that the reauthentication code allows access includes comparing the time component to the current time to determine that a specified time limit has not been exceeded.

28. The method according to claim **27**, including the step of authenticating the security device with the computer system by communicating system authentication protocol information from the security device to the computer system when the current time is not within the specified time limit.

29. The method according to claim **19**, further including the step authenticating the computer user to the security device by the computer user providing information to the security device selected from the list of a response to a question and a biometric indicia, and wherein the provided information must match device authentication protocol information stored in the security device prior to authenticating the security device with the computer system.

30. The method according to claim **29** wherein, when biometric indicia is provided, the indicia is provided by the computer user using a biometric sensor in the security device to sense the indicia.

31. The method according to claim **29**, further including the step of incrementing a count in the security device when the computer user is not authenticated to the security device, the count recording the inability of the security device to authenticate the computer user.

32. The method according to claim **31**, further including the step of activating a security device security function selected from the list including (i) erasing a portion of the memory of the security device,(ii) transmitting an alert message to the computer system, and (iii) disabling the security device when the count exceeds a limit.

33. The method according to claim **32**, including the step of storing the count in the memory of the security device.

34. The method according to claim **33**, further including the step of resetting the count to zero when the count is less than or equal to a limit and the computer user is able to authenticate himself to the security device.

35. A method of initiating access between a computer user having a security device and a computer system containing information, the method comprising the steps of:

a. providing a first terminal including a display screen for presenting information to the computer user where the first terminal is separate from the security device;

b. communicating system authentication protocol information from the security device to the computer system at a first time;

c. authenticating the security device with the computer system using the authentication protocol information;

d. upon successful completion of the authenticating step, initiating a first access by the computer user to the computer system via the first terminal;

e. creating and storing a reauthentication code that is related to a time limit;

f. logging the computer user off the first terminal;

g. facilitating a second access by the computer user to the computer system via the first terminal using the reauthentication code at a second time that is within the time limit;

h. providing a second terminal where a neighborhood terminal is selected from a list including the first terminal and the second terminal;

i. presenting the security device at the neighborhood computer terminal and obtaining the authentication code at a third time subsequent to the second time;

j. determining that the third time is subsequent to the time limit; and

k. where the third time is subsequent to the time limit, granting access to the computer system only after the user provides authentication protocol information via the neighborhood computer terminal and the provided information is matched to stored system authentication protocol information.

36. The method of claim **35** wherein the terminal is a first terminal and the method further includes providing a second terminal including a second display screen for presenting information to the computer user where the second terminal is separate from the security device, the first and second terminals in a common neighborhood of the computer system and wherein the step of initiating a first access to the computer system at the first time includes using the first terminal to obtain authentication protocol information and the step of facilitating a second access includes using the second terminal to obtain the reauthentication code.

37. The method of claim **35** wherein the security device is an externally powered electronic device.

38. The method of claim **36**, wherein each of the first and second terminals includes at least one of a card reader, electrical contacts, radio frequency identification antenna, an infrared transceiver and a bar code reader.

39. The method of claim **36**, wherein the step of facilitating a second access includes bringing the security device proximate to the second terminal so as to contact the terminal.

40. The method of claim **35** wherein step of communicating system authentication protocol information includes the step of providing a user identifier and a password.

41. The method of claim **35** wherein step of communicating system authentication protocol information includes providing a user biometric indicia.

42. The method of claim **35** wherein the step of facilitating a second access includes initiating a second access by the computer user to the computer system via the terminal by communicating the reauthentication code to the computer system from the security device and when the reauthentication code is within the time limit allowing the second access.

43. The method of claim **35** wherein the reauthentication code is stored by the computer system.

44. The method of claim 43 wherein the reauthentication code is associated with a security device identifier within the computer system.

45. The method of claim 35 wherein the security device must be proximate to the terminal to communicate with the computer system.

46. The method of claim 1 wherein the security device is an externally powered electronic device.

47. The method of claim 19 wherein the security device is an externally powered electronic device.

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