EXHIBIT C

US006044382A

United States Patent [19]

Martino

[11] Patent Number: 6,044,382

[45] Date of Patent: Mar. 28, 2000

[54] **DATA TRANSACTION ASSEMBLY SERVER**

[75] Inventor: **Rocco L. Martino**, Villanova, Pa.

[73] Assignee: **Cyber Fone Technologies, Inc.**, Wayne, Pa.

[21] Appl. No.: **08/877,636**

[22] Filed: **Jun. 20, 1997**

Related U.S. Application Data

[63] Continuation-in-part of application No. 08/446,546, May 19, 1995, Pat. No. 5,805,676.

[51] **Int. Cl.**[7] **G06F 13/14**; H04M 11/00

[52] **U.S. Cl.** **707/505**; 379/93.17

[58] **Field of Search** 705/3; 707/505; 379/93.01, 93.17, 93.25

[56] **References Cited**

U.S. PATENT DOCUMENTS

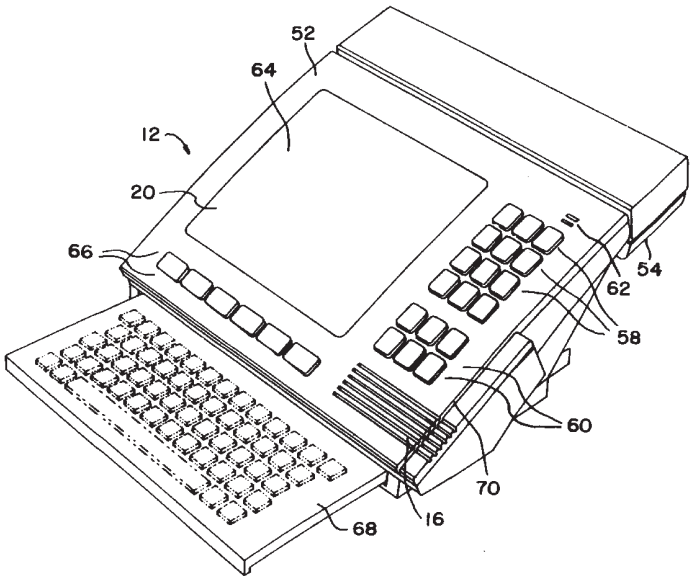
4,591,662	5/1986	Legros et al.	179/2 DP
4,598,171	7/1986	Hanscom et al.	381/110
4,689,478	8/1987	Hale et al.	379/96
4,776,016	10/1988	Hansen	381/110
4,813,013	3/1989	Dunn	364/900
4,835,372	5/1989	Gombrich et al.	379/93
4,851,999	7/1989	Moriyama	364/400
4,858,121	8/1989	Barber et al.	395/202
4,860,342	8/1989	Danner	379/96
4,937,439	6/1990	Wanninger et al.	235/456
4,972,462	11/1990	Shibata	379/89
4,984,155	1/1991	Geier et al.	364/401
4,991,199	2/1991	Perekh et al.	379/97
5,008,927	4/1991	Weiss et al.	379/98
5,047,960	9/1991	Sloan	364/523
5,189,632	2/1993	Paajanen et al.	364/705.05
5,195,086	3/1993	Baumgartner et al.	379/202
5,195,130	3/1993	Weiss et al.	379/98
5,204,813	4/1993	Samph et al.	364/419
5,278,751	1/1994	Adiano et al.	364/402
5,301,105	4/1994	Cummings, Jr.	364/401 M
5,333,266	7/1994	Boaz et al.	379/89
5,351,076	9/1994	Hata et al.	348/14
5,365,577	11/1994	Davis et al.	379/96
5,410,646	4/1995	Tondevold et al.	395/149
5,416,831	5/1995	Chewning et al.	379/96
5,572,421	11/1996	Altman et al.	395/203
5,704,029	12/1997	Wright, Jr.	395/149
5,757,655	5/1998	Shih et al.	364/489
5,805,676	9/1998	Martino	379/93.17

Primary Examiner—Stephen S. Hong
Assistant Examiner—Robert D. Bourque
Attorney, Agent, or Firm—Woodcock Washburn Kurtz Mackiewicz & Norris LLP

[57] **ABSTRACT**

A form driven operating system which permits dynamic reconfiguration of any host processor into a virtual machine which supports any of a number of operating system independent applications. A data transaction assembly server (TAS) downloads menus and forms which are unique to each application requiring data to be input for local or remote processing. The data transactions and forms are exchanged between the TAS, which functions as a form driven operating system of the host computer, and a remote processor in a real-time fashion so that virtually any operating system independent software application may be implemented in which a form driven operating system may be used to facilitate input, and in which the data input into the form may be processed locally or remotely, returned as a data stream, and displayed to the user. The TAS merely requires a flash PROM for storing the TAS control firmware, a RAM for storing the data streams making up the forms and menus, and a small RAM which operates as an input/output transaction buffer for storing the data streams of the template and the user replies to the prompts during assembly of a data transaction.

36 Claims, 18 Drawing Sheets



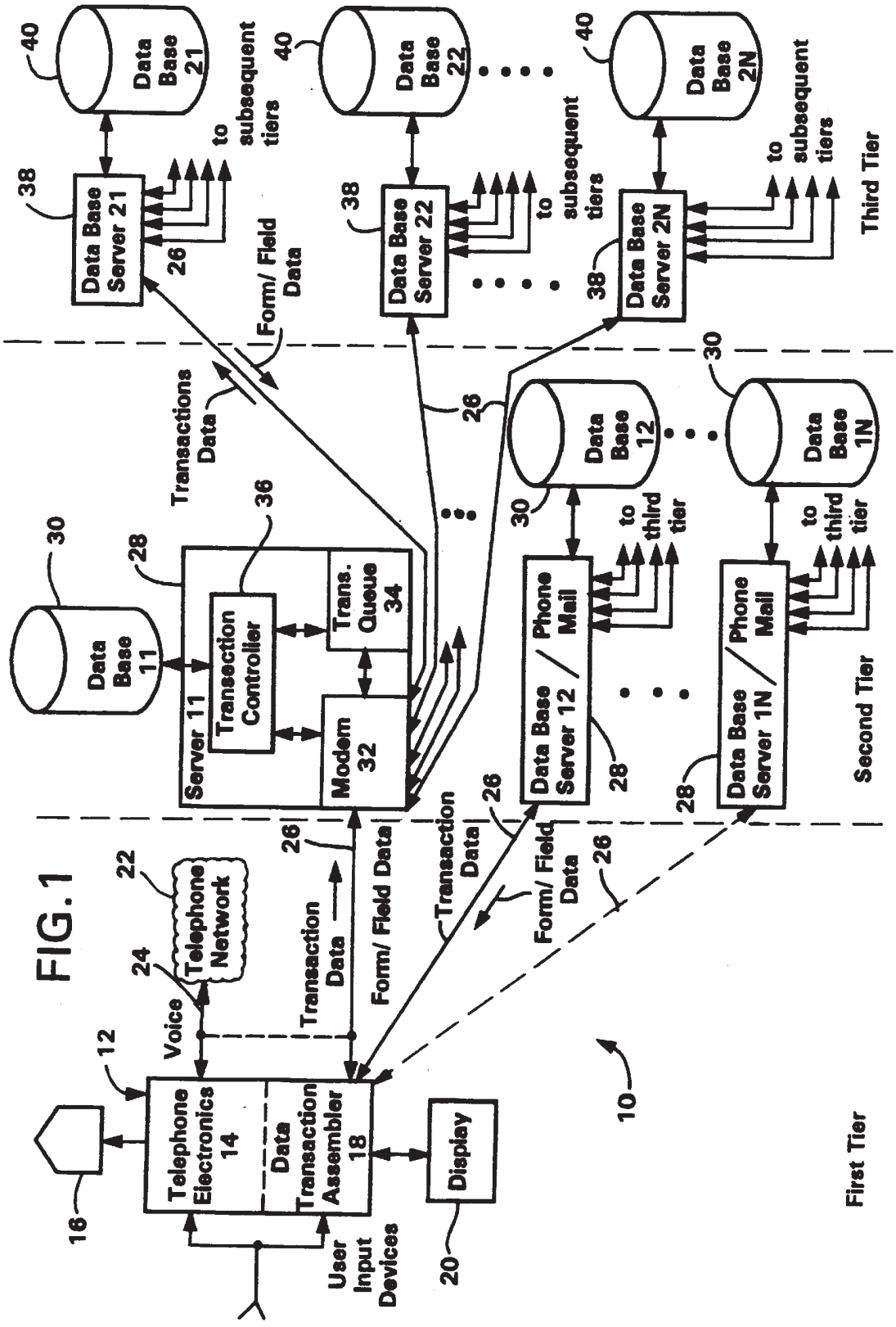

Data Base 21
Data Base 22
Data Base 2N
Data Base Server 21
Data Base Server 22
Data Base Server 2N
to subsequent tiers
Third Tier
Form/ Field Data
Transactions Data
Data Base 12
Data Base 1N
Data Base 11
Transaction Controller
Trans. Queue 34
Modem 32
Server 11
Phone Mail
Data Base Server 12
Data Base Server 1N
to third tier
Second Tier
Transaction Data
Telephone Network
Voice
Telephone Electronics 14
Data Transaction Assembler 18
Display
User Input Devices
First Tier
FIG. 1

FIG.2

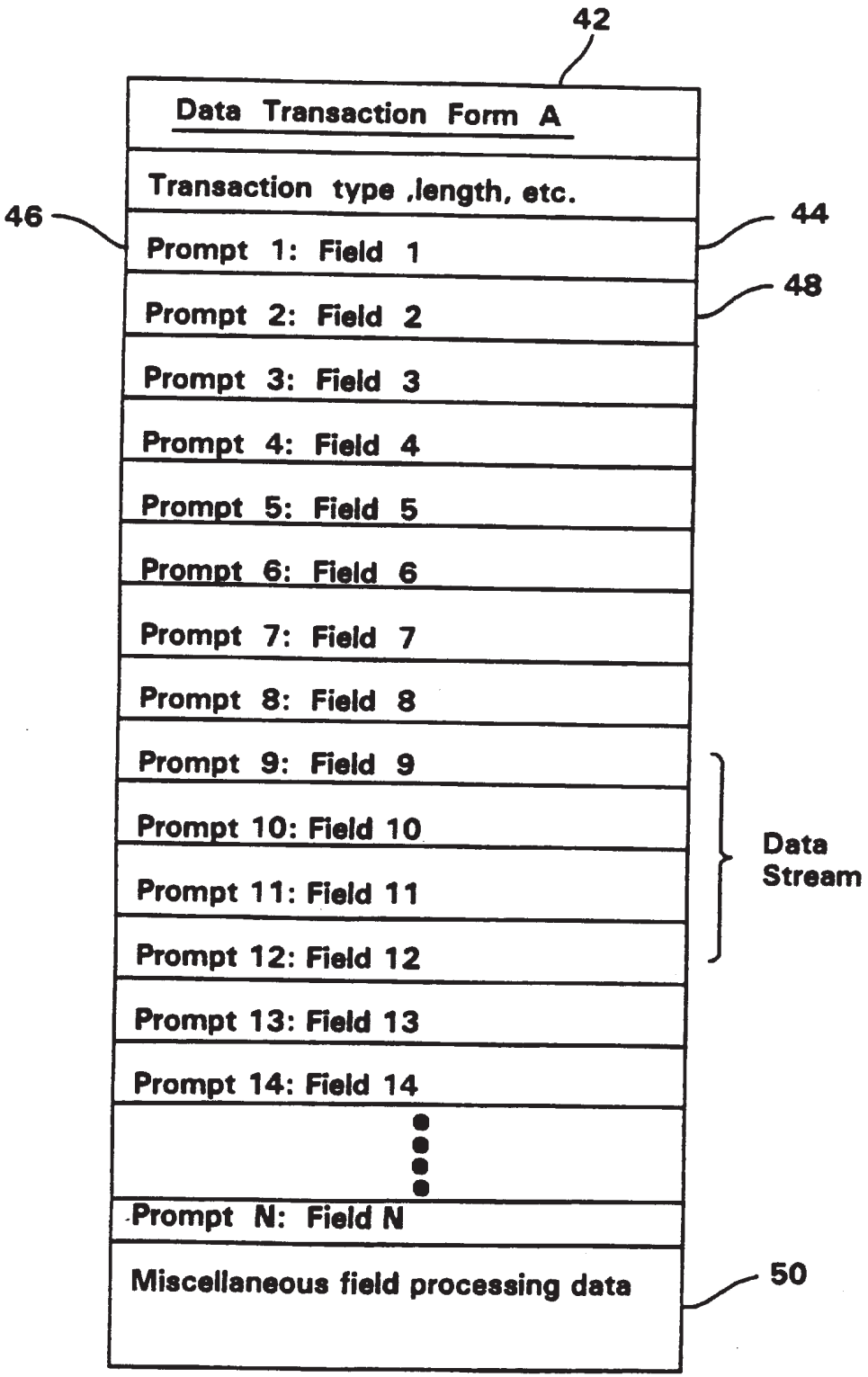

42
Data Transaction Form A
Transaction type ,length, etc.
46
Prompt 1: Field 1
44
Prompt 2: Field 2
48
Prompt 3: Field 3
Prompt 4: Field 4
Prompt 5: Field 5
Prompt 6: Field 6
Prompt 7: Field 7
Prompt 8: Field 8
Prompt 9: Field 9
Prompt 10: Field 10
Prompt 11: Field 11
Prompt 12: Field 12
Data Stream
Prompt 13: Field 13
Prompt 14: Field 14
Prompt N: Field N
Miscellaneous field processing data
50

FIG.3

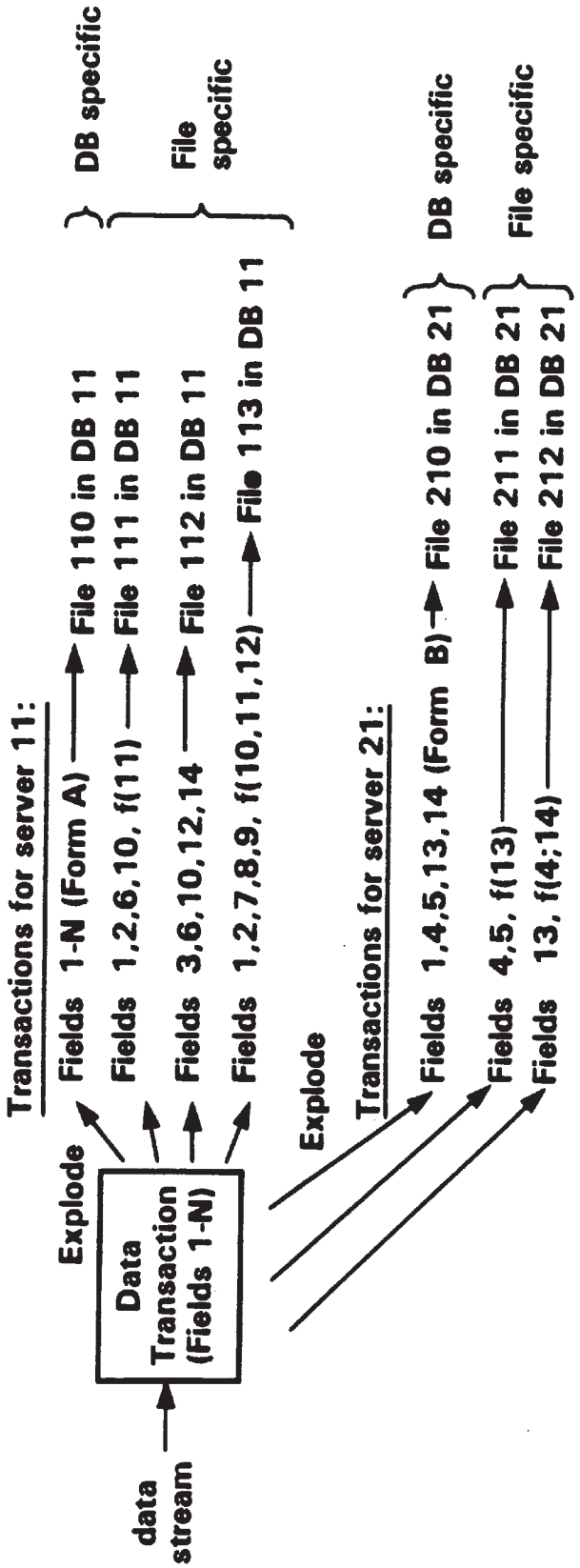
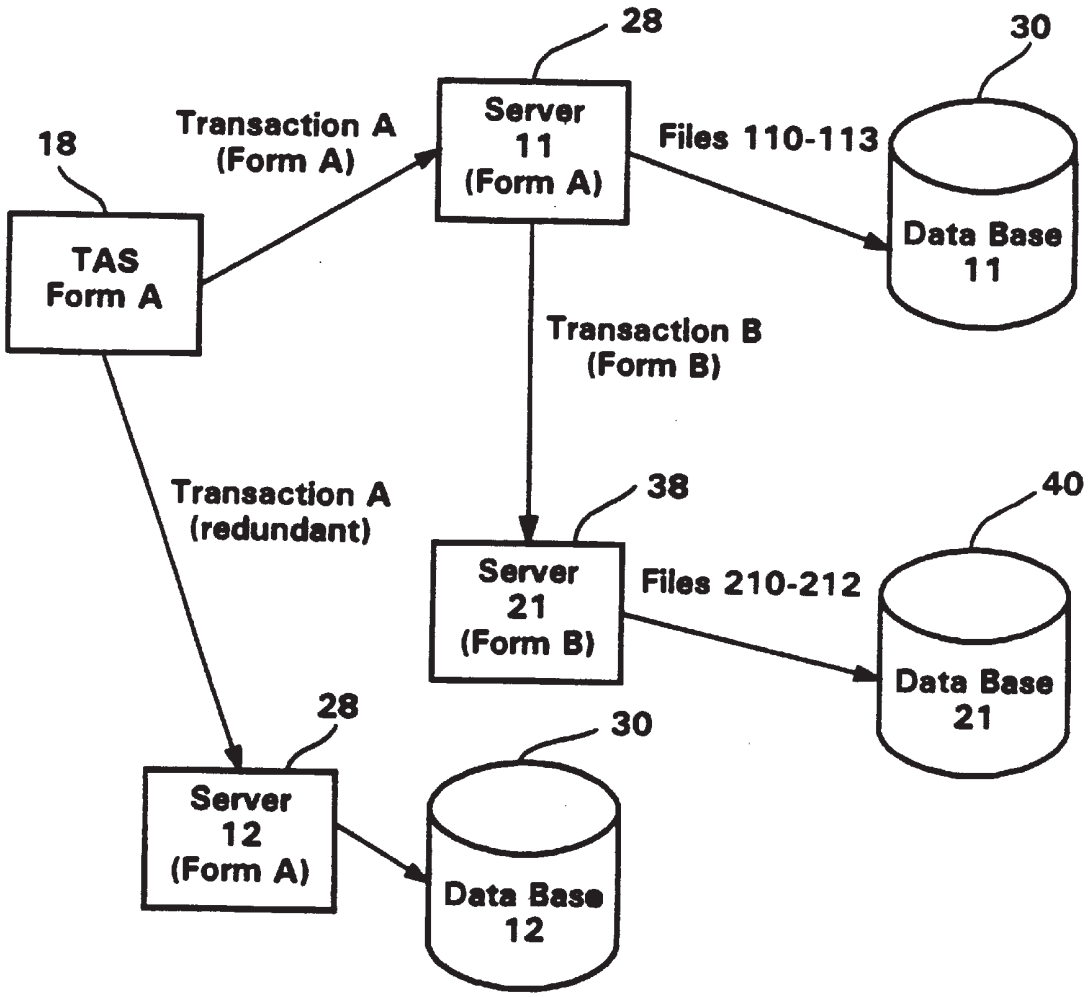

data stream
Data Transaction (Fields 1-N)
Explode
Transactions for server 11:
Fields 1-N (Form A) → File 110 in DB 11
Fields 1,2,6,10, f(11) → File 111 in DB 11
Fields 3,6,10,12,14 → File 112 in DB 11
Fields 1,2,7,8,9, f(10,11,12) → File 113 in DB 11
DB specific
File specific
Explode
Transactions for server 21:
Fields 1,4,5,13,14 (Form B) → File 210 in DB 21
Fields 4,5, f(13) → File 211 in DB 21
Fields 13, f(4;14) → File 212 in DB 21
DB specific
File specific

FIG.4


28
30
18
Transaction A
(Form A)
Server
11
(Form A)
Files 110-113
TAS
Form A
Data Base
11
Transaction B
(Form B)
Transaction A
(redundant)
38
40
Server
21
(Form B)
Files 210-212
Data Base
21
28
30
Server
12
(Form A)
Data Base
12

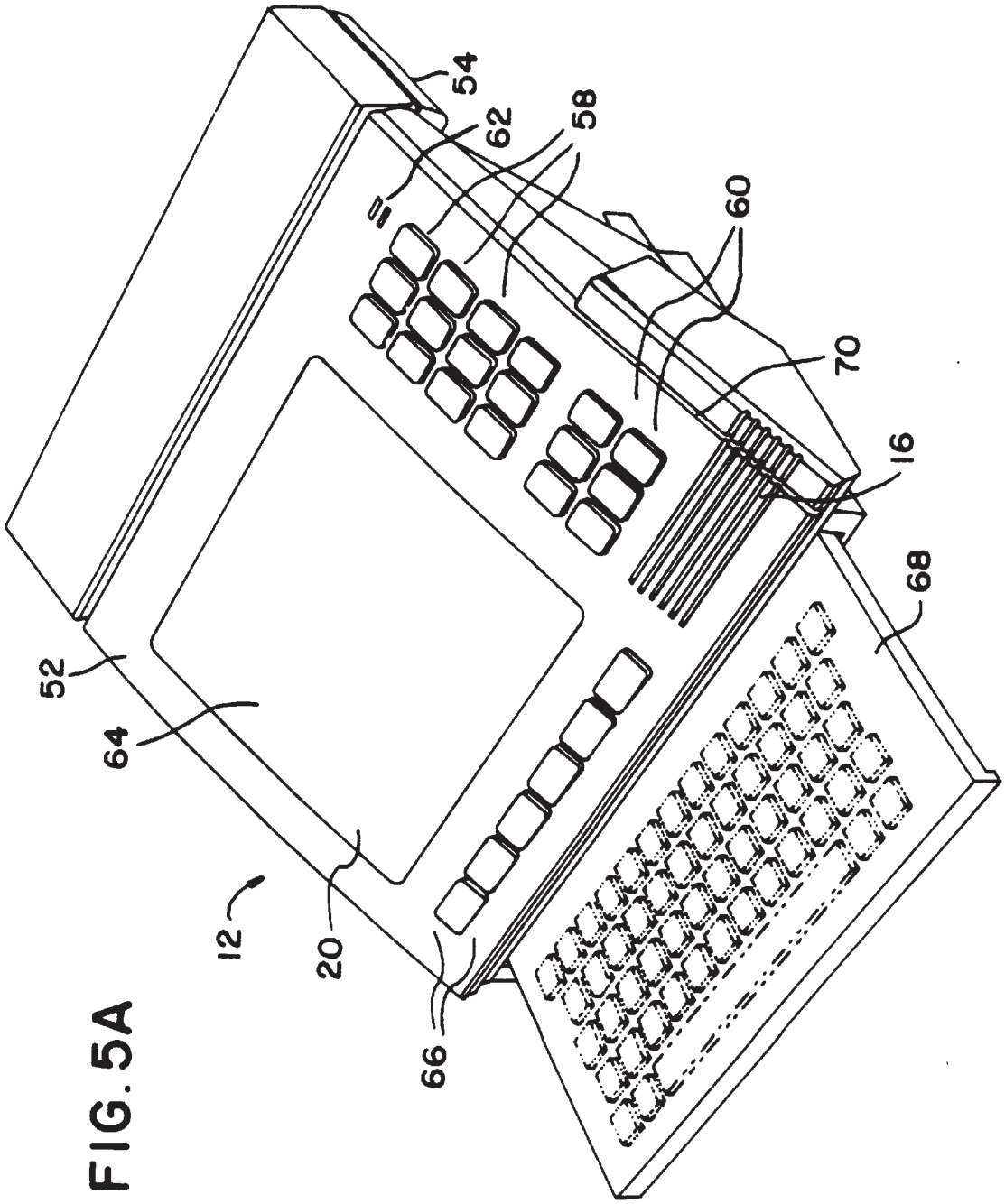


FIG. 5A

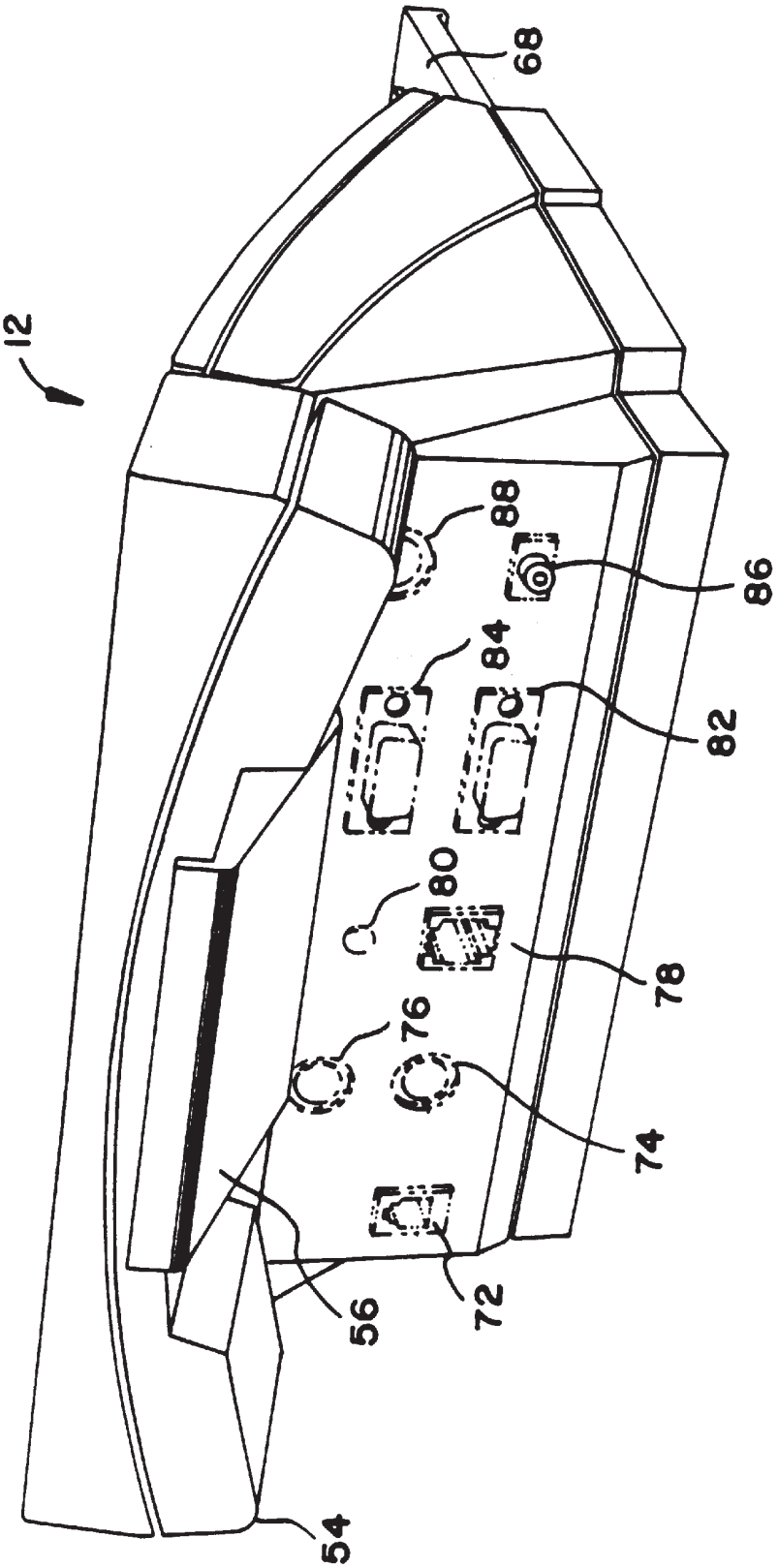


FIG. 5B

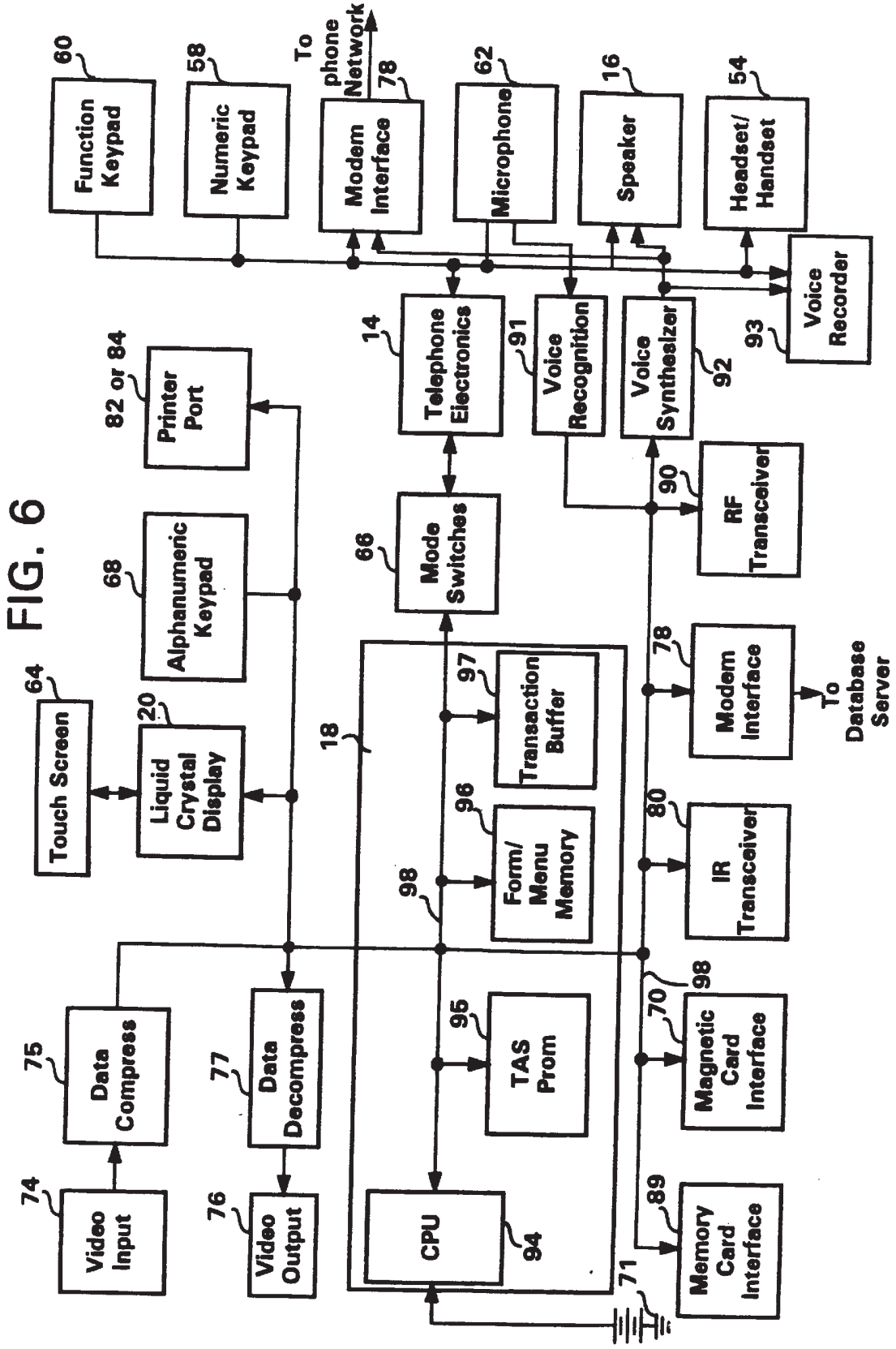

Function Keypad
60
Numeric Keypad
58
To phone Network
Modem Interface
78
Microphone
62
Speaker
16
Headset/ Handset
54
Voice Recorder
93
Telephone Electronics
14
Voice Recognition
91
Voice Synthesizer
92
Printer Port
82 or 84
Alphanumeric Keypad
68
Mode Switches
66
RF Transceiver
90
Touch Screen
64
Liquid Crystal Display
20
18
Transaction Buffer
97
Modem Interface
78
To Database Server
Form/ Menu Memory
96
98
IR Transceiver
80
Data Compress
75
Data Decompress
77
TAS Prom
95
Magnetic Card Interface
70
98
Video Input
74
Video Output
76
CPU
94
Memory Card Interface
89
71

FIG. 6

FIG. 7

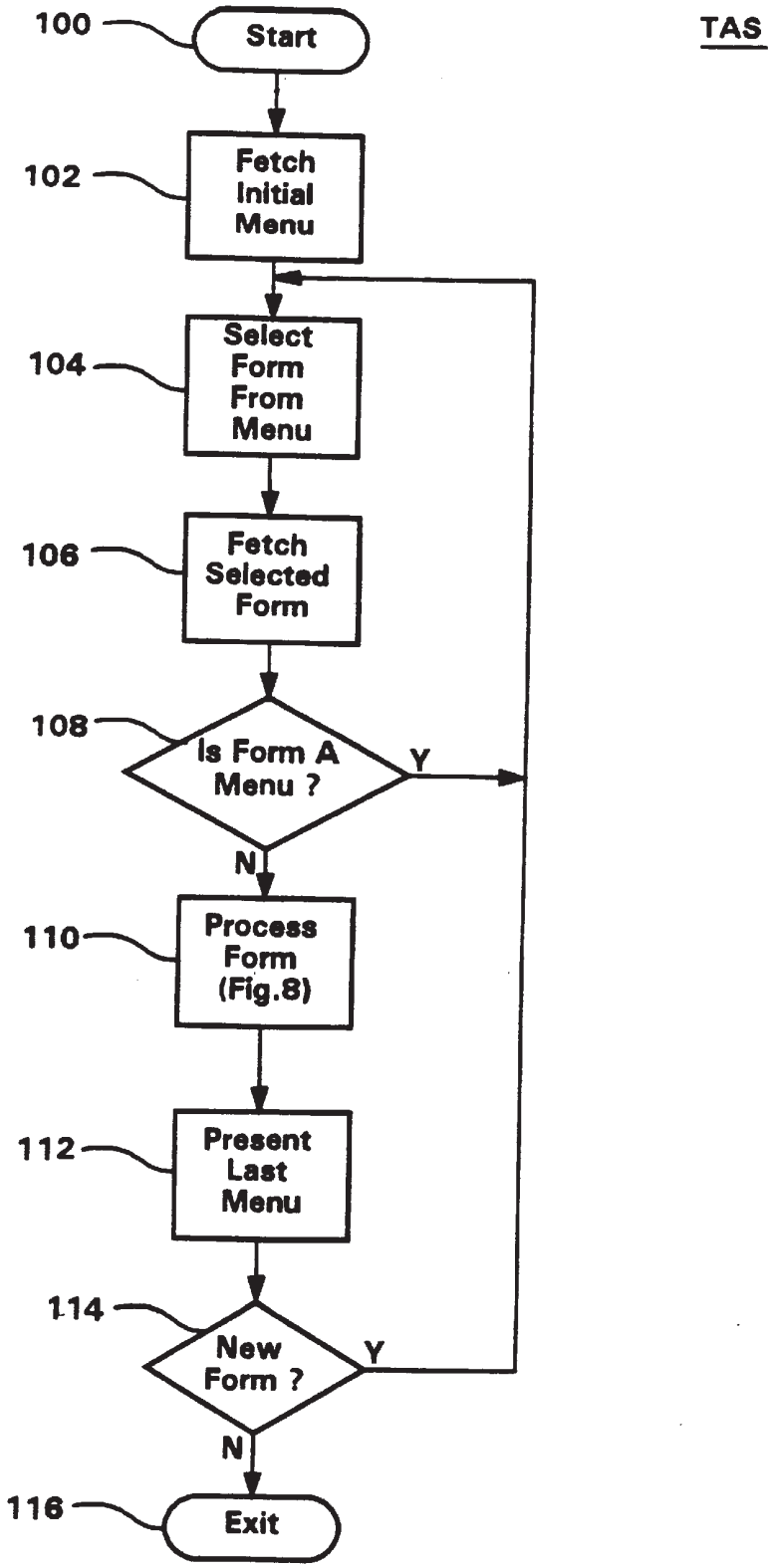

100
Start
TAS
102
Fetch Initial Menu
104
Select Form From Menu
106
Fetch Selected Form
108
Is Form A Menu ?
Y
N
110
Process Form (Fig.8)
112
Present Last Menu
114
New Form ?
Y
N
116
Exit

FIG.8

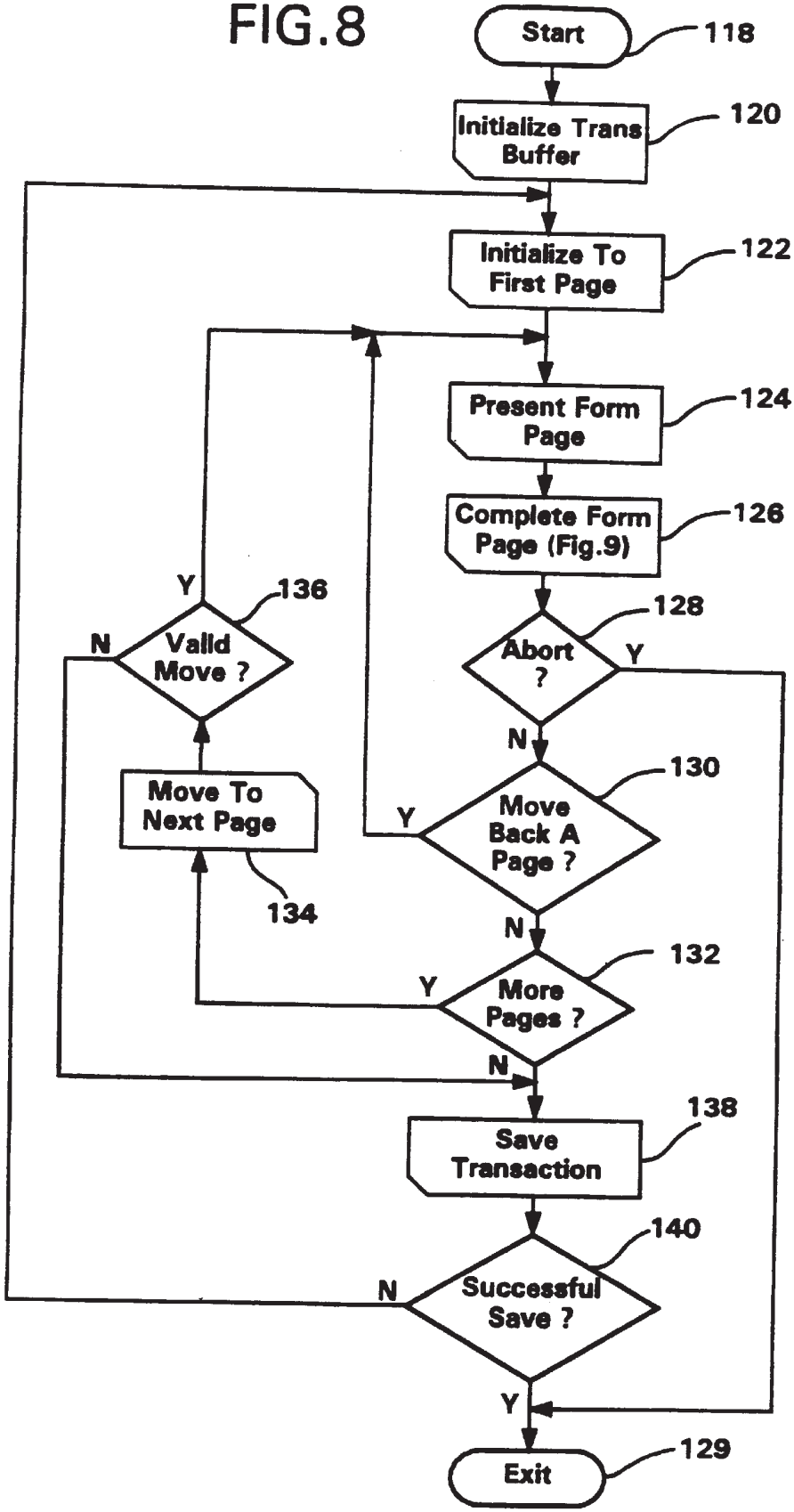

Start
118
Initialize Trans Buffer
120
Initialize To First Page
122
Present Form Page
124
Complete Form Page (Fig.9)
126
Abort ?
128
Y
N
Move Back A Page ?
130
Y
N
More Pages ?
132
Y
N
Move To Next Page
134
Valid Move ?
136
Y
N
Save Transaction
138
Successful Save ?
140
N
Y
Exit
129

FIG.9A

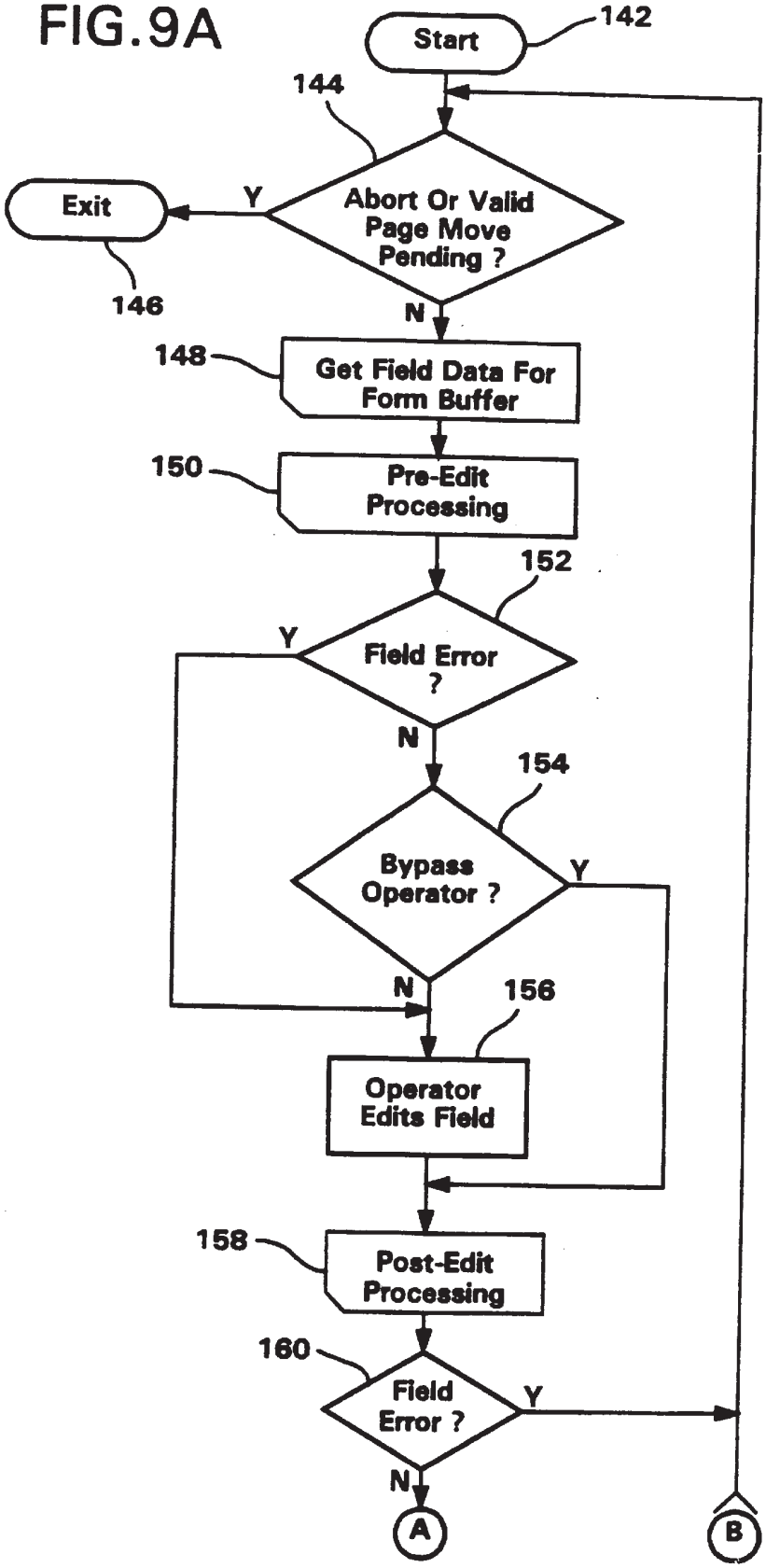
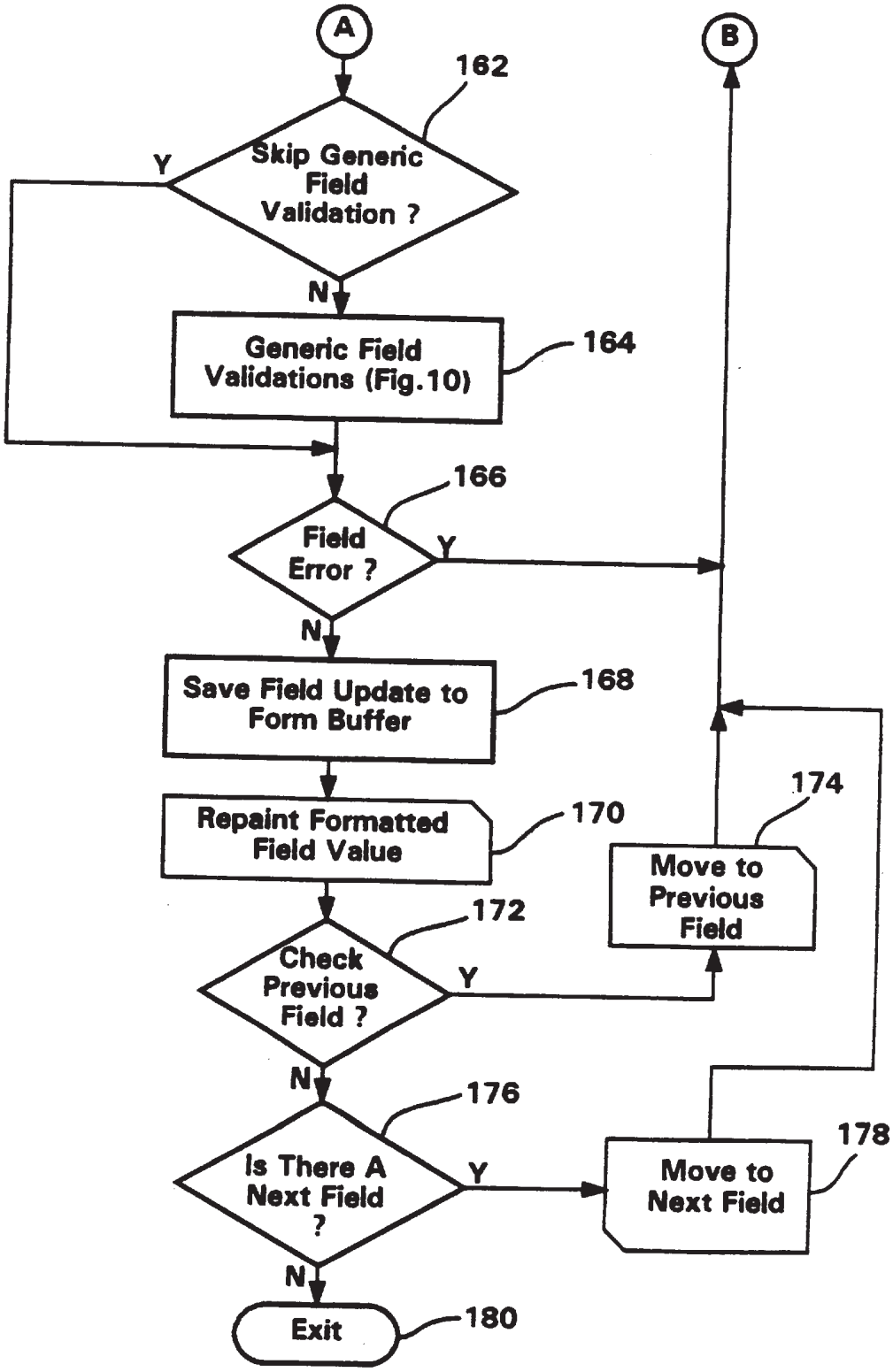

Start
142
144
Abort Or Valid Page Move Pending ?
Y
Exit
146
N
148
Get Field Data For Form Buffer
150
Pre-Edit Processing
152
Field Error ?
Y
N
154
Bypass Operator ?
Y
N
156
Operator Edits Field
158
Post-Edit Processing
160
Field Error ?
Y
N
A
B

FIG.9B


A
B
162
Skip Generic Field Validation ?
Y
N
Generic Field Validations (Fig.10)
164
166
Field Error ?
Y
N
Save Field Update to Form Buffer
168
Repaint Formatted Field Value
170
174
Move to Previous Field
172
Check Previous Field ?
Y
N
176
Is There A Next Field ?
Y
178
Move to Next Field
N
Exit
180

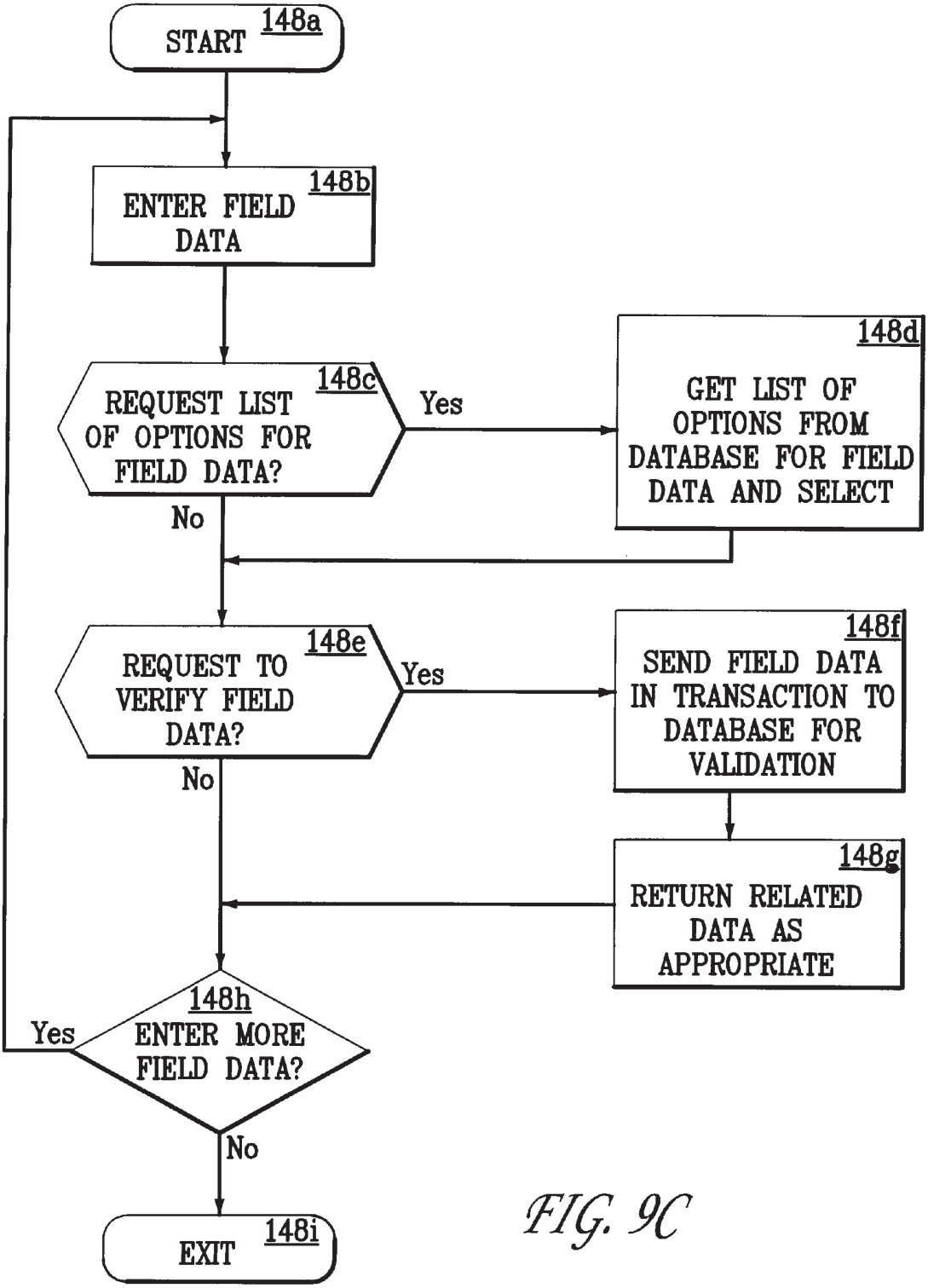

START
148a
ENTER FIELD DATA
148b
REQUEST LIST OF OPTIONS FOR FIELD DATA?
148c
Yes
No
GET LIST OF OPTIONS FROM DATABASE FOR FIELD DATA AND SELECT
148d
REQUEST TO VERIFY FIELD DATA?
148e
Yes
No
SEND FIELD DATA IN TRANSACTION TO DATABASE FOR VALIDATION
148f
RETURN RELATED DATA AS APPROPRIATE
148g
ENTER MORE FIELD DATA?
148h
Yes
No
EXIT
148i

FIG. 9C

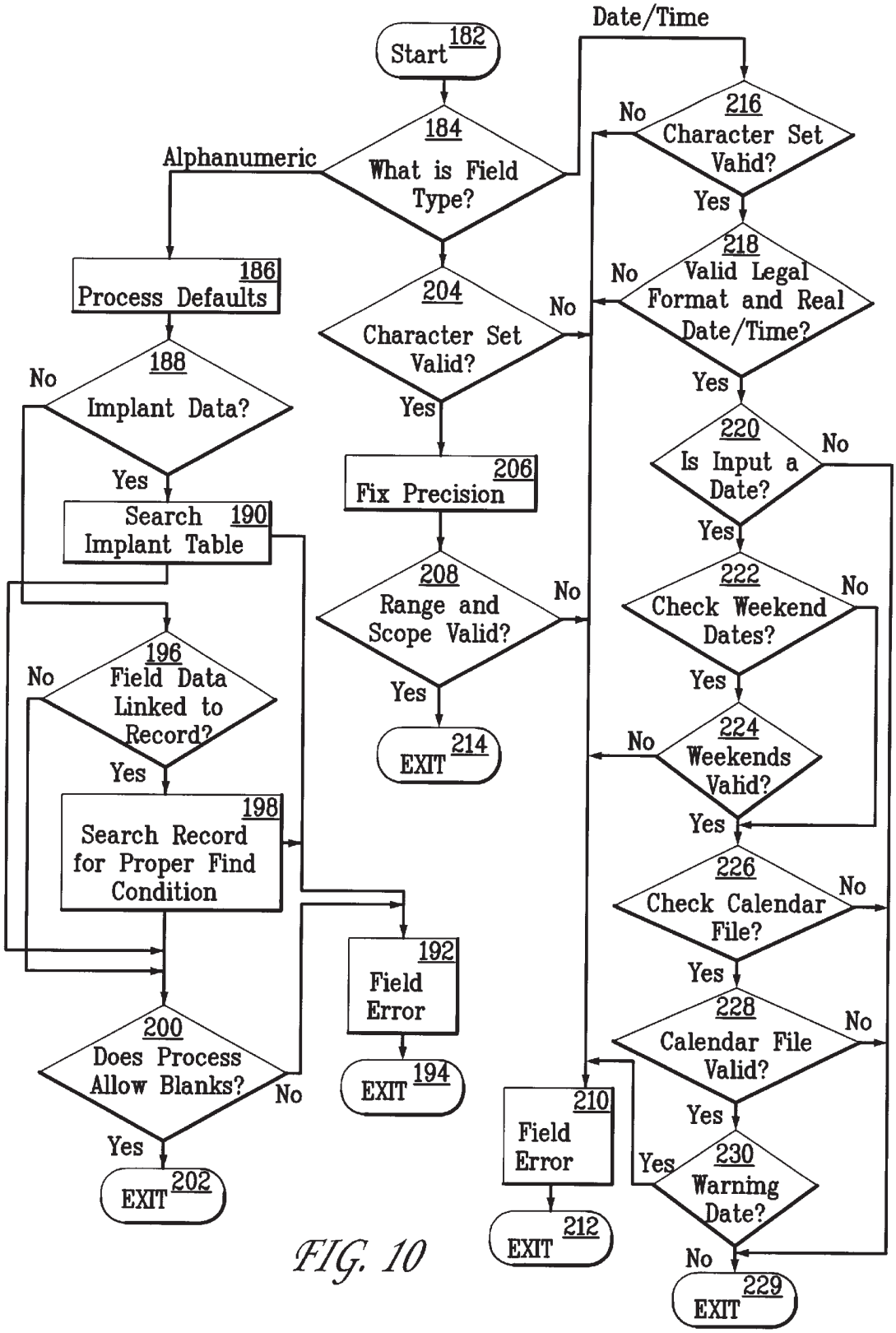

Start 182
184 What is Field Type?
Alphanumeric
Date/Time
186 Process Defaults
188 Implant Data?
No
Yes
Search 190 Implant Table
196 Field Data Linked to Record?
No
Yes
198 Search Record for Proper Find Condition
200 Does Process Allow Blanks?
No
Yes
EXIT 202
192 Field Error
EXIT 194
204 Character Set Valid?
No
Yes
206 Fix Precision
208 Range and Scope Valid?
No
Yes
EXIT 214
216 Character Set Valid?
No
Yes
218 Valid Legal Format and Real Date/Time?
No
Yes
220 Is Input a Date?
No
Yes
222 Check Weekend Dates?
No
Yes
224 Weekends Valid?
No
Yes
226 Check Calendar File?
No
Yes
228 Calendar File Valid?
No
Yes
230 Warning Date?
Yes
No
210 Field Error
EXIT 212
EXIT 229

FIG. 10

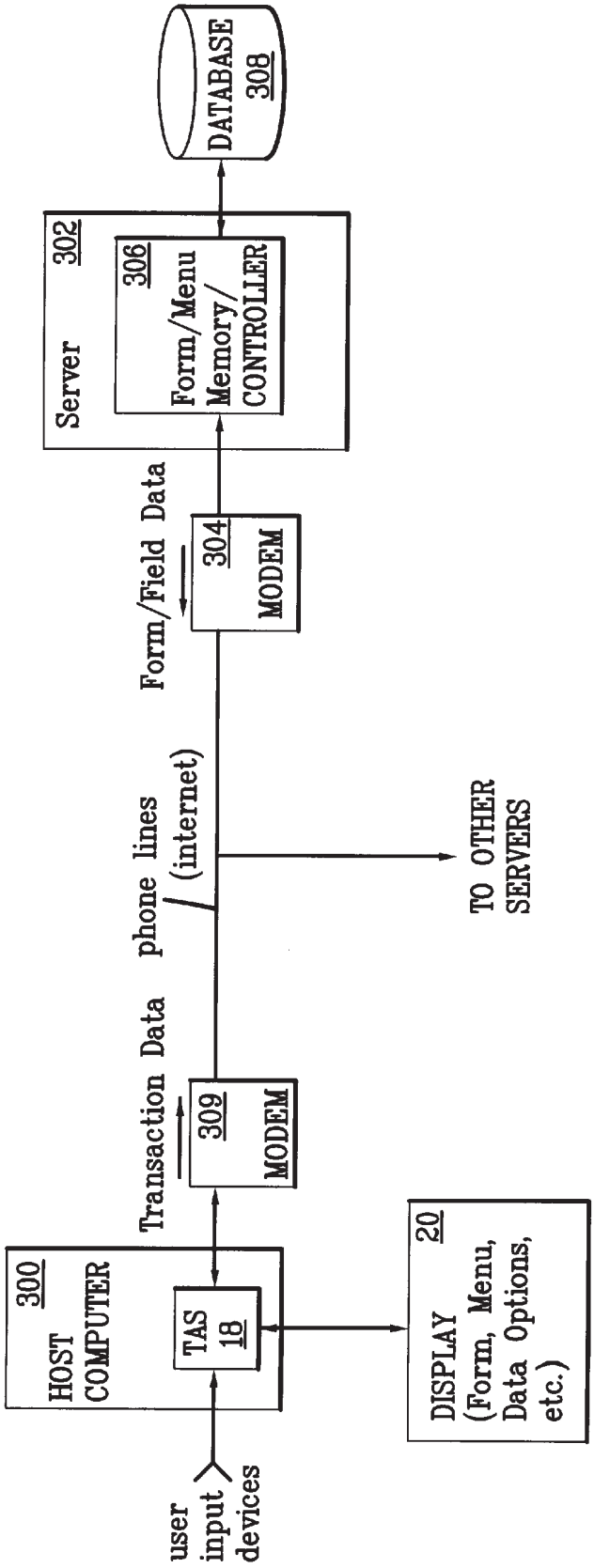

DATABASE
308
Server
302
306
Form/Menu
Memory/
CONTROLLER
Form/Field Data
304
MODEM
phone lines
(internet)
TO OTHER
SERVERS
Transaction Data
309
MODEM
300
HOST
COMPUTER
TAS
18
20
DISPLAY
(Form, Menu,
Data Options,
etc.)
user
input
devices

FIG. 11

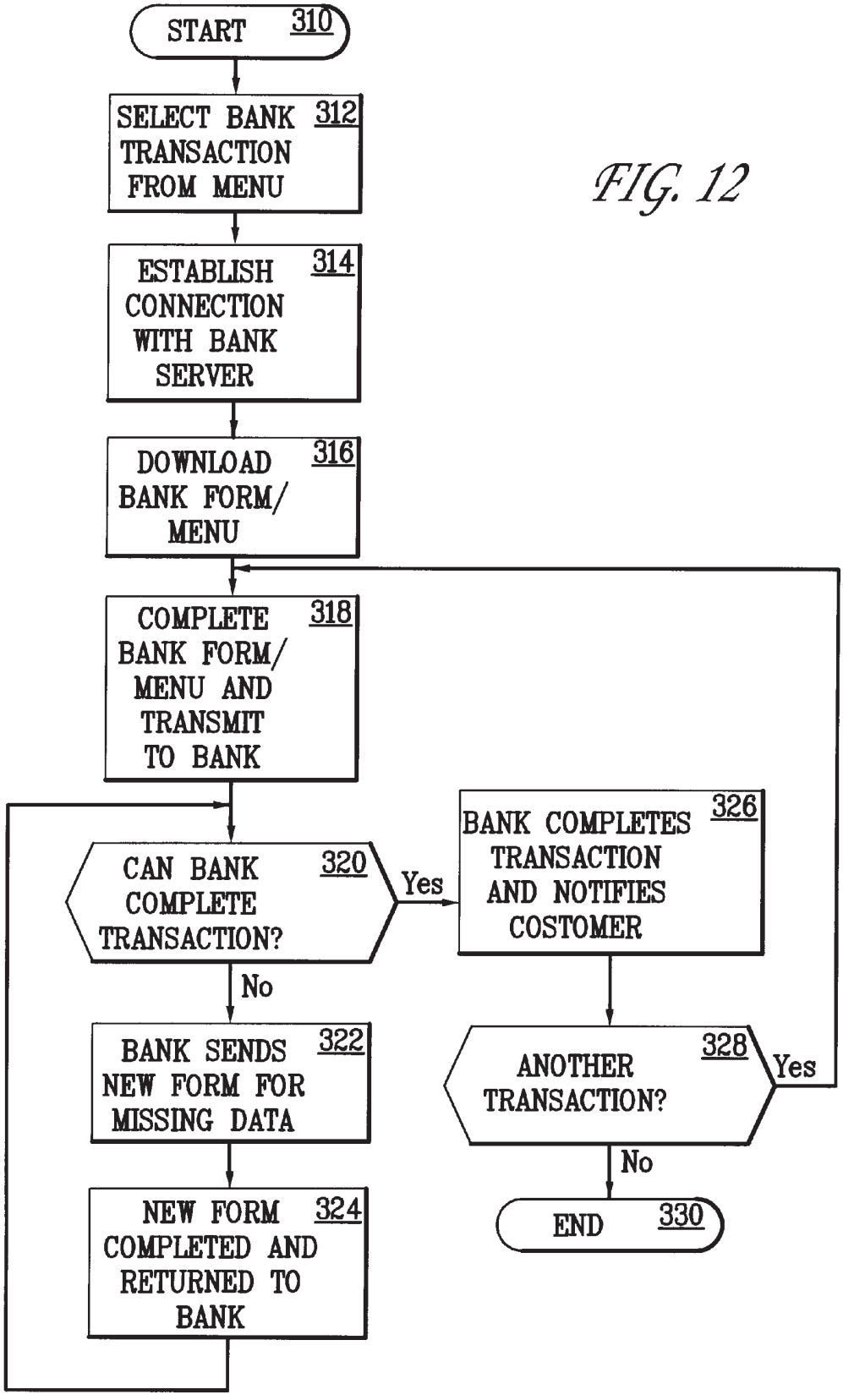

START 310
SELECT BANK TRANSACTION FROM MENU 312
ESTABLISH CONNECTION WITH BANK SERVER 314
DOWNLOAD BANK FORM/ MENU 316
COMPLETE BANK FORM/ MENU AND TRANSMIT TO BANK 318
CAN BANK COMPLETE TRANSACTION? 320
Yes
No
BANK COMPLETES TRANSACTION AND NOTIFIES COSTOMER 326
BANK SENDS NEW FORM FOR MISSING DATA 322
NEW FORM COMPLETED AND RETURNED TO BANK 324
ANOTHER TRANSACTION? 328
Yes
No
END 330

FIG. 12

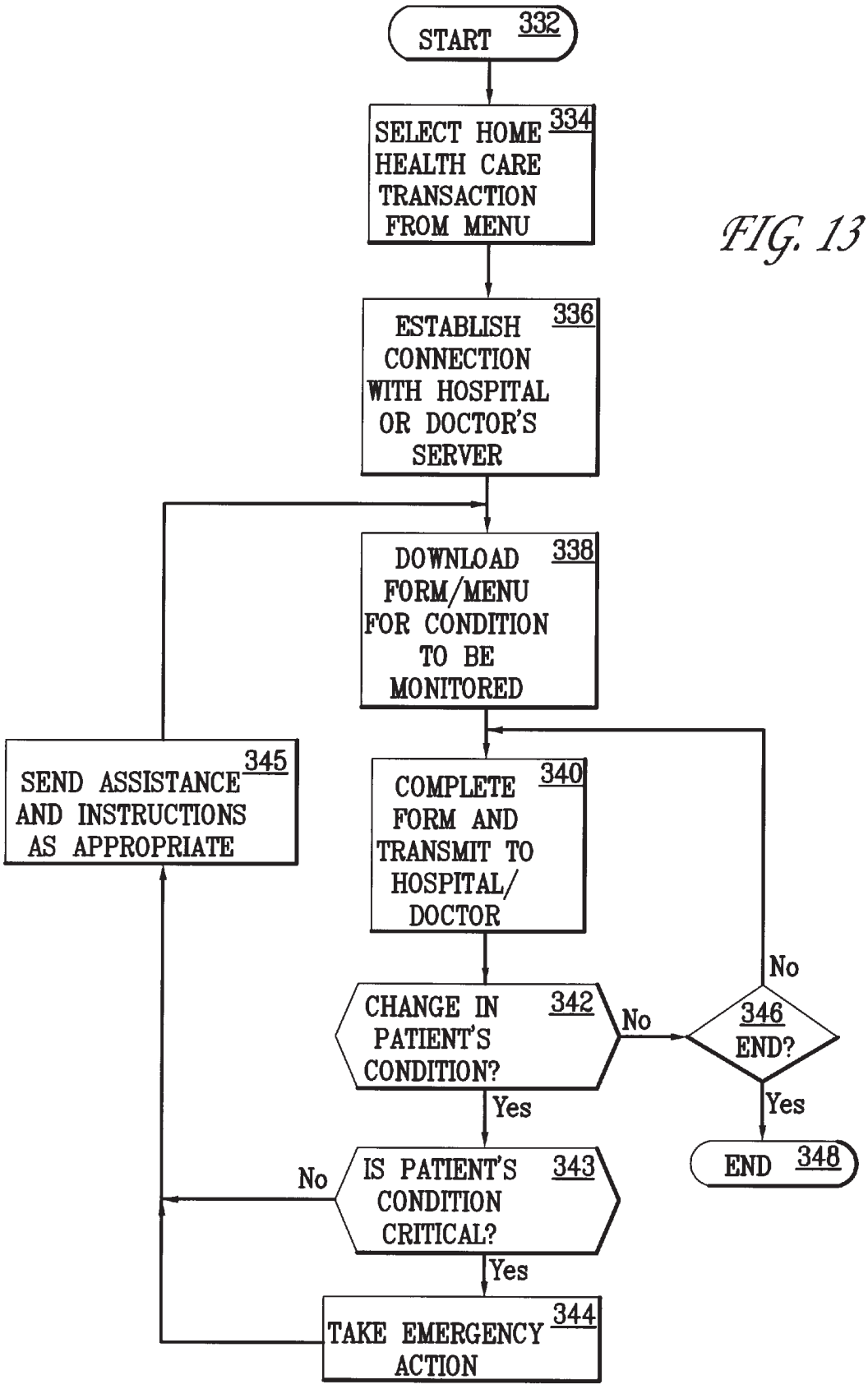

START 332
SELECT HOME HEALTH CARE TRANSACTION FROM MENU 334
ESTABLISH CONNECTION WITH HOSPITAL OR DOCTOR'S SERVER 336
DOWNLOAD FORM/MENU FOR CONDITION TO BE MONITORED 338
COMPLETE FORM AND TRANSMIT TO HOSPITAL/ DOCTOR 340
CHANGE IN PATIENT'S CONDITION? 342
No
346 END?
No
Yes
Yes
END 348
IS PATIENT'S CONDITION CRITICAL? 343
No
Yes
TAKE EMERGENCY ACTION 344
SEND ASSISTANCE AND INSTRUCTIONS AS APPROPRIATE 345

FIG. 13

I. OBJECTIVE

A. Enter ID#.

B. Measure the number of times you breath per minute ☐☐

C. Measure your Pulse for a minute and enter the # (refer to Pulse and BP). ☐☐

D. Measure Peak Flow and enter the # (use Peak Flow number) ☐☐☐

E. Measure Oxygen SAT and enter # (use Oximeter) ☐☐☐

F. How many times in the last 24 hours have you used the Red Inhaler? (Beta–Agonist). ☐☐

G. Use of Oxygen in the last 24 hours? ☐ less ☐ more ☐ no change

II. SUBJECTIVE

A. Has your cough changed? ☐ less ☐ more ☐ no change

B. Has the color of your Sputum changed? ☐ yes ☐ no

C. If yes, has it changed from clear to colored? ☐ yes ☐ no

1) What color ☐ yellow ☐ green ☐ bloody

D. Has your shortness of breath changed? ☐ better ☐ worse ☐ no change

E. Has your ability to walk changed? ☐ better ☐ worse ☐ no change

FIG. 14

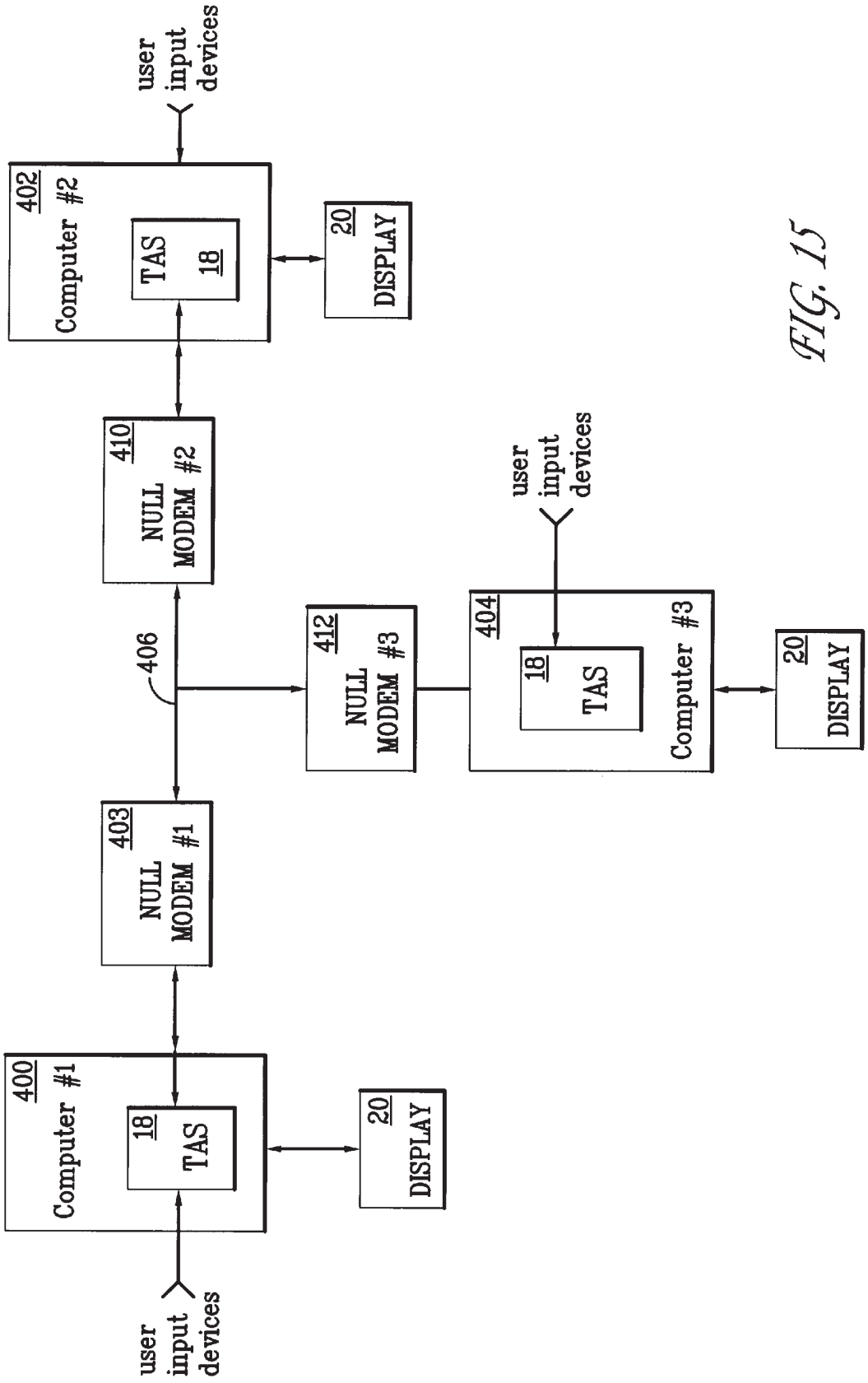

user input devices
402
Computer #2
TAS
18
20
DISPLAY
410
NULL MODEM #2
406
412
NULL MODEM #3
user input devices
404
18
TAS
Computer #3
20
DISPLAY
403
NULL MODEM #1
400
Computer #1
18
TAS
20
DISPLAY
user input devices

FIG. 15

DATA TRANSACTION ASSEMBLY SERVER

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part of U.S. patent application Ser. No. 08/446,546, filed May 19, 1995, now U.S. Pat. No. 5,805,676, the contents of which are hereby incorporated by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a form driven operating system which permits dynamic reconfiguration of the host processor into a virtual machine which supports any of a number of operating system independent data transactions, and more particularly, to a data transaction assembly server which downloads data transactions representative of different applications. The respective applications are implemented using menus which navigate the user to application specific forms which facilitate the entry of data appropriate to that application. The resulting data transactions and forms are exchanged between the form driven operating system of the host computer and a remote processor in a real-time fashion so that virtually any operating system independent software application may be implemented in which the form driven operating system is used to facilitate input, and in which the data input into the form may be processed remotely, returned as a data stream, and displayed to the user in real-time.

2. Description of the Prior Art

Point-of-entry systems have been developed which incorporate computer processing capabilities into conventional telephones. For example, a computer/telephone apparatus is described in U.S. Pat. Nos. 5,195,130, 5,008,927, and 4,991,199 which configures a telephone as a programmable microcomputer which is operated through the standard telephone 12-key keypad. A programmable gate array is reconfigured to accommodate various types of software which require different hardware configurations but without actually reconfiguring the hardware. The reconfiguration data is received from a network host computer and is used by the programmable microcomputer to emulate the hardware of any of a plurality of service bureaus which communicate with the network host computer. In this manner, the telephone/computer is configured to communicate data to/from any of a number of different service bureaus via conventional telephone lines.

However, telephone/computer systems of the type described in the afore-mentioned patents are typically quite complicated and expensive and are limited by the types of operating software which can be downloaded from the network host computer. Also, such telephone/computer systems are relatively slow since the microcomputer must be reconfigured before it will permit communication with the requested service bureau. Because of these characteristic features, such telephone/computer systems are typically used in public locations and are not efficient for creating point-of-entry transactions in typical commercial or private settings. A point-of-entry transaction system is desired which does not have such limitations and which is operating system independent.

Elimination of the requirement of a conventional operating system, with its command interpreters, memory management functions, function schedulers, disk operation functions, and the like, to run application programs and the need to write and compile a number of individual application programs for each application implemented by the microprocessor of a data entry and/or transaction creation device would greatly decrease the cost of such a device. However, to date, this has not been possible because an operating system with the afore-mentioned features is needed to run the application programs which control the data communications and together handle discrete parts of the computer system. Unfortunately, such application programs require substantial amounts of local memory and substantial processing power for performing the desired functions. Also, the operating systems themselves tend to be quite costly to purchase and maintain.

Accordingly, a data entry system is desired which does not have the inherent limitations of conventional point-of-entry systems such as the requirement of a standard operating system for communication with a remote service bureau or file server. A data entry device and associated system is desired which performs a minimal amount of processing at the data entry device so that the data entry device may be as simple and inexpensive as possible, thereby bringing the cost of such a device into a range suitable for most commercial and private uses. It is also preferable that such a data entry device provide a wide range of functionality without requiring a complicated local operating system program and a plurality of applications programs for implementing functions other than simple hardware functions.

Typically, a microprocessor is viewed to be a general purpose computer which is modified by application programs into a special purpose computer. In other words, when an application program is loaded into and running on a host processor, the application program reconfigures the host processor into a special purpose computer whose function is determined by that application program. Unfortunately, to be able to run on a host computer, the application programs must be written in accordance with the protocols of the operating system loaded onto the host processor, such as Windows™ 3.11, Windows95™, DOS™, and the like. Typically, these operating systems require a great amount of memory and utilize a great deal of processor overhead to operate efficiently.

More recently, the application programs have been written in an operating system independent language developed by Sun Microsystems, Inc. known as JAVA. JAVA is a compiler with its own memory management and run-time module which can be adapted to each host processor and is thus independent of the host processor and the host processor's operating system. However, JAVA requires the application program to be compiled in JAVA. This individually compiled application program is then useable on any computer that has a JAVA enabler for executing the JAVA program. Hence, even with JAVA, specific application dependent programs must be written and then individually compiled. A simplified operating system environment is desired which allows dynamic reconfiguring of the host processor for each application without requiring the programming and compilation of code at the host processor for each application.

The present invention has been designed to meet these needs in the art.

SUMMARY OF THE INVENTION

A data transaction assembly server (TAS) in accordance with the invention which meets the above-mentioned needs in the art is preferably implemented in a transaction entry

device that permits the user to organize and control all aspects of his or her personal transactions as well as any transactions that may occur in an office setting. The TAS of the invention may also be implemented in a personal computer or any other general purpose computer which emulates the transaction entry device. In its simplest terms, the TAS formats input data into a data transaction having content which is dependent upon the type of application to which the associated data pertains. These data transactions are then transferred to a local or remote database server which may or may not "explode" each data transaction into its component parts for updating all databases containing data to which the data in the component parts pertain. In this "transaction entry mode," the TAS of the invention permits the transaction entry device to function as a multi-purpose workstation. However, since the data transactions are created without the use of a conventional operating system or application programs, the transaction entry device is quite simple and inexpensive and may be readily integrated with the customer's desktop telephone or portable telephone, implemented on a disk, a board, or a PCMCIA card for insertion into a standard personal computer, or implemented in a video control box.

The transaction entry device is driven by a microprocessor which is, in turn, driven by the operating system independent transaction assembly (or application) server (TAS) of the invention which is generally implemented as data streams stored in a flash PROM. The TAS is absolutely self-contained in its relationship to the hardware of the transaction entry device or personal computer and in general performs the two basic functions of (1) generating a template or form from a data stream, where the template or form can be a report or a set of data options, and (2) developing a data transaction as the user inputs data in response to prompts in the template or form. TAS may also include a mechanism for device handling, e.g., for driving a display and providing data to a modem. Generally, the template generated by the TAS is a series of data streams read from a local flash memory or transmitted directly from an external source such as a database file server.

During operation, the data entered by the user in response to prompts in the template are accumulated into data transactions which are transmitted to an external database server individually or accumulated and sent as a batch, which may depend on the application. Unlike typical prior art systems, the data transactions need not be locally stored for processing by the local microprocessor once the data transaction has been completed. On the contrary, the only required storage in the transaction entry device is a flash PROM, PCMCIA card, or disk for storing the TAS, a random access memory (RAM), a PCMCIA card, or disk for storing the data streams used by the TAS to complete a form and for storing the modem numbers for the remote database servers, and the same or an additional small RAM which stores an externally received data stream and/or operates as an input/output transaction buffer for storing the data streams of the template and the user replies to the prompts in the template during assembly of a data transaction or transactions. In an interactive process, the RAM may store values for selection and branching to different data streams. In this manner, the TAS permits the transaction entry device to serve as an assembly point for one or more specific data transactions until they are ready for transmission to a local or a remote database server for processing and storage for use in the current or another application.

The data transaction or transactions, which may be requests for data or a process, formed by the transaction entry device is/are transmitted via cellular, wired, or wireless modem to a local or remote database server for processing and/or storage. The data transaction is received via standard protocols at the database server which, depending upon the application, stores the entire data transaction, explodes the data transaction to produce ancillary records which are then stored, and/or forwards the data transaction or some or all of the ancillary records to other database servers for updating other databases associated with those database servers. Also, in response to requests from the transaction entry device, any of the database servers may send data streams back to the transaction entry device for use in completing the fields in the data transaction or in displaying new forms or menus with new sets of data options or reports for selection. To the extent that these data streams sent to the transaction entry device are forms and menus for particular applications to be executed on the microprocessor, these data streams permit the host processor to be dynamically reconfigured for the application(s) represented by the data streams in a manner which is totally independent of conventional operating systems.

Preferably, the transaction assembly (application) server (TAS) controls a microprocessor such as an Intel 80386SX or higher, and is implemented as data stored on a computer readable medium for processing by the microprocessor. One or more megabytes of RAM (internal or external) are used for dynamically storing the data streams for the templates, one-half megabyte or more of flash PROM is used for storing the TAS, and a 128 kB or larger RAM buffer which functions as a transaction buffer is used for storing the data streams of the templates and the user responses until completion of the data transaction. In one embodiment of the invention, the RAM, the PROM, and a microprocessor are provided on an removable PCMCIA card for selectively reconfiguring the host computer. Alternatively, the TAS RAM and PROM may be located on a circuit board internal to the host computer or data transaction device.

A graphics or numeric display screen also may be provided for displaying the templates to the user for the entry of the data which will form the data transactions. Preferably, the graphics or numeric display screen is on the order of 25 lines by 40 characters or more for a desktop unit and 12 lines by 40 characters or more for a cellular unit. The actual size and colors used on the display may be determined by the user by responding to prompts in a setup template.

The transaction assembly (application) server (TAS) guides the user to the desired template via menu selections, where the menus and templates are stored in RAM as data streams and are called up by the TAS when selected by the user. Generally, the menus are treated as a special type of template or form. The templates stored in the RAM may be updated at any time to handle particular applications by reading in a new data set which has been created off-line and downloaded via cellular, wired or wireless modem or direct connection to the RAM of the transaction entry device. Alternatively, the data may be downloaded via an RS-232 input to RAM, to a PCMCIA card, or to a disk. The same connections may be used to provide an automatic read from a remote database or an automatic write to a remote database. New applications may be added simply by adding additional memory elements containing the necessary templates for the new application or by replacing the existing templates stored in the RAM with templates received from an external device. A new disk or PCMCIA card containing the new templates could also be substituted.

Since all data is entered as data transactions determined by templates tailored to particular applications, the user

applications may be generalized so that no unique user application programs need to be written when a new application is added. The templates themselves may be created off-line, e.g., in response to prompts in a template used for template creation. However, if code is needed, or if a multimedia element is to be included in a data transaction, it can be appended to a data transaction as an additional parameter stream in the stream of data forming the data transaction. Also, since the nature of the data in the respective fields of the templates for particular applications is known in advance, the interface to a database server to permit storage of the data transactions and their component parts in the appropriate databases in the appropriate formats for each database becomes much simpler.

In a preferred embodiment of the invention, the transaction assembly (application) server (TAS) permits the user to select a set of forms to download for a particular application. The forms are downloaded as data byte streams and stored in a non-volatile flash memory or disk or a volatile memory such as RAM. When the forms are being completed by the user, a cellular, wired or wireless modem connection of the data transaction device may be used to acquire desired data for completing the forms from remote databases. On the other hand, the modem connection may be used to download new forms or menus of associated data options. Data processing for a particular application may proceed in an interactive manner until all of the desired data has been entered. For example, interactive techniques using TAS forms may be used to provide home banking, retail shopping (with or without rebates), fund raising techniques, telemarketing, hotel and airlines reservations, and home use medical systems for inputting vital signs data and the like to permit a patient to be remotely monitored with or without the assistance of medical personnel. Alternatively, the TAS and its associated microprocessor may be part of a medical or bank kiosk, a medical or banking facility, or plugged into a television, videophone, or a medical imaging system, such as CAT scanner, MRI device, and the like.

In an alternative embodiment of the invention, two or more data transaction devices with form driven operating systems in accordance with the invention may be set up to communicate with each other to provide a simple, inexpensive small data network. For example, a simple, small scale data network may be created without conventional HUBs, Ethernet cards, and/or network software by simply connecting two or more data transaction devices with a TAS so that they communicate via a cellular, wired or wireless modem or null modem (connector), as in the case of a small network in a residential home or small office. Data transactions are sent from device to device by filling out respective forms and communicating the data via modem (or null modem) as data transactions. The data transactions merely need to contain the address of the destination device, and each device needs to merely look for data addressed to it and to ignore all other data transactions. Thus, each device having a TAS effectively functions as a data transaction "tuner" which only receives data transactions addressed to it. Due to this characteristic of the system, there is no need to resolve data conflicts, thereby greatly simplifying the transmission hardware and software.

In particular implementations of the TAS of the invention, it is further contemplated that TAS can be implemented as part of a stand alone data transaction device which is reconfigurable to virtually any application for which data may be entered into forms and transmitted as data transactions, in a portable computer, or in a cellular telephone adapted to include a small display for presenting TAS forms. The data transactions created by TAS during the completion of a form can be broadcast via the Internet or via the telephone system using a cellular, wired, or wireless modem and received by particular database servers which "tune" to data transactions having the designated source address. Alternatively, the TAS may "tune" into the Internet to download from web sites and to collect and distribute e-mail. TAS may also be used to setup browser search requests and send the associated search codes to the Internet browsers for search. TAS may also allow the user to store phone numbers, names, addresses, and the like compressed in a flash PROM or RAM for recall. Other applications of the invention will also be apparent to those skilled in the art based on the following detailed description of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned characteristic features of the invention will become more apparent to those skilled in the art in view of the following detailed description of the invention, of which:

FIG. **1** is a schematic diagram of a system for entering data transactions into databases in accordance with the invention.

FIG. **2** illustrates a generic template for use in creating a data transaction in accordance with the invention.

FIG. **3** illustrates an "exploded" data transaction in which the component parts of a data transaction are stored in database-specific and file-specific locations.

FIG. **4** illustrates the "exploded" transaction of FIG. **3** in the context of the system illustrated in FIG. **1**.

FIGS. **5**(*a*) and **5**(*b*) together illustrate a preferred embodiment of a transaction entry device in accordance with the invention.

FIG. **6** is a schematic diagram of the electronics of the transaction entry device illustrated in FIGS. **5**(*a*) and **5**(*b*).

FIG. **7** is a flow diagram of a menu driven transaction assembly (application) server (TAS) in accordance with the invention.

FIG. **8** is a flow diagram illustrating a technique for processing a form used to create a data transaction in accordance with the invention.

FIGS. **9**(*a*)–**9**(*c*) together illustrate a flow diagram of a technique for completing and editing a data transaction in accordance with the invention.

FIG. **10** is a flow diagram illustrating how the TAS validates the fields of each data transaction.

FIG. **11** illustrates how TAS may be used to reconfigure a host computer for any user input application in accordance with the techniques of the invention.

FIG. **12** is a flow diagram illustrating how TAS may be used in a home banking context.

FIG. **13** is a flow diagram illustrating how TAS may be used in a home health care (remote monitoring) context.

FIG. **14** is a sample form for the home health care (remote monitoring) embodiment of FIG. **13**.

FIG. **15** illustrates a small scale network in which several computers having a TAS are connected to share data without requiring a sophisticated (and costly) network interface.

DETAILED DESCRIPTION OF THE PRESENTLY PREFERRED EMBODIMENT

A system and method which meets the above-mentioned objects and provides other beneficial features in accordance

with the presently preferred exemplary embodiments of the invention will be described below with reference to FIGS. **1–15**. Those skilled in the art will readily appreciate that the description given herein with respect to those figures is for explanatory purposes only and is not intended in any way to limit the scope of the invention. For example, those skilled in the art will appreciate that the telephone/transaction entry device and system for entering data transactions into remote databases in accordance with the invention may be used in numerous settings in numerous applications. Accordingly, all questions regarding the scope of the invention should be resolved by referring to the appended claims.

A. System Description

1. Overview

The system of the invention provides a simplified form driven operating system which permits all data to be input as data transactions which are determined by templates (forms) tailored to each application handled by the processor. Menus are provided to navigate to the desired forms. Thus, when a particular application is desired, the user simply navigates through the menus to select the desired form. The user then completes the form and transmits it to a local or remote server for processing. As a result, no unique user application program needs to be written for the processor when a new application is added: only the menus and forms needed for the new application need to be downloaded. As will be explained in more detail below, a transaction assembly (application) server (TAS) permits the user to select a set of forms to download from a remote server for a particular application. The selected forms are downloaded as byte streams and stored in a non-volatile flash memory, PCMCIA card, or disk or a volatile RAM memory. The forms are completed by the user directly or using interactive techniques in which certain of the data requested by the forms is obtained from remote databases via other servers. Data transaction processing for a particular application specified by the menus and forms proceeds in an interactive manner until all of the desired data has been entered, transmitted, and processed.

A first embodiment of a system implementing such a form driven operating system is used for the automatic capture and computerization of data associated with data transactions as they occur. Additional system embodiments will be described for creating a computer system which is totally reconfigurable for new applications by simply downloading new sets of menus and forms as data transactions. Such system embodiments include home banking or retail shopping, home use medical monitoring, a simple, inexpensive small data network, a visible phone mail menu, hotel and airlines reservations, fund raising techniques, and telemarketing. Alternatively, the TAS and its associated microprocessor may be part of a medical or bank kiosk, a medical or banking facility, or plugged into a television, videophone, or a medical imaging system, such as CAT scanner, MRI device, and the like. The data transactions created by TAS during the completion of a form can be broadcast via the Internet or via the telephone system using a cellular, wired or wireless modem and received by particular database servers which "tune" to data transactions having the designated source address. Alternatively, the TAS may "tune" into the Internet to download from web sites and to collect and distribute e-mail. TAS may also be used to setup browser search requests and send the associated search codes to the Internet browsers for search. TAS may also allow the user to store phone numbers, names, addresses, and the like compressed in a flash PROM or RAM for recall.

As used herein, a data transaction is the combination of a form or template or a series of forms or templates containing data entry prompts and the data entered in response to those prompts; however, in certain circumstances, the data transaction actually transmitted may include only the data entered in response to the prompts in the template. Throughout this specification, the words "form" and "template" are used interchangeably.

The data transactions are generated by a transaction entry device through an interactive process between the user and the form. The data transaction is assembled in a transaction buffer in the data transaction entry device and then transmitted one at a time or in a batch to an external database for storage and processing. No local storage for data transactions is necessary except as desired to permit the data transactions to be sent in batches or if local processing is desired, as when the data transaction entry device of the invention is being emulated on a personal computer. The data transaction is defined externally by the database in that all applications consist of a series of customized forms and prompts for soliciting entry of the data needed to update the databases or to provide data for a particular application to another data processing device as a data stream. Generally, the data transaction will have a one-to-many relationship to the file structures of the database containing data for that application, although the data transaction may have a single application specific file structure for communicating data to another similarly configured data processing device.

In a first embodiment of the invention, the data transactions are entered using a transaction entry device which is integrated with telephone electronics so that the resulting device may selectively operate as a conventional telephone or as a data transaction entry device. The resulting transaction entry device preferably includes a touch screen, a keyboard, a portable (infrared) mouse, and/or a 10 key touch tone keypad or "sounder"device which provides input to a transaction assembly (application) server (TAS) which, in turn, presents selection options via menus and forms for completion by the user. Menu and form selection and form completion is made by touch, by key selection from the keyboard, by moving a cursor to the appropriate selection point and depressing a key, or even by voice command (which is particularly useful if the input is simple commands or numerics). Whenever data entry (other than mere selection) is desired, it is accomplished via a menu-driven selection process and/or by direct entry of data using a keyboard, a keypad, a touch screen, a mouse, and the like. In the menu-driven case, a set of options is presented to the display screen by the TAS. If this set of options exceeds the capacity of the display screen, then the list is scrolled up or down through the use of scroll keys on the device, by voice command, or by touch at scroll command points. Once the selection is made, the data associated with that selection is automatically entered into the form by interaction with a local or remote database, or the data is input by the user. In the event of keyboard entry, the TAS may present a keyboard at the bottom of the display screen for touch entry; alternately, an optional keyboard located at the base of the transaction entry device or an external keyboard, keypad, or DTMF generating device (for touch tones) may be used.

When the data is entered independently of a selection process, such data also may be entered using a swipe card, PCMCIA memory card, smart card, a CD ROM, a floppy disk, and the like, if the data resides on the card, or the data may be transferred into the data transaction via cellular, wired or wireless modem from an external source. The data read from the card or received via modem can be used to fill

out a form or may be transmitted to an external database or computer. Data returned from the external database or computer via modem may also be used to interactively fill out the fields in the form. As desired, the data in a data transaction may also be written to a swipe card, smart card, PCMCIA memory card, writable CD ROM, floppy disk, and the like.

The TAS of the invention stores the options as well as control programs (microcode) for the processor for use with the templates in creating the data transactions. The TAS also includes a program allowing connection via cellular, wired or wireless modem to one or more external computers and databases. Preferably, two modes of operation are available: transaction entry mode (with or without modem connection) and telephone mode. A selection of either the transaction entry mode or the telephone mode is made through a switch selection on the transaction entry device.

When the transaction entry device is placed in the transaction entry mode, the TAS immediately enables the telephone keypad and presents a selection menu for all of the options the system is programmed to handle. However, if the transaction entry device is implemented on a disk, PCMCIA card, and the like, the card or board containing the necessary software (TAS) must be inserted prior to operation. In the telephone mode, on the other hand, the telephone keypad is enabled and a dial tone is provided. In telephone mode, one or more lines may be connected so as to allow simultaneous use of the transaction entry device without interfering with the modem connection. However, if a single telephone line is used, the telephone capability is available at all times or intermittently via cellular, wired or wireless modem as specified by the particular application. In the intermittent mode, upon a "save" the transaction entry device will control a dial up and transfer of data to a remote database server. On the other hand, if the telephone is used with an automatic dialer mechanism utilizing a phone list, the transaction entry device may automatically change from the telephone mode to the transaction entry mode. In this case, a display on the telephone or an associated computer display screen may be used to present a name and telephone list from which a selection can be made.

Other embodiments of the invention provide transaction entry devices or host computers including transaction assembly (application) servers which permit such systems to be reconfigured for each application specified by a form. The form facilitates the entry of data for local or remote processing without the requirement of a conventional operating system for memory management functions, command interpretation, function scheduling, disk operation, and the like, although some form of device handling for driving, for example, the display, is still desirable. Such conventional operating system functions becomes unnecessary since all data is input/output through a data transaction buffer for remote or off-line processing and since only a single application is processed at a time for each set of forms. As will be explained in more detail below, such characteristics of the invention permit a conventional processor to be inexpensively reconfigured as a "virtual" application computer which does not require the purchase of a single application program or a complex operating system for operation.

2. Data Transaction System (FIGS. 1–4)

FIG. **1** is a schematic diagram of a system **10** for entering data transactions into databases in accordance with a first embodiment of the invention. As illustrated, system **10** comprises a first tier for capturing a data transaction having a one-to-many relationship to file structures, a second tier for exploding the data transaction into component parts having a one-to-one relationship to file structures, and a third tier for providing additional explosion of the data transactions for specific applications.

The first tier comprises a transaction entry device **12** which captures the data transaction from the user in response to any of a plurality of inputs from the user. Transaction entry device **12** includes conventional telephone electronics **14** and speaker **16** and a data transaction assembly server (TAS) **18** for creating a data transaction in accordance with the invention. A display screen **20** is preferably associated with TAS **18** so that the user may monitor creation of each data transaction. Telephone electronics **14** are connected to a telephone switching network **22** via a conventional voice connection **24** over the cellular, wired and/or wireless telephone lines, while TAS **18** is connected via cellular, wired and/or wireless telephone lines **26** to one or more database servers **28**. As illustrated in FIG. **1**, telephone lines **24** and **26** may be separate lines, thereby permitting simultaneous use of the telephone and data entry functions, or the telephone electronics **14** and TAS **18** may be connected to a single line as illustrated in phantom in FIG. **1**. Of course, when the telephone electronics **14** and TAS **18** are connected to a single line, a mode switch will enable their mutually exclusive operation, or alternatively, any of a number of conventional transmission schemes may be used to permit simultaneous transmission of the voice from the telephone electronics **14** and the data from the TAS **18** over the same line.

During operation in the transaction entry mode, transaction entry device **12** is responsive to user input devices such as a touch screen, a telephone keypad, a keyboard, a microphone, a swipe card, a memory card, video input, and the like, to form data transactions using TAS **18**. Alternatively, the transaction entry device **12** operates in a telephone mode as a conventional telephone and receives inputs from a microphone and/or a handset, a touch tone keypad, and the like. More details of the transaction entry device **12** and TAS **18** will be provided in the next sections with respect to FIGS. **5–10**.

The second tier comprises one or more database servers **28** and their associated databases **30**. In general, each database server **28** receives data transactions from one or more transaction entry devices **12** and "explodes" the received data transactions into their component parts for storage in the appropriate files of the associated database **30**. In other words, the one-to-many file structure of the data transactions from one or more transaction entry devices **12** is converted into many one-to-one data transactions for storage in individual files of database **30**.

Each database server **28** includes a cellular, wired or wireless modem **32** for transmitting/receiving data from the telephone lines **26**, particularly the data transactions from one or more transaction entry devices **12**. Preferably, the data transactions are transmitted over the telephone lines **26** as data packets having, for example, 128 bytes, where 120 bytes contain information and 8 bytes contain control data. A transaction queue **34** acts as an input buffer for the received data transactions and controls the rate of presentation of the data transactions to transaction controller **36**. Transaction controller **36** processes the received data transactions to extract the physical file relationships of the component parts of the data transactions and stores the components parts and different combinations thereof in the appropriate files of associated database **30**. Alternatively, transaction controller **36** may process a data request from

TAS **18** requesting information from database **30** for completing certain fields of a data transaction being prepared by the transaction entry device **12**. Database **30** then provides the requested information to database server **28** which, via modem **32**, provides a data stream back to TAS **18** for use in completing the data transactions or presenting additional menus and forms for use in completing the data transactions in accordance with the invention. Typically, a user ID and password are transmitted to the transaction controller **36** to permit a connection to be made by TAS **18**. Thus, transaction controller **36** also checks and stores startup and logoff information in addition to storing data transactions and directing reconstituted data transactions to other database servers as described herein. In addition, database server **28** may include a conventional phone mail system with an associated database for storing voice mail messages. In this case, the data transaction may include voice data for storage in the remote voice mail system.

As shown in FIG. **1**, several database servers **28** may be provided. Preferably, each transaction entry device **12** has an associated database server **28** for performing any desired processing of its data transactions, although it is preferred that the data transactions be copied to at least one other database server **28** as shown in FIG. **1**. This redundancy minimizes the possibility of losing data in the event of a power outage and the like. Preferably, each database server **28** contains essentially the same hardware, although modem **32**, transaction queue **34**, and transaction controller **36** have not been shown for all database servers **28** for ease of illustration.

In transaction entry mode, the TAS **18** of transaction entry device **12** creates a data transaction that is transmitted to an associated transaction controller **36** of an associated database server **28**. By "associated" it is meant that the database server **28** functions to perform any processing requested or necessary in conjunction with the storage of a data transaction from a particular transaction entry device **12**. Of course, a particular database server **28** may have several transaction entry devices **12** associated with it, and vice-versa. So that no data will be lost, a particular database server **28** may also serve as a backup for another database server **28** in the event of the failure of any database server **28**.

As will be explained in more detail below with respect to FIGS. **2–4**, database server **28** "explodes" data transactions received from TAS **18** and provides the component parts of the "exploded" file dependent data transactions via modem **32** to other database servers **28** as necessary to update other databases. Alternatively, the "explosion" of the data transactions may be performed by the TAS **18** at the transaction entry device **12** and the component parts transmitted to all appropriate databases **28** for updating the data therein. For this purpose, the TAS **18** will also need to know the modem numbers for all database servers **28** to be updated by the exploded data transactions. However, those skilled in the art will appreciate that this latter alternative will require access to numerous phone lines by the transaction entry device and that such phone lines are not always available to the user.

Finally, the third tier of the system **10** includes additional database servers **38** and databases **40** which support file dependent data transactions for specific applications. This additional tier of database servers **38** and databases **40** permits the data in the data transactions to be routed to application specific databases for storage of application specific data and access by those transaction entry devices **12** requesting data related to that specific application.

The creation and storage of a data transaction in accordance with the invention now will be described with respect to FIGS. **2–4**.

Data transactions are created by TAS **18** as a data stream of a known format. A generic data transaction is illustrated in FIG. **2**. As defined herein, a data transaction is created using a form containing one or more of the following: instructions, prompts, menu selection options, and a template with fields for data entry. Generally, the menu form consists of prompts for selecting a form, another menu, or a process, and a single slot for entering a selection, while the data entry form consists of prompts and instructions together with fields for entering data, as shown in FIG. **2**. The data entry form can have either single or multiple fields for entering data.

In transaction entry mode, the user navigates through menus of TAS **18** until a form related to a particular type of data entry operation is selected. Once selected, data transaction form **42** is presented to the user on display device **20**. The data transaction form **42** is a collection of data defining the visual presentation on the display device **20** and a list of the fields through which linkages to external database files are defined.

As shown in FIG. **2**, data transaction form **42** includes a format field **44** which identifies the type of data transaction this form pertains to, the length of the form, the number of pages in the form, the number of bytes in each field, storage keys, and the like. The body of the data transaction form **42** comprises a predetermined series of prompts **46** which are provided to the display screen **20** as a data stream. The prompts preferably include descriptive data which may be alphanumeric, an icon, or a list that scrolls, if necessary. Fields **48** are blank spaces of predetermined size provided for accepting user input in response to each prompt. Generally, the size of each field **48** is also stored in the stream of data defining the data transaction form **42**. Since the prompts are tailored to elicit the necessary data for the application for which the data transaction form **42** was created, the fields **48** will include the user data necessary for processing a data transaction for that particular type of application. The user responses become part of the data stream which forms the data transaction. Typically, the data transaction form **42** also includes a miscellaneous processing field **50** which permits processing data unique to that form to be appended to the data transaction for transmission. Such processing data may include, for example, equations which define the relationships of the data in certain fields of the data transaction or audio or video data attached to a multimedia data transaction. In addition, non-display data associated with the time of data entry, the date of data entry, the user ID, and the like may be stored in miscellaneous processing field **50**. In addition, vital signs data and the like may be placed in miscellaneous processing field **50** when the transaction entry device **12** is used in a remote medical monitoring environment (described below).

FIGS. **3** and **4** illustrate the "explosion" of the stream of data forming the data transaction created using the data transaction form **42** of FIG. **2**. As shown in FIG. **3**, each data transaction contains data which is specific to a particular database and/or specific to particular files in one or more databases. The data in the data transaction is "exploded" accordingly. For example, the complete data transaction from FIG. **2** (Form A) is stored in a particular file (file **110**) of the database **30** associated with the transaction entry device **12** which created the data transaction (database **11** in FIG. **1**). Storage of the entire data transaction is desired so that records may be maintained in the event of system error, power failure, and the like. The transaction controller **36** then extracts data from those fields of the data transaction which it knows to be related in forms of that particular type.

For example, the data in fields **1**, **2**, **6**, **10**, and a function of the data in field **11** may relate to a particular application stored in file **111** of database **11**. Similarly, the data in fields **3**, **6**, **10**, **12**, and **14** may be related to an application stored in file **112** of database **11**, while the data in fields **1**, **2**, **7**, **8**, **9**, and a function of the data in fields **10**, **11**, and **12** may be related to an application stored in file **113** of database **11**. These fields are extracted from the received data transaction by transaction controller **36**, reconstituted into a file entry of the appropriate format (as necessary), and stored in the associated database **30**.

All of the data in the received data transaction, or a subset thereof, may also be retransmitted to one or more additional application specific databases, such as database **21** of the databases **40** in tier **3**. As illustrated in FIG. **3**, the database specific data of fields **1**, **4**, **5**, **13**, and **14**, forming the subset (Form B) of the original transaction (Form A), is stored in file **210** of database **21** so that a complete record may be maintained. Subsets of the data in Form B are then stored in specific files of database **21** as indicated. In this manner, the data of the original data transaction (Form A) is automatically sent to all databases which contain files which must be updated by any or all of the data in Form A.

FIG. **4** illustrates the explosion of the data transaction in FIG. **3** for the system **10** illustrated in FIG. **1**. As shown, the data in the data transaction (Form A) is extracted to update files **110–113** of database **11** as well as files **210–212** of database **21**. A redundant copy of Form A is also maintained in database **12**.

As will be explained more fully below, the system of FIGS. **1–4** is significant in that the data in a data transaction may update one or more databases serviced by file servers operating under control of numerous types of operating systems without the requirement of a terminal or operating system emulation by the transaction entry device **12**. On the contrary, the transaction entry device **12** of the invention permits data capture and storage with a minimum amount of processing at the transaction entry point (tier **1**), which, of course, minimizes system cost.

B. Transaction Entry Device **12** (FIGS. **5–10**)

As noted above, the transaction entry device **12** is particularly characterized by the TAS **18**, which controls the various operations of the transaction entry device **12** in its transaction entry mode. Preferably, TAS **18** uses simple menu structures and predetermined forms stored as data steams in a flash memory or RAM for facilitating data entry. The menus are treated as a special type of form and are used to call other menus, forms, or processes. The forms, on the other hand, are used to create data transactions which are sent to one or more file servers operating under different operating systems, where the data transaction is "exploded" into its component parts for storage in a unique file structure for updating all records affected by the data in that data transaction. In turn, the "exploded" data transactions may be transmitted to another application specific database (tier **3**) for storage. Processes, on the other hand, are selected to perform limited processing of the values in the fields of the forms. Such processing may be performed locally but is preferably performed by the associated database server **28**.

1. Hardware

A preferred embodiment of a transaction entry device **12** incorporated into a conventional telephone is illustrated in FIGS. **5** and **6**. As shown in FIG. **5***a*, a preferred desktop embodiment of a transaction entry device **12** includes a housing **52** on the order of 8 inches wide by 12 inches long for housing telephone electronics **14** and the hardware (board and/or a disk, PCMCIA memory card, smart card, CD ROM, or floppy disk reader) of TAS **18**. Transaction entry device **12** includes an optional handset (or headset) **54**, cradle **56** (FIG. **5***b*), numeric keypad **58**, telephone function/line keys **60**, microphone **62**, and speaker **16**, which facilitate operation of the transaction entry device in the telephone mode. As known to those skilled in the art, telephone functions accessed by telephone function keys **60** may include mute, speaker, line select, conference, hold, transfer, volume control, and the like.

However, the transaction entry device **12** is further characterized by display **20** with touch screen **64**, mode switch/computer function keys **66**, optional retractable keyboard **68**, an optional magnetic card reader **70**, a touch tone keypad **58**, a voice transceiver **62**, and/or a portable mouse (not shown), which facilitate operation of the transaction entry device **12** in the transaction entry mode. A memory (PCMCIA), smart card, CD ROM, or floppy disk reader may also be accessed via a door (not shown) as in a laptop computer. Preferably, display **20** is a super twisted, high contrast, reflective liquid crystal display (LCD) with a minimum of 20 characters per line and 16 lines (preferably, 40 columns by 25 lines), while touch screen **64** is preferably a clear pressure sensitive keyboard made up of 224 keys (16 rows of 14 keys) attached to the face of the LCD. Preferably, the LCD is also available as a backlit unit. Of course, touch screen **64** is not necessary if optional keyboard **68** is provided. In addition, a battery backup **71** (FIG. **6**) may also be provided; alternatively, the battery **71** may be the primary power source for a portable (cellular) embodiment of the transaction entry device **12** in accordance with the invention.

FIG. **5***b* illustrates several of the connections to transaction entry device **12**. Typically, transaction entry device **12** includes a handset (headset) jack **72** for connecting optional handset (headset) **54** to telephone electronics **14** when it is desired to communicate more privately than when only microphone **62** and speaker **16** are used. A video input port **74** is also provided for connecting conventional data compression circuitry **75** within the transaction entry device **12** (FIG. **6**) to an optional video camera which provides picture phone type video or to a facsimile device or scanner. Such video data may be appended a frame at a time to the end of a data transaction in miscellaneous processing field **50** to create a multimedia data transaction as described above with respect to FIG. **2**. A video output port **76** is also provided for providing decompressed video or facsimile data from data decompression circuit **77** (FIG. **6**) to a video receiver, a high quality computer monitor, a facsimile device, and the like. Such data may also be provided to printer port **82** or **84** as desired. A multi-line phone jack for a wired modem interface **78** is also provided, although a wireless or cellular modem may also be used. Preferably, modem interface **78** provides separate modem connections for the telephone electronics **14** and the TAS **18**, although only a single modem connection is necessary.

An optional infrared or wireless transceiver **80** is further provided for enabling remote control operation of television and stereo equipment and the like in response to data transactions transmitted/received by the transaction entry device **12**. Transceiver **80** includes an internal signal generator chip which reads parameters stored in TAS **18** for determining the appropriate transmission frequencies for the infrared or other wireless signals. Control of the devices is then provided through menus on the display **20**. Additional transceivers **80** may also be provided on each corner of the housing **52** so that the infrared or other wireless signal will