EXHIBIT T
(Part 3)

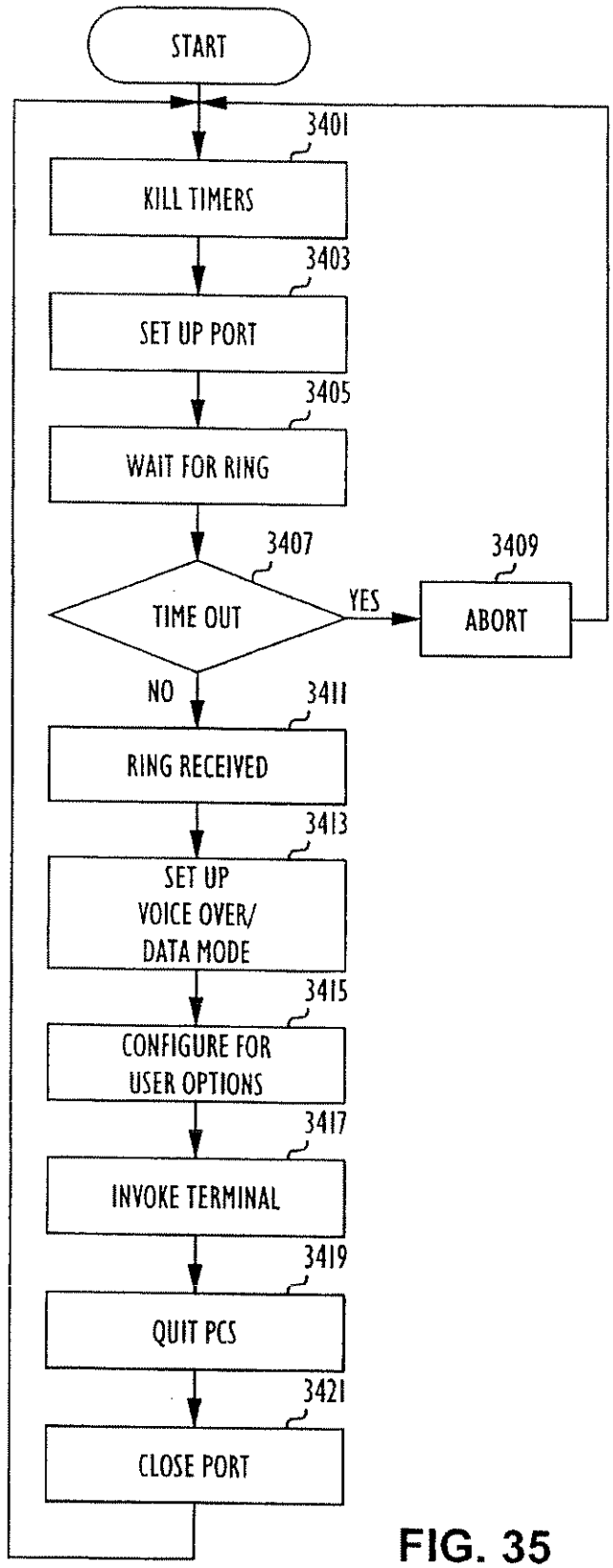
START
3401
KILL TIMERS
3403
SET UP PORT
3405
WAIT FOR RING
3407
TIME OUT
YES
3409
ABORT
NO
3411
RING RECEIVED
3413
SET UP VOICE OVER/ DATA MODE
3415
CONFIGURE FOR USER OPTIONS
3417
INVOKE TERMINAL
3419
QUIT PCS
3421
CLOSE PORT

FIG. 35

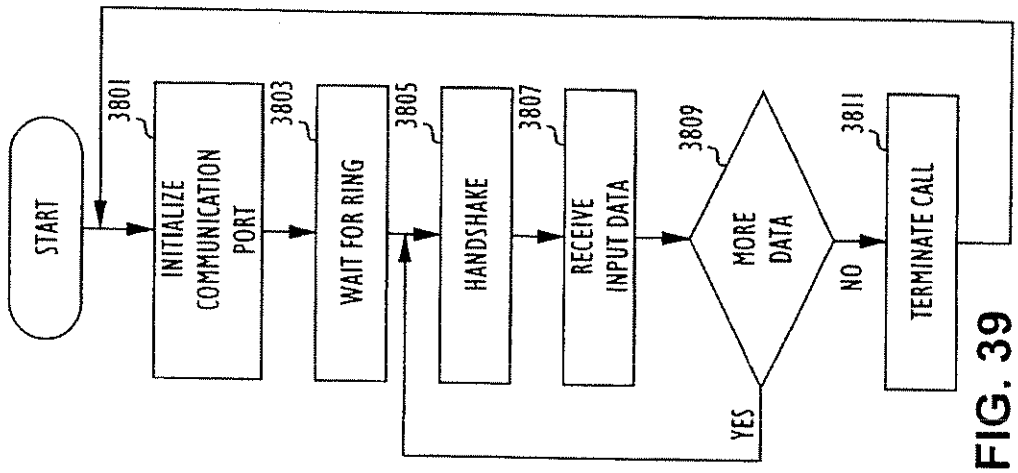

FIG. 39

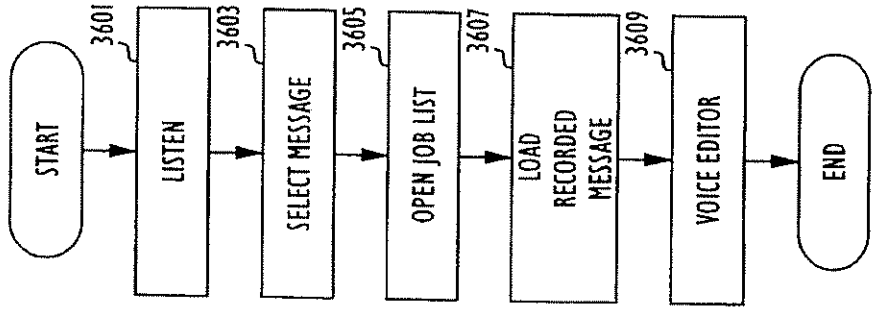

FIG. 37

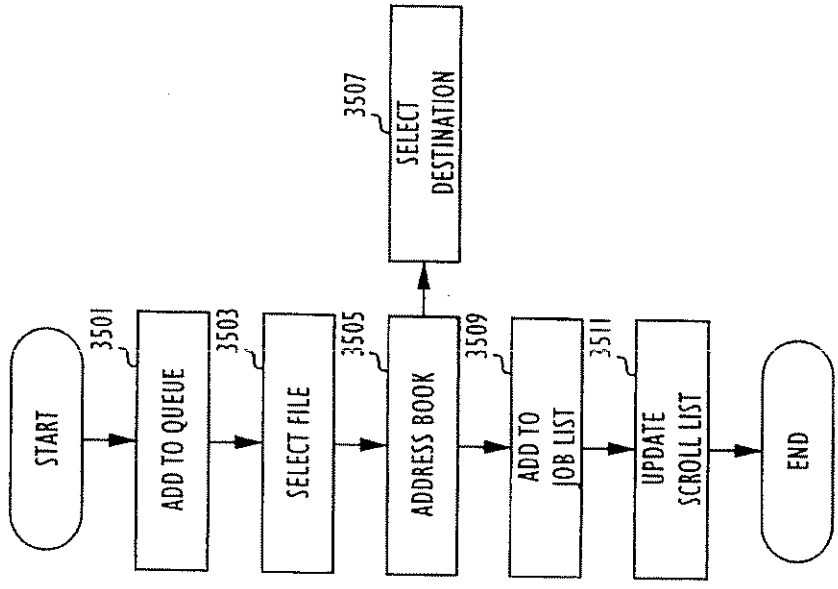

FIG. 36

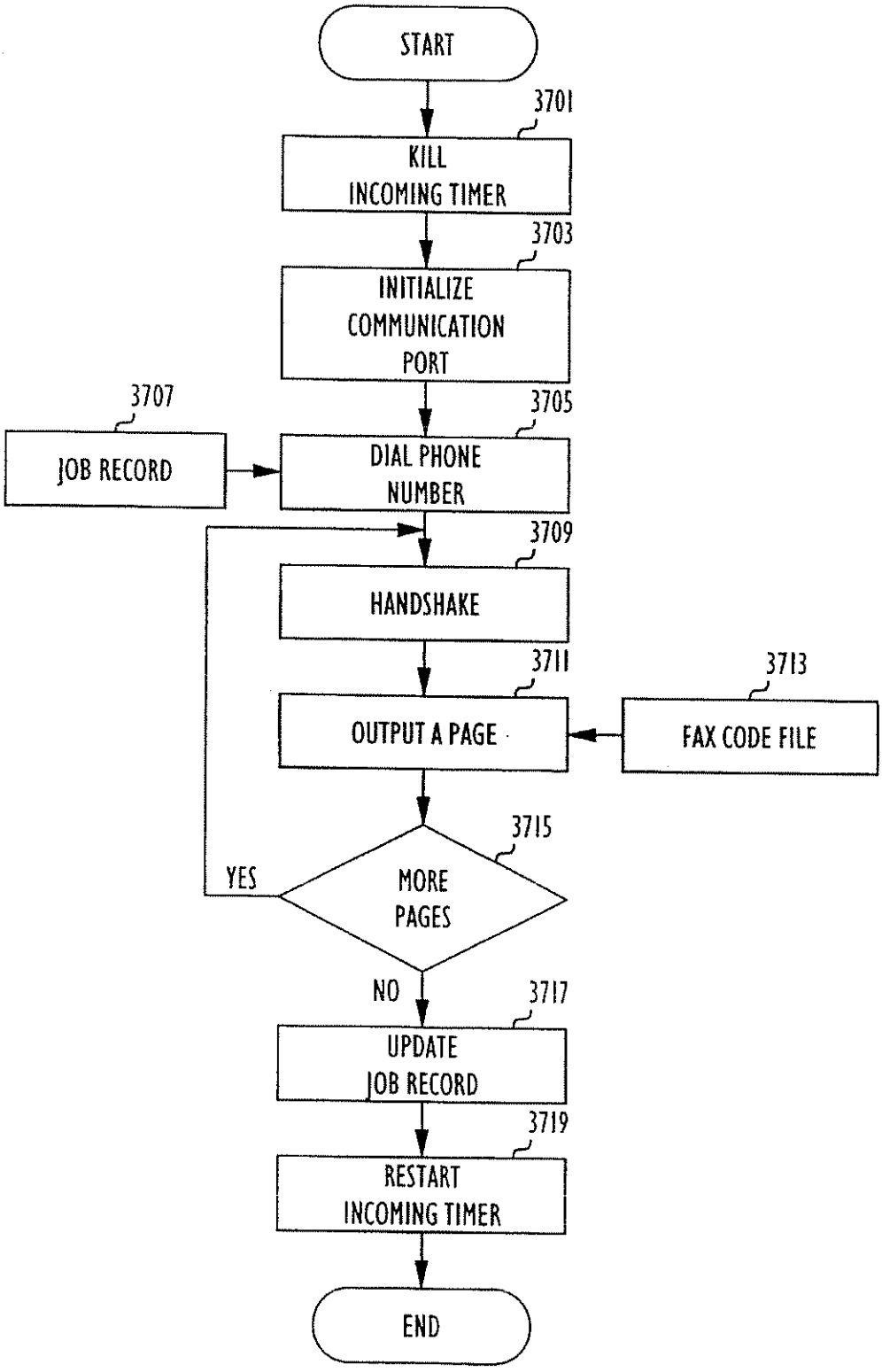
START
3701
KILL INCOMING TIMER
3703
INITIALIZE COMMUNICATION PORT
3707
JOB RECORD
3705
DIAL PHONE NUMBER
3709
HANDSHAKE
3711
OUTPUT A PAGE
3713
FAX CODE FILE
3715
MORE PAGES
YES
NO
3717
UPDATE JOB RECORD
3719
RESTART INCOMING TIMER
END

FIG. 38

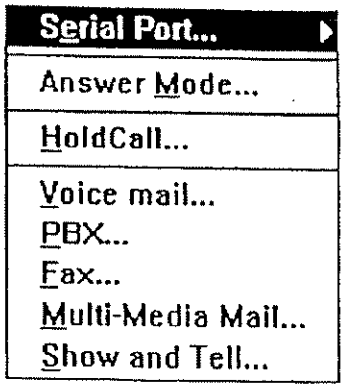

FIG. 40

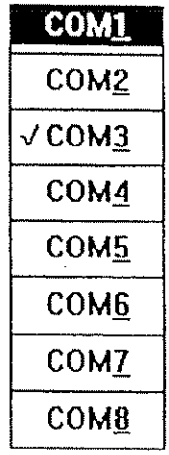

FIG. 41

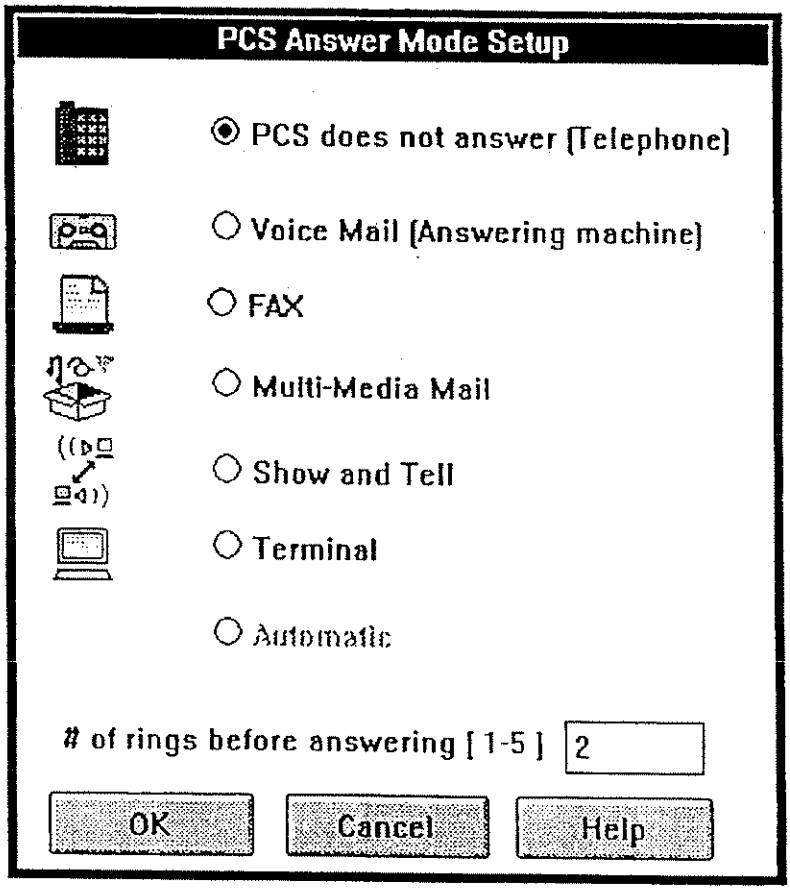

FIG. 42

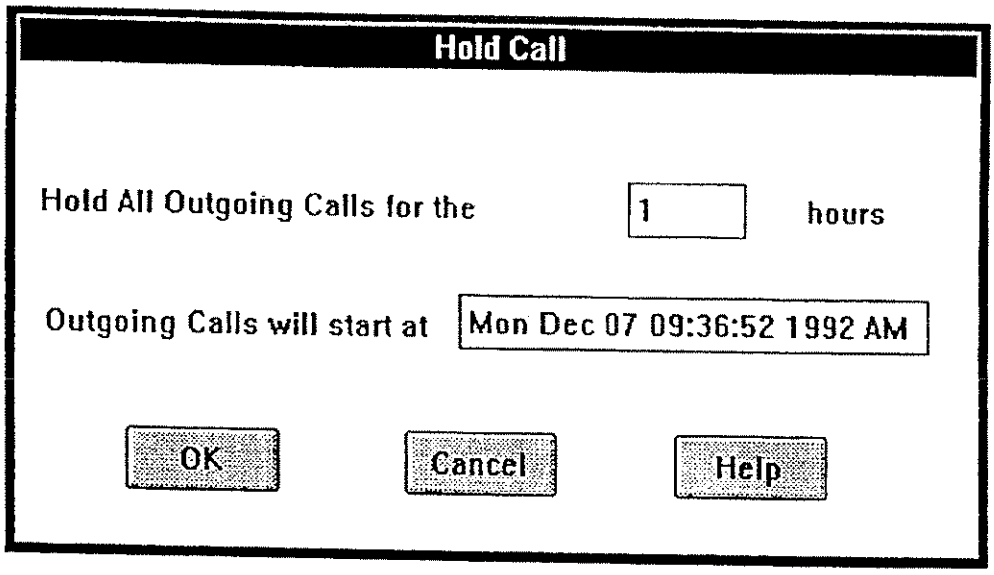
Hold Call
Hold All Outgoing Calls for the
1
hours
Outgoing Calls will start at
Mon Dec 07 09:36:52 1992 AM
OK
Cancel
Help

FIG. 44

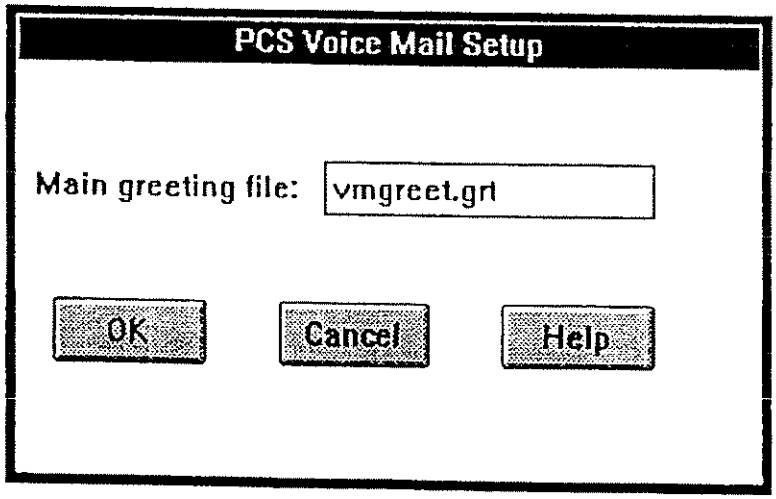
PCS Voice Mail Setup
Main greeting file:
vmgreet.grt
OK
Cancel
Help

FIG. 43

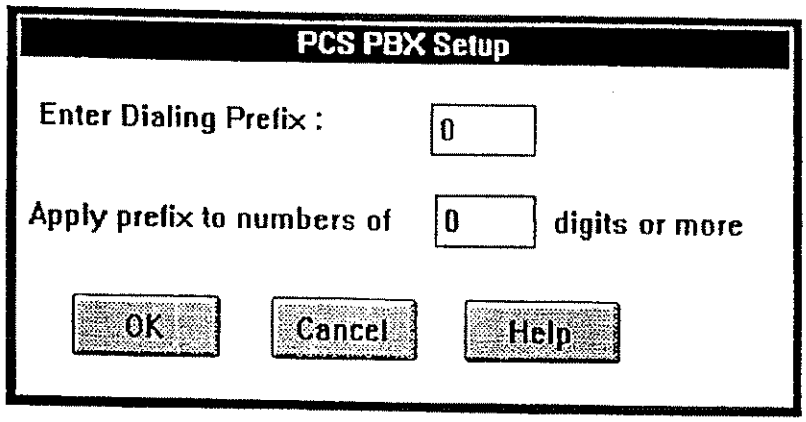

FIG. 45

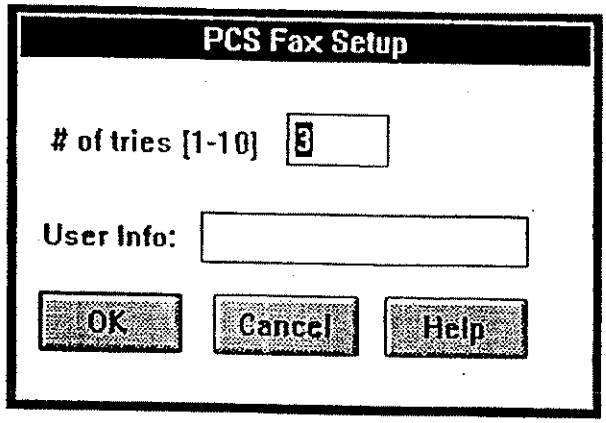

FIG. 46

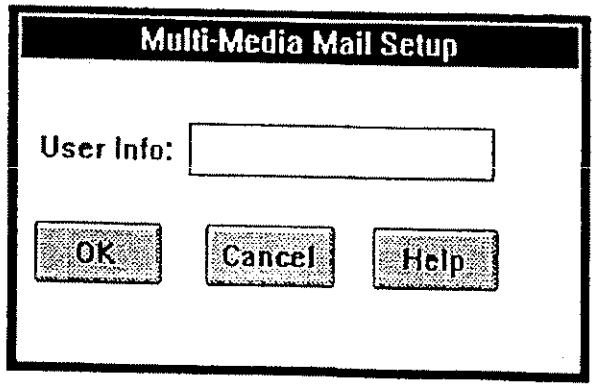

FIG. 47

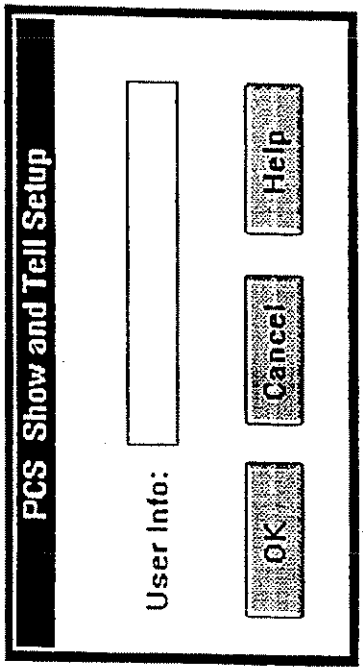
PCS Show and Tell Setup
User Info:
OK
Cancel
Help

FIG. 48

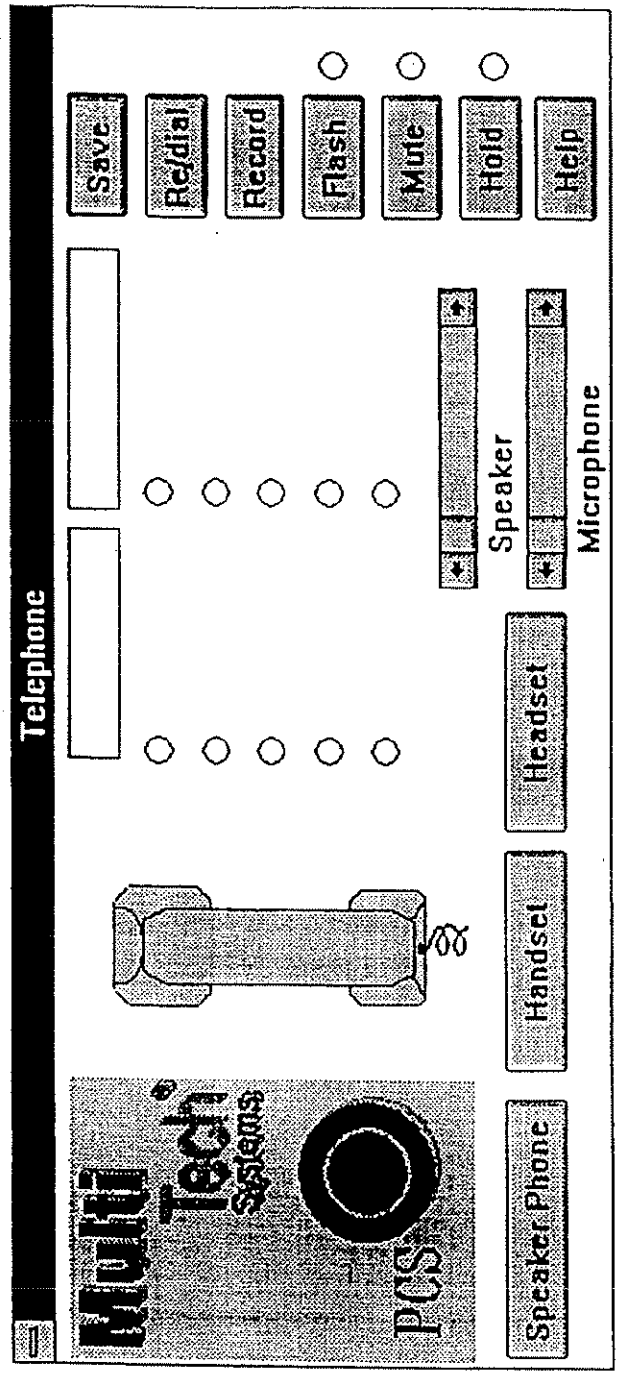
Telephone
Save
Redial
Record
Flash
Mute
Hold
Help
Speaker
Microphone
Headset
Handset
Speaker Phone
MultiTech Systems
PCS

FIG. 49

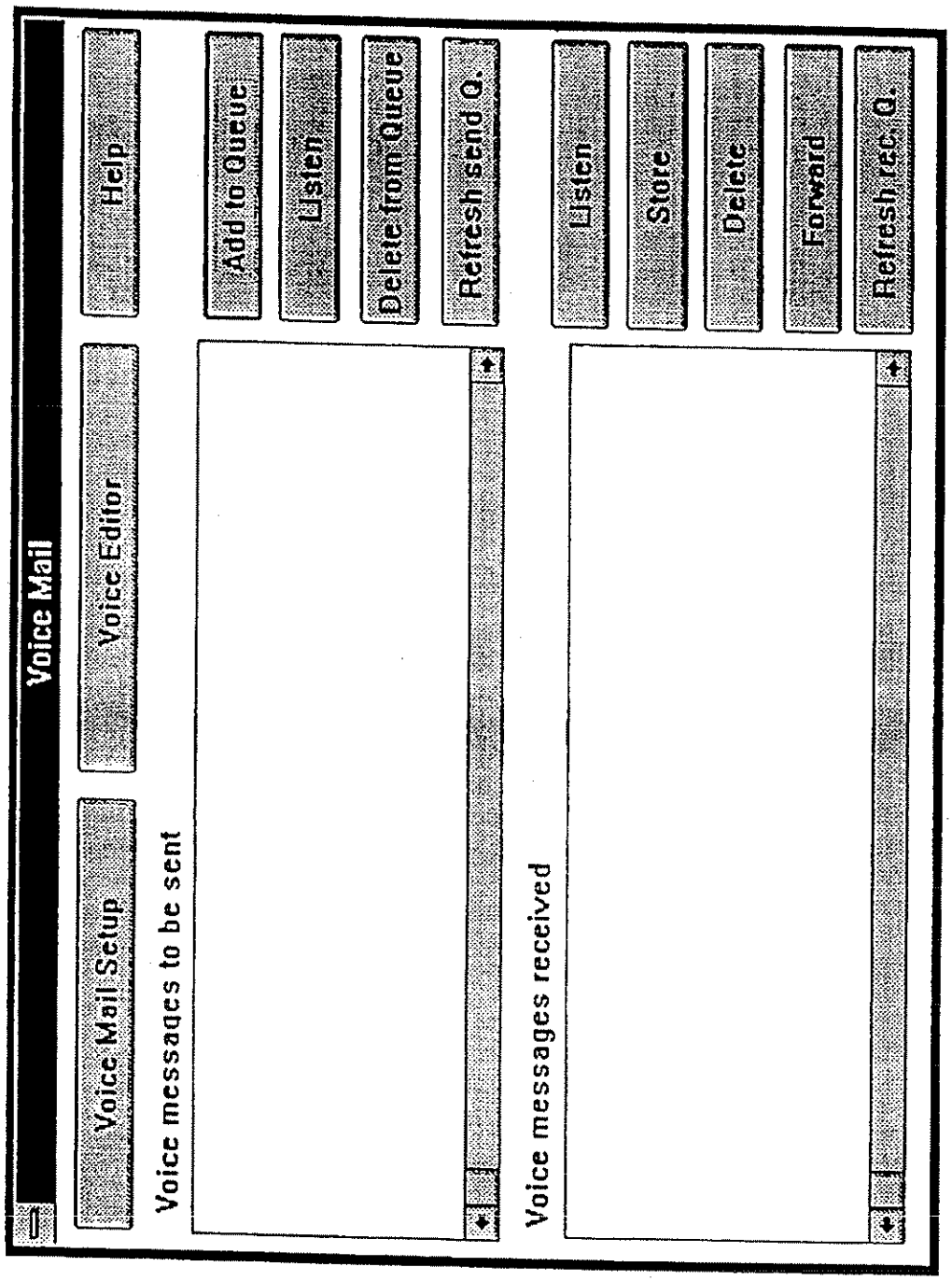
Voice Mail
Voice Mail Setup
Voice Editor
Help
Voice messages to be sent
Add to Queue
Listen
Delete from Queue
Refresh send Q.
Voice messages received
Listen
Store
Delete
Forward
Refresh rec. Q.

FIG. 50

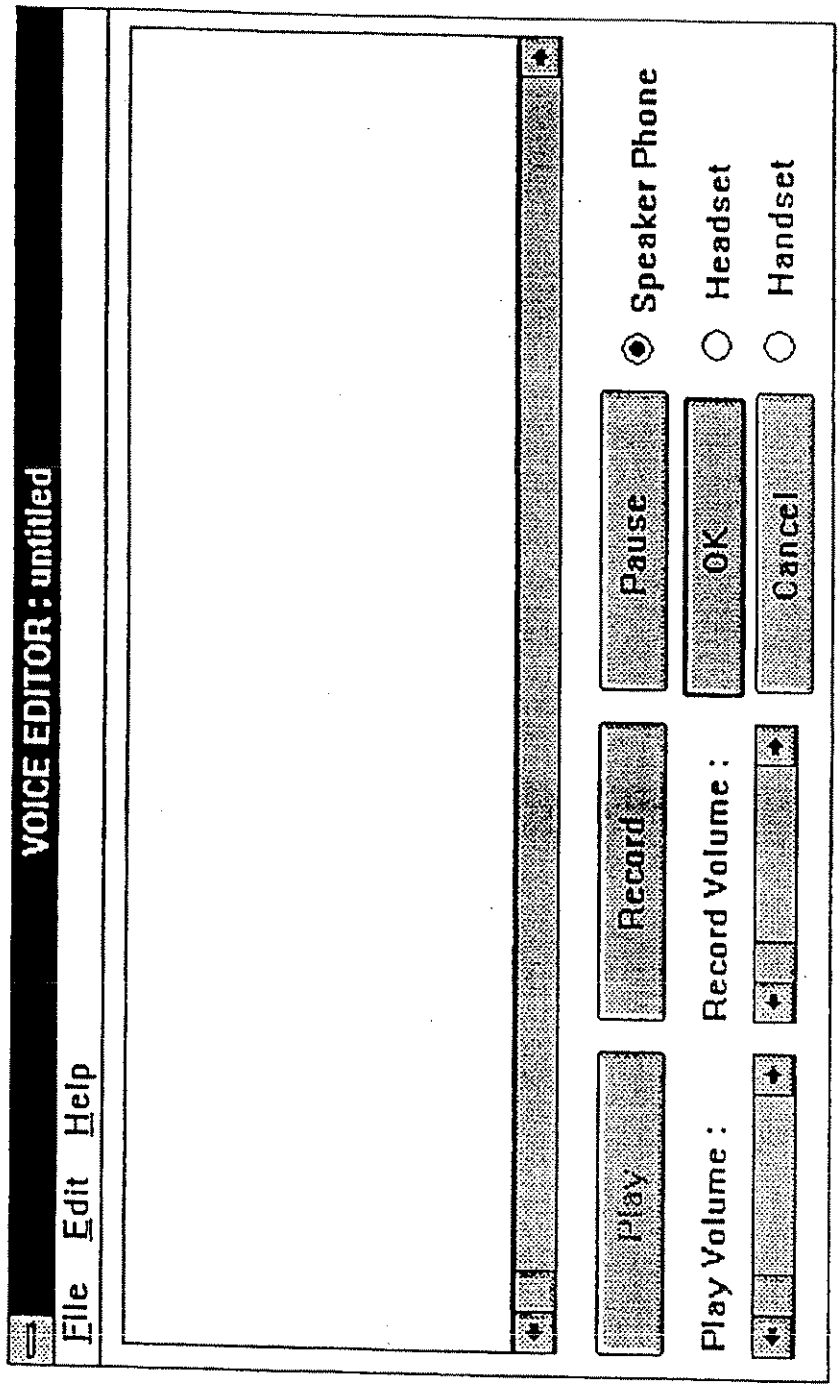
VOICE EDITOR : untitled
File Edit Help
Play
Record
Pause
Speaker Phone
Headset
Handset
OK
Cancel
Play Volume :
Record Volume :

FIG. 51

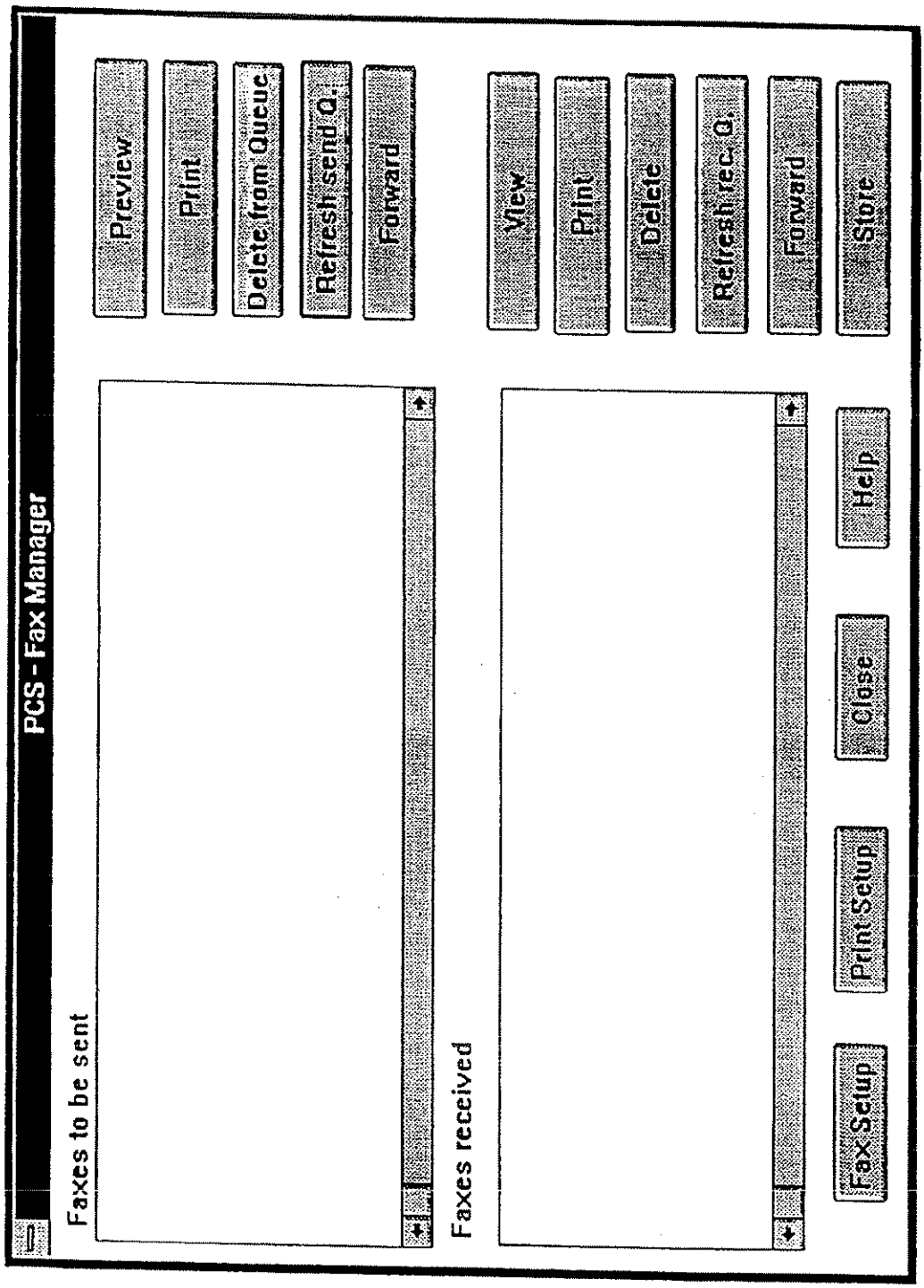
PCS - Fax Manager
Faxes to be sent
Preview
Print
Delete from Queue
Refresh send Q.
Forward
Faxes received
View
Print
Delete
Refresh rec. Q.
Forward
Store
Fax Setup
Print Setup
Close
Help

FIG. 52

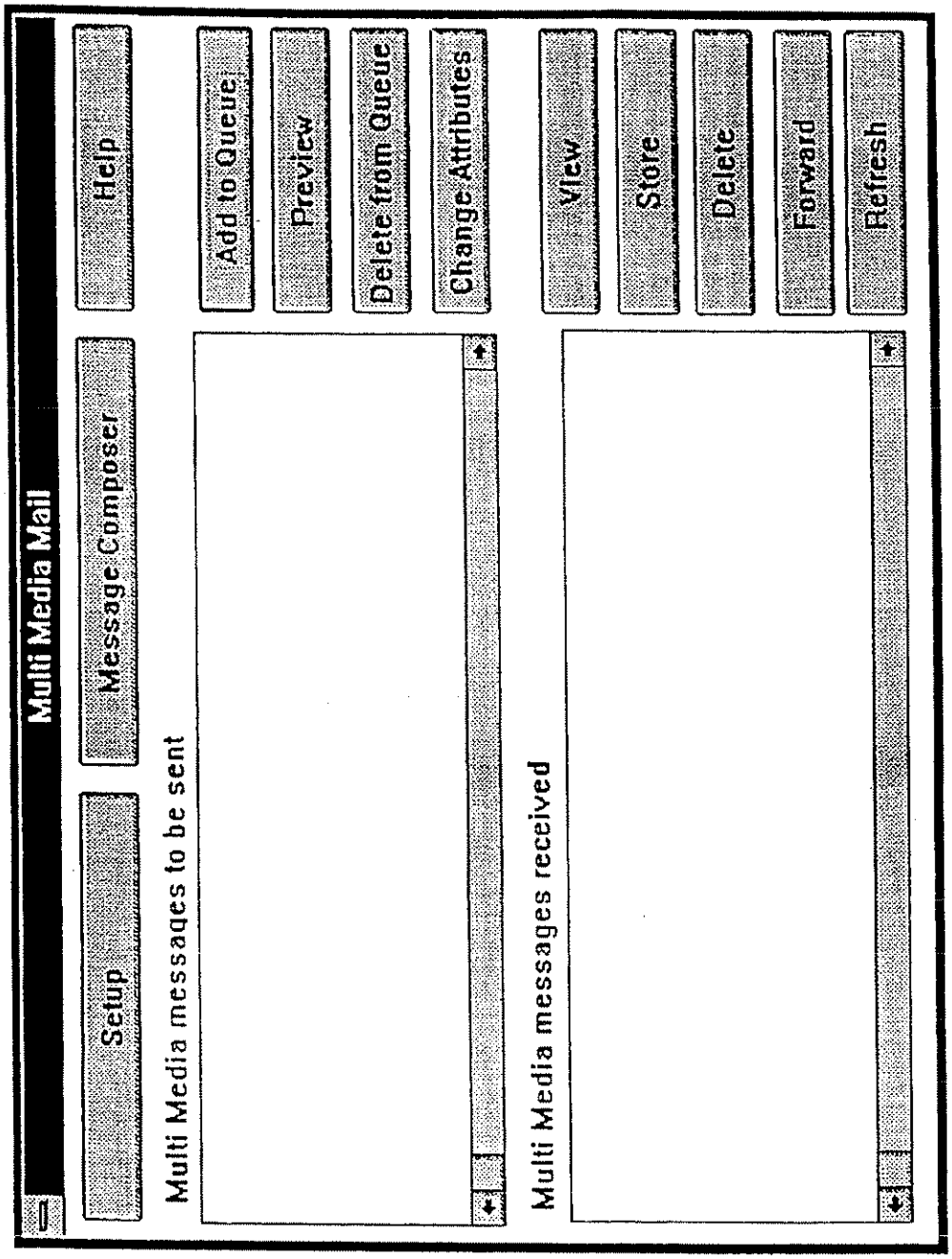
Multi Media Mail
Setup
Message Composer
Help
Multi Media messages to be sent
Add to Queue
Preview
Delete from Queue
Change Attributes
Multi Media messages received
View
Store
Delete
Forward
Refresh

FIG. 53

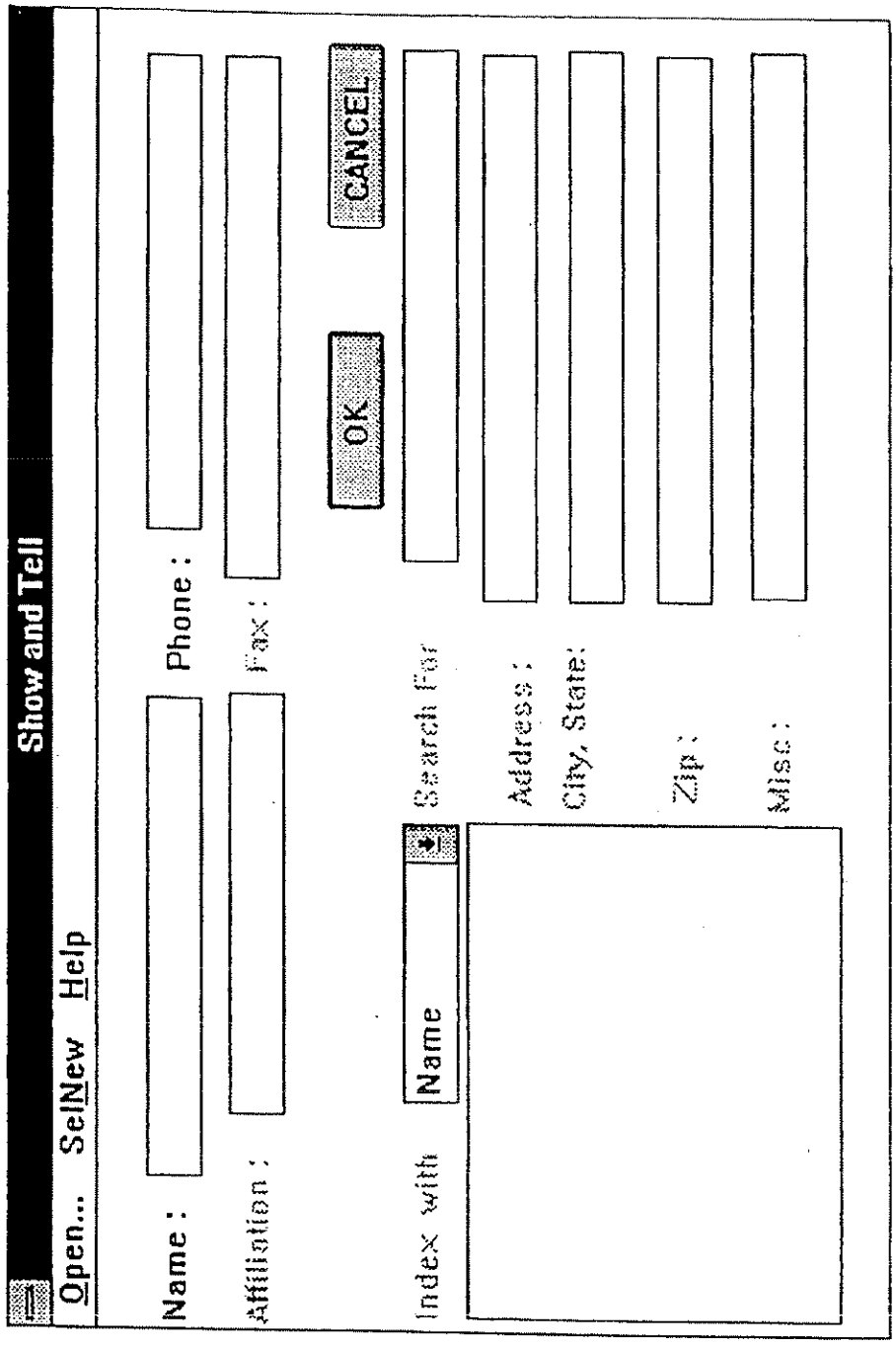
Show and Tell
Open... SelNew Help
Name :
Phone :
Affiliation :
Fax :
OK
CANCEL
Index with
Name
Search For
Address :
City, State:
Zip :
Misc :

FIG. 54

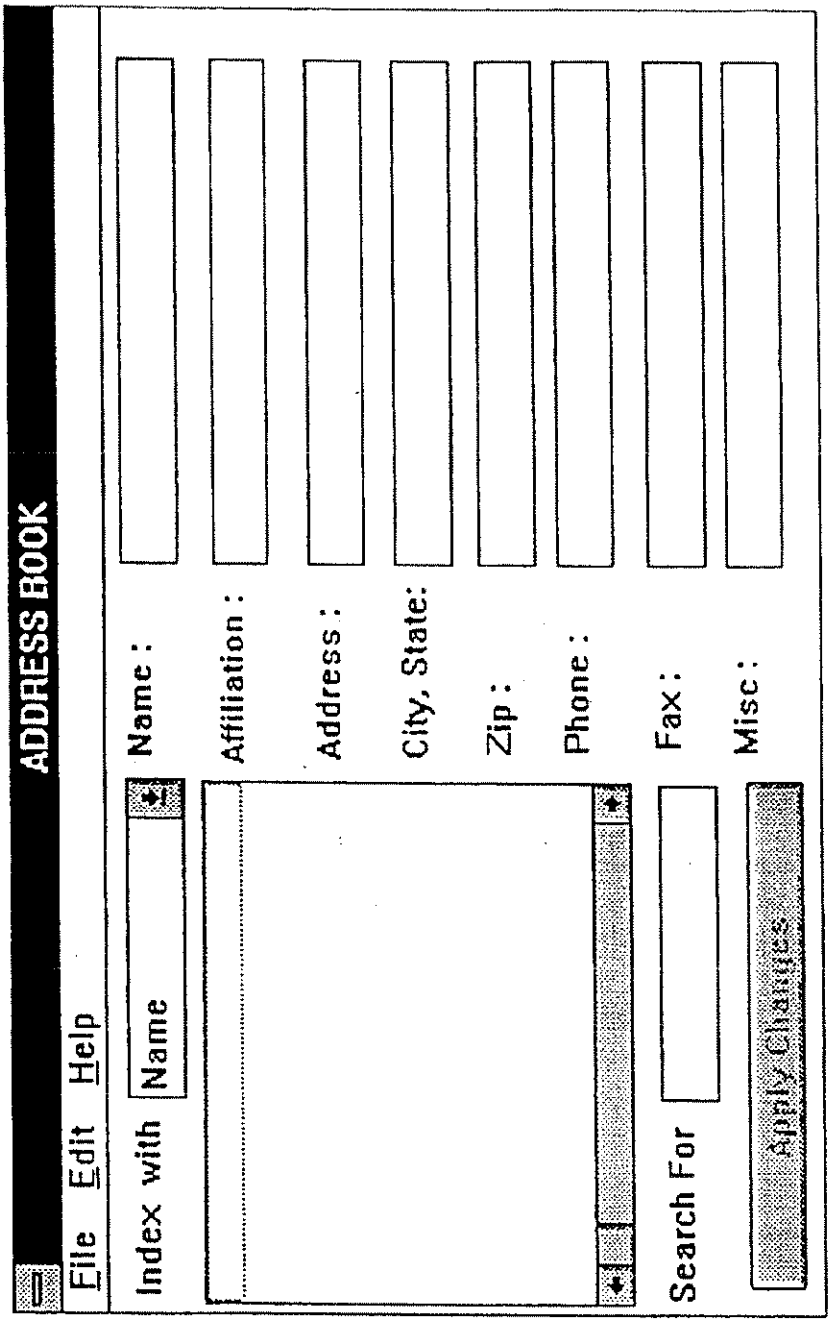
ADDRESS BOOK
File Edit Help
Index with Name
Name :
Affiliation :
Address :
City, State:
Zip :
Phone :
Fax :
Misc :
Search For
Apply Changes

FIG. 55

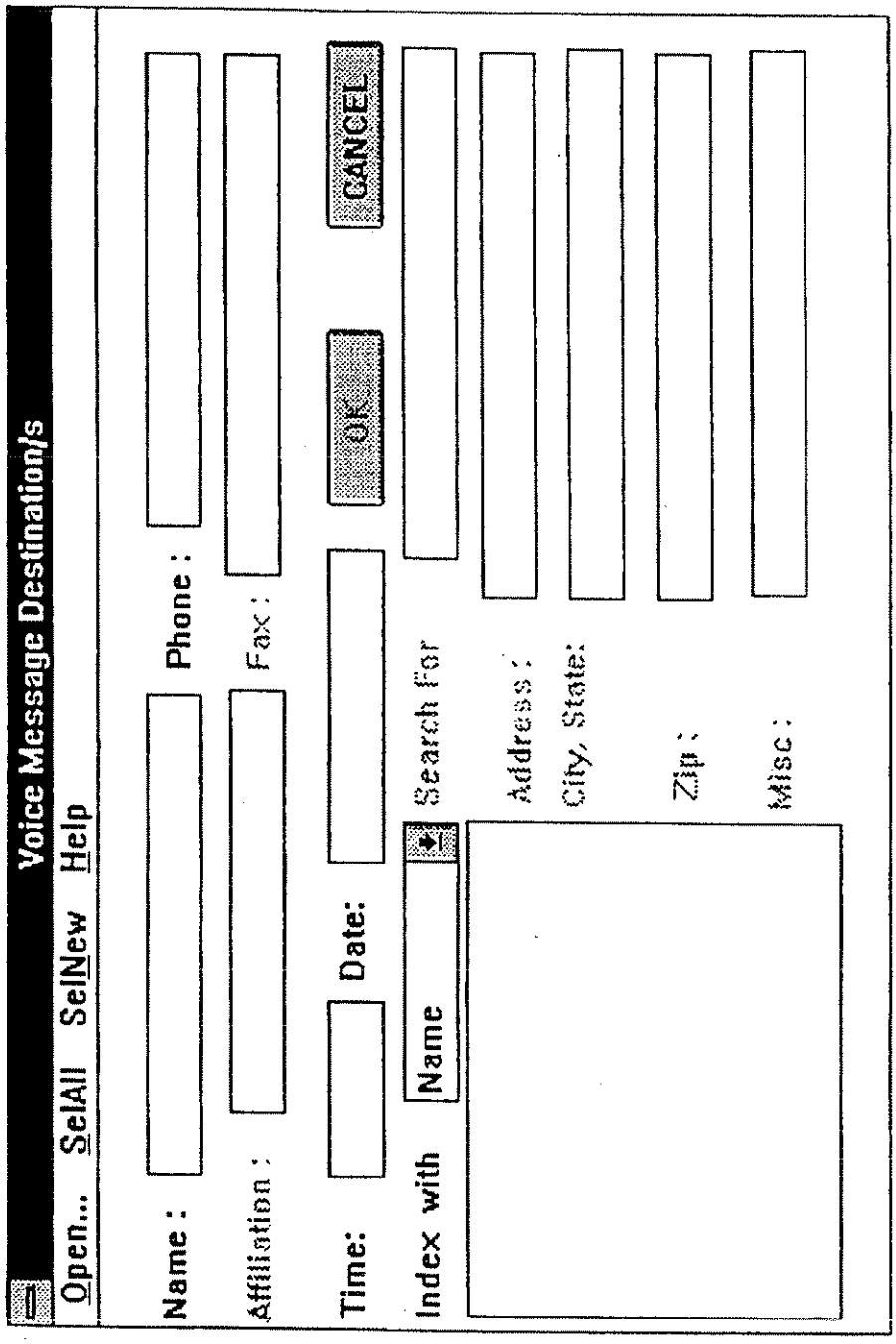
Voice Message Destination/s
Open... SelAll SelNew Help
Name :
Phone :
Affiliation :
Fax :
Time:
Date:
OK
CANCEL
Search For
Index with
Name
Address :
City, State:
Zip :
Misc :

FIG. 56

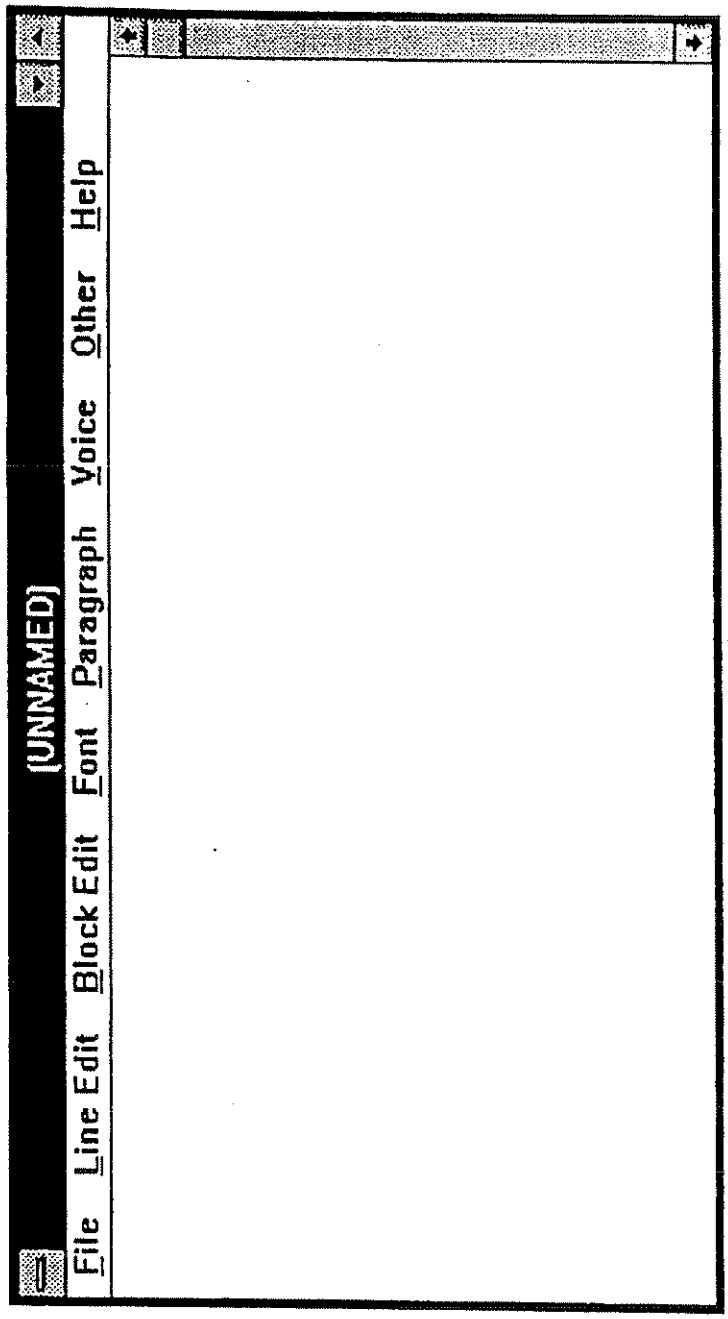
[UNNAMED]
File Line Edit Block Edit Font Paragraph Voice Other Help

FIG. 57

DIGITAL SIMULTANEOUS VOICE AND DATA MODEM

This is a divisional of application Ser. No. 08/002,467, filed Jan. 8, 1993, U.S. Pat. No. 5,452,289.

The specification includes a microfiche appendix consisting of 14 microfiche films having images of 1,172 pages of software program code and data. Specification, drawings and appendix, Copyright 1995, Multi-Tech Systems, Inc. All rights reserved.

FIELD OF THE INVENTION

The present invention relates to communications systems and in particular to computer assisted digital communications including data, fax and digitized voice.

BACKGROUND OF THE INVENTION

A wide variety of communications alternatives are currently available to telecommunications users. For example, facsimile transmission of printed matter is available through what is commonly referred to as a stand-alone fax machine. Alternatively, fax-modem communication systems are currently available for personal computer users which combine the operation of a facsimile machine with the word processor of a computer to transmit documents held on computer disk. Modem communication over telephone lines in combination with a personal computer is also known in the art where file transfers can be accomplished from one computer to another. Also, simultaneous voice and modem data transmitted over the same telephone line has been accomplished in several ways.

There is a need in the art, however, for a personal communications system which combines a wide variety of communication functions into an integrated hardware-software product such that the user can conveniently choose a mode of communication and have that communication automatically invoked from a menu driven selection system.

SUMMARY OF THE INVENTION

The present disclosure describes a complex computer assisted communications system which contains multiple inventions. The subject of the present multiple inventions is a personal communications system which includes components of software and hardware operating in conjunction with a personal computer. The user interface control software operates on a personal computer, preferably within the Microsoft Windows® environment. The software control system communicates with hardware components linked to the software through the personal computer serial communications port. The hardware components include telephone communication equipment, digital signal processors, and hardware to enable both fax and data communication with a hardware components at a remote site connected through a standard telephone line. The functions of the hardware components are controlled by control software operating within the hardware component and from the software components operating within the personal computer.

Communications between the software components running on the personal computer and the local hardware components over the serial communications link is by a special packet protocol for digital data communications. This bi-directional communications protocol allows uninterrupted bidirectional full-duplex transfer of both control information and data communication.

The major functions of the present system are a telephone function, a voice mail function, a fax manager function, a multi-media mail function, a show and tell function, a terminal function and an address book function. The telephone function allows the present system to operate, from the users perspective, as a conventional telephone using either hands-free, headset or handset operation. The telephone function is more sophisticated than a standard telephone in that the present system converts the voice into a digital signal which can be processed with echo cancellation, compressed, stored as digital data for later retrieval and transmitted as digital voice data concurrent with the transfer of digital information data.

The voice mail function of the present system operates as a telephone answering machine which can receive, compress and store voice messages for later retrieval or reuse in response messaging.

The fax manager function of the present system allows the transmission and reception of facsimile information. The software component of the present system operates in conjunction with other commercially available software programs such as word processors and the like to transmit and receive facsimile pages of digital data stored on a computer system.

The multi-media mail component of the present system allows the operator to create documents that include text, graphics and voice mail messages which can be sent as a combined package over conventional telephone lines for receipt at a like-configured site using the present system.

The show and tell component of the present system enables the operator to simultaneously transmit voice and data communication to a remote site. This voice over data function dynamically allocates data bandwidth over the telephone line depending on the demands of the voice grade digitized signal.

The terminal feature of the present system allows the user to establish a data communications session with another computer system allowing the user's local computer system to operate as a dumb terminal.

The address book function of the present system is a versatile database that is built by the user and operates in conjunction with the other components of the present system to dial and establish communication links with remote sites to enable data communication, voice mail, facsimile, file transfer all in an automated mode without user intervention.

The hardware components of the present system include circuitry to enable digital data communication and facsimile communication over standard telephone lines. The hardware components also include circuitry to convert the voice to digital data and compress that data for transfer to the software component on the personal computer or transfer it over the telephone lines to a remote site.

Many of the functions of the present system are accomplished by including a voice control digital signal processor (DSP) to operate in conjunction with a data/fax modem implemented with a data pump DSP. The data pump DSP and the voice control DSP accomplish the following functions in an integrated hardware arrangement:

A sophisticated telephone apparatus with its attached handset, headset and a built-in hands free telephone operation using the integrated microphone and speaker system. The hands free telephone works in full duplex mode through the use of voice echo cancellation performed by the voice control DSP.

The voice control DSP in conjunction with a telephone CODEC provides voice compression which can be sent to

the computer system that is attached the RS232 port for storage and later retrieval. The compressed voice from the voice control DSP can also be multiplexed with the input data stream from the personal computer with dynamic time allocation. Whereas, the input data from the attached computer is transmitted using the error control protocol like MNP or V.42 with or without data compression (e.g., V.42bis), the speech is packetized using a different header defining it as a speech packet and then transmitted through a controller. The speech packets, like the data packets, have the attached CRC codes. However, the speech packets are not sequenced and the like hardware at the receiving end ignores the accompanying CRC codes for voice packets and passes the voice packets to the voice control DSP for decompression. The decompressed speech is played through one of the telephone receiving units, i.e., the headset, handset or the built in speaker.

The voice control DSP allows the compressed speech to be recorded on a recording media, e.g., the hard disc drive of the attached computer system. This provides the function of an answering machine. In addition to the answering machine function, the recorded speech can be provided for the voice mail functions.

The special packet protocol over the RS232 interface between the software component and the hardware component that governs the operation of the hardware component is so designed that it allows various control functions to be intermixed with data over the RS232 serial port. The software component of the present system accepts the generic AT modem commands when not in the special packet mode. When the hardware component is configured to accept the packet level protocol over the RS232 port, it can be made to switch to the generic command mode through the use of a break sequence.

The hardware components of the present system functions as a data/fax modem when the speech compression or telephone mode is not invoked. The packet mode or the generic AT command mode may be used for this purpose.

The hardware components Of the present system incorporate a provision for a special link integrity packet to facilitate the device to work over cellular networks. This scheme allows the modem in one of its plurality of modes to ignore the carrier dropouts (selective fading) inherent in the cellular networks. Such a scheme does not use carrier detect circuitry of the modem. The disconnect of the cellular connection is done through a negotiation scheme using packet interchange between the two ends of the link.

In cellular networks the multiplexed voice data technology of the present system allows a single apparatus to function as a smart telephone, an intelligent data modem as well as a fax modem. These features along with the voice data multiplex mode provides a traveling user complete freedom to use his or her moving vehicle as a true traveling office.

These features of the hardware component of the present system along with the features of the software component of the present system running on a PC provides a user with a complete range of telecommunications functions of a modern office, be it a stationary or mobile.

DESCRIPTION OF THE DRAWINGS

In the drawings, where like numerals describe like components throughout the several views,

FIG. **1** shows the telecommunications environment within which the present may operate in several of the possible modes of communication;

FIG. **2** is the main menu icon for the software components operating on the personal computer;

FIG. **3** is a block diagram of the hardware components of the present system;

FIG. **4** is a key for viewing the detailed electrical schematic diagrams of FIGS. **5A–10C** to facilitate understanding of the interconnect between the drawings;

FIGS. **5A–5C**, **6A–6C**, **7A–7C**, **8A–8B**, **9A–9C** and **10A–10C** are detailed electrical schematic diagrams of the circuitry of the hardware components of the present system;

FIG. **11** is a signal flow diagram of the speech compression algorithm;

FIG. **12** is a detailed function flow diagram of the speech compression algorithm;

FIG. **13** is a detailed function flow diagram of the speech decompression algorithm;

FIG. **14** is a detailed function flow diagram of the echo cancellation algorithm;

FIG. **15** is a detailed function flow diagram of the voice/data multiplexing function;

FIG. **16** is a perspective view of the components of a digital computer compatible with the present invention;

FIG. **17** is a block diagram of the software structure compatible with the present invention;

FIG. **18** is a block diagram of the control structure of software compatible with the present invention;

FIG. **19** is a block diagram of the main menu structure of software compatible with the present invention;

FIG. **20** is a flow diagram of answer mode software compatible with the present invention;

FIG. **21** is a flow diagram of telephone software compatible with the present invention;

FIG. **22** is a flow diagram of voice mail software compatible with the present invention;

FIG. **23** is a flow diagram of fax manager software compatible with the present invention;

FIG. **24** is a flow diagram of multi-media mail software compatible with the present invention;

FIG. **25** is a flow diagram of a timing loop compatible with the present invention;

FIG. **26** is a flow diagram of telephone control software compatible with the present invention;

FIG. **27** is a flow diagram of voice mail control software compatible with the present invention;

FIG. **28** is a flow diagram of high resolution fax driver software compatible with the present invention;

FIG. **29** is a flow diagram of low resolution fax driver software compatible with the present invention;

FIG. **30** is a flow diagram of multi media mail control software compatible with the present invention;

FIG. **31** is a flow diagram of multi media mail editor software compatible with the present invention;

FIG. **32** is a flow diagram of multi media mail transmit software compatible with the present invention;

FIG. **33** is a flow diagram of multi media mail receive software compatible with the present invention;

FIG. **34** is a flow diagram of show and tell transmit software compatible with the present invention;

FIG. **35** is a flow diagram of show and tell receive software compatible with the present invention;

FIG. **36** is a flow diagram of voice mail transmit software compatible with the present invention;

FIG. **37** is a flow diagram of voice mail receive software compatible with the present invention;

FIG. **38** is a flow diagram of an outgoing timer loop compatible with the present invention;

FIG. **39** is a flow diagram of an outgoing timer loop compatible with the present invention;

FIG. **40** is an initialization screen display compatible with the present invention;

FIG. **41** is a communication port setup screen display compatible with the present invention;

FIG. **42** is an answer mode setup screen display compatible with the present invention;

FIG. **43** is a hold call setup screen display compatible with the present invention;

FIG. **44** is a voice mail setup screen display compatible with the present invention;

FIG. **45** is a PBX setup screen display compatible with the present invention;

FIG. **46** is a fax setup screen display compatible with the present invention;

FIG. **47** is a multi-media mail setup screen display compatible with the present invention;

FIG. **48** is a show and tell setup screen display compatible with the present invention;

FIG. **49** is a telephone control screen display compatible with the present invention;

FIG. **50** is a voice mail control screen display compatible with the present invention;

FIG. **51** is a voice editor screen display compatible with the present invention;

FIG. **52** is a fax manager control screen display compatible with the present invention;

FIG. **53** is a multi-media mail control screen display compatible with the present invention;

FIG. **54** is a show and tell control screen display compatible with the present invention;

FIG. **55** is an address book control screen display compatible with the present invention;

FIG. **56** is a voice message destination screen display compatible with the present invention; and

FIG. **57** is a message composer screen display compatible with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The specification for the multiple inventions described herein includes the present description, the drawings and a microfiche appendix. In the following detailed description of the preferred embodiment, reference is made to the accompanying drawings which form a part hereof, and in which is shown by way of illustration specific embodiments in which the inventions may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that Structural changes may be made without departing from the spirit and scope of the present inventions. The following detailed description is, therefore, not to be taken in a limiting sense, and the scope of the present inventions is defined by the appended claims.

FIG. **1** shows a typical arrangement for the use of the present system. Personal computer **10** is running the software components of the present system while the hardware components **20** include the data communication equipment and telephone headset. Hardware components **20** communicate over a standard telephone line **30** to one of a variety of remote sites. One of the remote sites may be equipped with the present system including hardware components **20***a* and software components running on personal computer **10***a*. In one alternative use, the local hardware components **20** may be communicating over standard telephone line **30** to facsimile machine **60**. In another alternative use, the present system may be communicating over a standard telephone line **30** to another personal computer **80** through a remote modem **70**. In another alternative use, the present system may be communicating over a standard telephone line **30** to a standard telephone **90**. Those skilled in the art will readily recognize the wide variety of communication interconnections possible with the present system by reading and understanding the following detailed description.

The ornamental features of the hardware components **20** of FIG. **1** are claimed as part of Design Patent Application Number 29/001368, filed Nov. 12, 1992 entitled "Telephone/Modem case for a Computer-Based Multifunction Personal Communications System" assigned to the same assignee of the present inventions and hereby incorporated by reference.

General Overview

The present inventions are embodied in a commercial product by the assignee, MultiTech Systems, Inc. The software component operating on a personal computer is sold under the commercial trademark of MultiExpressPCS™ personal communications software while the hardware component of the present system is sold under the commercial name of MultiModemPCS™, Intelligent Personal Communications System Modem. In the preferred embodiment, the software component runs under Microsoft® Windows® however those skilled in the art will readily recognize that the present system is easily adaptable to run under any single or multi-user, single or multi-window operating system.

The present system is a multi-function communication system which includes hardware and software components. The system allows the user to connect to remote locations equipped with a similar system or with modems, facsimile machines or standard telephones over a single analog telephone line. The software component of the present system includes a number of modules which are described in more detail below.

FIG. **2** is an example of the Windows®-based main menu icon of the present system operating on a personal computer. The functions listed with the icons used to invoke those functions are shown in the preferred embodiment. Those skilled in the art will readily recognize that a wide variety of selection techniques may be used to invoke the various functions of the present system. The icon of FIG. **2** is part of Design Patent Application Number 29/001397, filed Nov. 12, 1992 entitled "Icons for a Computer-Based Multifunction Personal Communications System" assigned to the same assignee of the present inventions and hereby incorporated by reference.

The telephone module allows the system to operate as a conventional or sophisticated telephone system. The system converts voice into a digital signal so that it can be transmitted or stored with other digital data, like computer information. The telephone function supports PBX and Centrex features such a call waiting, call forwarding, caller ID and three-way calling. This module also allows the user

to mute, hold or record a conversation. The telephone module enables the handset, headset or hands-free speaker telephone operation of the hardware component. It includes on-screen push button dialing, speed-dial of stored numbers and digital recording of two-way conversations.

The voice-mail portion of the present system allows this system to operate as a telephone answering machine by storing voice messages as digitized voice files along with a time/date voice step. The digitized voice files can be saved and sent to one or more destinations immediately or at a later time using a queue scheduler. The user can also listen to, forward or edit the voice messages which have been received with a powerful digital voice editing component of the present system. This module also creates queues for outgoing messages to be sent at preselected times and allows the users to create outgoing messages with the voice editor.

The fax manager portion of the present system is a queue for incoming and outgoing facsimile pages. In the preferred embodiment of the present system, this function is tied into the Windows "print" command once the present system has been installed. This feature allows the user to create faxes from any Windows®-based document that uses the "print" command. The fax manager function of the present system allows the user to view queued faxes which are to be sent or which have been received. This module creates queues for outgoing faxes to be sent at preselected times and logs incoming faxes with time/date steps.

The multi-media mail function of the present system is a utility which allows the user to compose documents that include text, graphics and voice messages using the message composer function of the present system, described more fully below. The multi-media mail utility of the present system allows the user to schedule messages for transmittal and queues up the messages that have been received so that can be viewed at a later time.

The show and tell function of the present system allows the user to establish a data over voice (DOV) communications session. When the user is transmitting data to a remote location similarly equipped, the user is able to talk to the person over the telephone line while concurrently transferring the data. This voice over data function is accomplished in the hardware components of the present system. It digitizes the voice and transmits it in a dynamically changing allocation of voice data and digital data multiplexed in the same transmission. The allocation at a given moment is selected depending on the amount of voice digital information required to be transferred. Quiet voice intervals allocate greater space to the digital data transmission.

The terminal function of the present system allows the user to establish a data communications session with another computer which is equipped with a modem but which is not equipped with the present system. This feature of the present system is a Windows®-based data communications program that reduces the need for issuing "AT" commands by providing menu driven and "pop-up" window alternatives.

The address book function of the present system is a database that is accessible from all the other functions of the present system. This database is created by the user inputting destination addresses and telephone numbers for data communication, voice mail, facsimile transmission, modem communication and the like. The address book function of the present system may be utilized to broadcast communications to a wide variety of recipients. Multiple linked databases have separate address books for different groups and different destinations may be created by the users. The address book function includes a textual search capability which allows fast and efficient location of specific addresses as described more fully below.

Hardware Components

FIG. **3** is a block diagram of the hardware components of the present system corresponding to reference number **20** of FIG. **1**. These components form the link between the user, the personal computer running the software component of the present system and the telephone line interface. As will be more fully described below, the interface to the hardware components of the present system is via a serial communications port connected to the personal computer. The interface protocol is well ordered and defined such that other software systems or programs running on the personal computer may be designed and implemented which would be capable of controlling the hardware components shown in FIG. **3** by using the control and communications protocol defined below.

In the preferred embodiment of the present system three alternate telephone interfaces are available: the telephone handset **301**, a telephone headset **302**, and a hands-free microphone **303** and speaker **304**. Regardless of the telephone interface, the three alternative interfaces connect to the digital telephone coder-decoder (CODEC) circuit **305**.

The digital telephone CODEC circuit **305** interfaces with the voice control digital signal processor (DSP) circuit **306** which includes a voice control DSP and CODEC. This circuit does digital to analog (D/A) conversion, analog to digital (A/D) conversion, coding/decoding, gain control and is the interface between the voice control DSP circuit **306** and the telephone interface. The CODEC of the voice control circuit **306** transfers digitized voice information in a compressed format to multiplexor circuit **310** to analog telephone line interface **309**.

The CODEC of the voice control circuit **306** is actually an integral component of a voice control digital signal processor integrated circuit, as described more fully below. The voice control DSP of circuit **306** controls the digital telephone CODEC circuit **305**, performs voice compression and echo cancellation.

Multiplexor (MUX) circuit **310** selects between the voice control DSP circuit **306** and the data pump DSP circuit **311** for transmission of information on the telephone line through telephone line interface circuit **309**.

The data pump circuit **311** also includes a digital signal processor (DSP) and a CODEC for communicating over the telephone line interface **309** through MUX circuit **310**. The data pump DSP and CODEC of circuit **311** performs functions such as modulation, demodulation and echo cancellation to communicate over the telephone line interface **309** using a plurality of telecommunications standards including FAX and modem protocols.

The main controller circuit **313** controls the DSP data pump circuit **311** and the voice control DSP circuit **306** through serial input/output and clock timer control (SIO/CTC) circuits **312** and dual port RAM circuit **308** respectively. The main controller circuit **313** communicates with the voice control DSP **306** through dual port RAM circuit **308**. In this fashion digital voice data can be read and written simultaneously to the memory portions of circuit **308** for high speed communication between the user (through interfaces **301**,**302** or **303**/**304**) and the personal computer connected to serial interface circuit **315** and the remote telephone connection connected through the telephone line attached to line interface circuit **309**.

As described more fully below, the main controller circuit **313** includes, in the preferred embodiment, a microprocessor which controls the functions and operation of all of the hardware components shown in FIG. **3**. The main controller is connected to RAM circuit **316** and an programmable and electrically erasable read only memory (PEROM) circuit **317**. The PEROM circuit **317** includes nonvolatile memory in which the executable control programs for the voice control DSP circuits **306** and the main controller circuits **313** operate.

The RS232 Serial interface circuit **315** communicates to the serial port of the personal computer which is running the software components of the present system. The RS232 serial interface circuit **315** is connected to a serial input/output circuit **314** with main controller circuit **313**. SIO circuit **314** is in the preferred embodiment, a part of SIO/CTC circuit **312**.

Functional Operation of the Hardware Components

Referring once again to FIG. **3**, the multiple and selectable functions described in conjunction with FIG. **2** are all implemented in the hardware components of FIG. **3**. Each of these functions will be discussed in turn.

The telephone function **115** is implemented by the user either selecting a telephone number to be dialed from the address book **127** or manually selecting the number through the telephone menu on the personal computer. The telephone number to be dialed is downloaded from the personal computer over the serial interface and received by main controller **313**. Main controller **313** causes the data pump DSP circuit **311** to seize the telephone line and transmit the DTMF tones to dial a number. Main controller **313** configures digital telephone CODEC circuit **305** to enable either the handset **301** operation, the microphone **303** and speaker **304** operation or the headset **302** operation. A telephone connection is established through the telephone line interface circuit **309** and communication is enabled. The user's analog voice is transmitted in an analog fashion to the digital telephone CODEC **305** where it is digitized. The digitized voice patterns are passed to the voice control circuit **306** where echo cancellation is accomplished, the digital voice signals are reconstructed into analog signals and passed through multiplexor circuit **310** to the telephone line interface circuit **309** for analog transmission over the telephone line. The incoming analog voice from the telephone connection through telephone connection circuit **309** is passed to the integral CODEC of the voice control circuit **306** where it is digitized.

The digitized incoming voice is then passed to digital telephone CODEC circuit **305** where it is reconverted to an analog signal for transmission to the selected telephone interface (either the handset **301**, the microphone/speaker **303/304** or the headset **302**). Voice Control DSP circuit **306** is programmed to perform echo cancellation to avoid feedback and echoes between transmitted and received signals, as is more fully described below.

In the voice mail function mode of the present system, voice messages may be stored for later transmission or the present system may operate as an answering machine receiving incoming messages. For storing digitized voice, the telephone interface is used to send the analog speech patterns to the digital telephone CODEC circuit **305**. Circuit **305** digitizes the voice patterns and passes them to voice control circuit **306** where the digitized voice patterns are digitally compressed. The digitized and compressed voice patterns are passed through dual port ram circuit **308** to the main controller circuit **313** where they are transferred through the serial interface to the personal computer using a packet protocol defined below. The voice patterns are then stored on the disk of the personal computer for later use in multi-media mail, for voice mail, as a pre-recorded answering machine message or for later predetermined transmission to other sites.

For the present system to operate as an answering machine, the hardware components of FIG. **3** are placed in answer mode. An incoming telephone ring is detected through the telephone line interface circuit **309** and the main controller circuit **313** is alerted which passes the information off to the personal computer through the RS232 serial interface circuit **315**. The telephone line interface circuit **309** seizes the telephone line to make the telephone connection. A pre-recorded message may be sent by the personal computer as compressed and digitized speech through the RS232 interface to the main controller circuit **313**. The compressed and digitized speech from the personal computer is passed from main controller circuit **313** through dual port ram circuit **308** to the voice control DSP circuit **306** where it is uncompressed and converted to analog voice patterns. These analog voice patterns are passed through multiplexor circuit **310** to the telephone line interface **309** for transmission to the caller. Such a message may invite the caller to leave a voice message at the sound of a tone. The incoming voice messages are received through telephone line interface **309** and passed to voice control circuit **306**. The analog voice patterns are digitized by the integral CODEC of voice control circuit **306** and the digitized voice patterns are compressed by the voice control DSP of the voice control circuit **306**. The digitized and compressed speech patterns are passed through dual port ram circuit **308** to the main controller circuit **313** where they are transferred using packet protocol described below through the RS232 serial interface **315** to the personal computer for storage and later retrieval. In this fashion the hardware components of FIG. **3** operate as a transmit and receive voice mail system for implementing the voice mail function **117** of the present system.

The hardware components of FIG. **3** may also operate to facilitate the fax manager function **119** of FIG. **2**. In fax receive mode, an incoming telephone call will be detected by a ring detect circuit of the telephone line interface **309** which will alert the main controller circuit **313** to the incoming call. Main controller circuit **313** will cause line interface circuit **309** to seize the telephone line to receive the call. Main controller circuit **313** will also concurrently alert the operating programs on the personal computer through the RS232 interface using the packet protocol described below. Once the telephone line interface seizes the telephone line, a fax carrier tone is transmitted and a return tone and handshake is received from the telephone line and detected by the data pump circuit **311**. The reciprocal transmit and receipt of the fax tones indicates the imminent receipt of a facsimile transmission and the main controller circuit **313** configures the hardware components of FIG. **3** for the receipt of that information. The necessary handshaking with the remote facsimile machine is accomplished through the data pump **311** under control of the main controller circuit **313**. The incoming data packets of digital facsimile data are received over the telephone line interface and passed through data pump circuit **311** to main controller circuit **313** which forwards the information on a packet basis (using the packet protocol described more fully below) through the serial interface circuit **315** to the personal computer for