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[54] **BACKGROUND SPEECH RECOGNITION FOR VOICE MESSAGING APPLICATIONS**

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[73] Assignee: **Lucent Technologies Inc.**, Murray Hill, N.J.

[*] Notice: This patent issued on a continued prosecution application filed under 37 CFR 1.53(d), and is subject to the twenty year patent term provisions of 35 U.S.C. 154(a)(2).

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[22] Filed: **Jan. 24, 1997**

[51] **Int. Cl.**[7] **H04M 1/64**

[52] **U.S. Cl.** **379/88.04**; 379/88.14

[58] **Field of Search** 704/251, 270, 704/275; 379/67, 88, 89, 142, 355, 201, 211, 88.01, 88.04, 88.13, 88.14, 88.15

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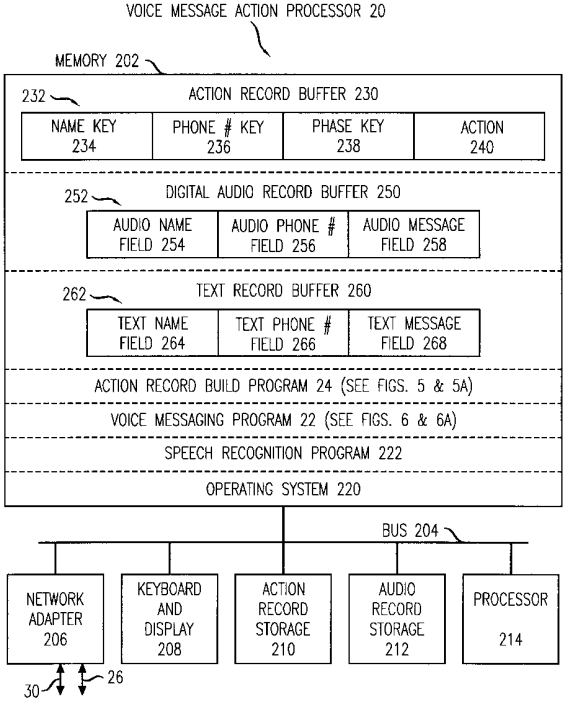
Primary Examiner—Daniel S. Hunter

[57] **ABSTRACT**

Recorded telephone messages may be automatically handled as specified by the called party by means of a background speech recognition server for a telephone network, a private branch exchange, or a personal computer telephone manager. The called party initializes the method by storing multiple action records in a computer, each containing a key word and an action description. Incoming telephone messages can then be automatically processed by subjecting the audio record of each message to a speech recognition program to produce a text record. The computer then compares the text record with the key words in the action records. When a match is found, the action specified in the action record bearing the matching key words, is performed. In this manner, recorded telephone messages may be automatically handled and prioritized as specified by the called party.

7 Claims, 8 Drawing Sheets



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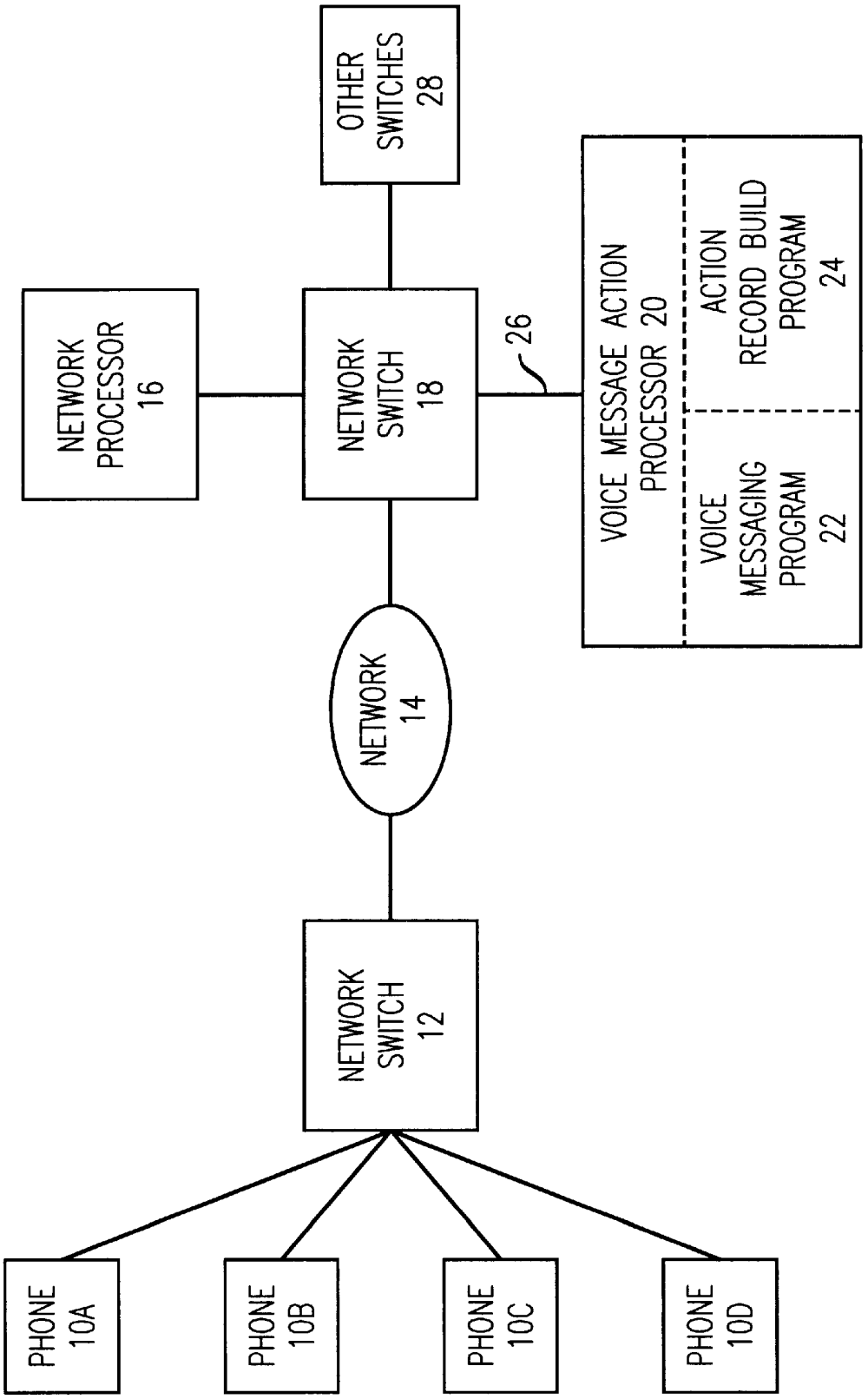

FIG. 1

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FIG. 1A

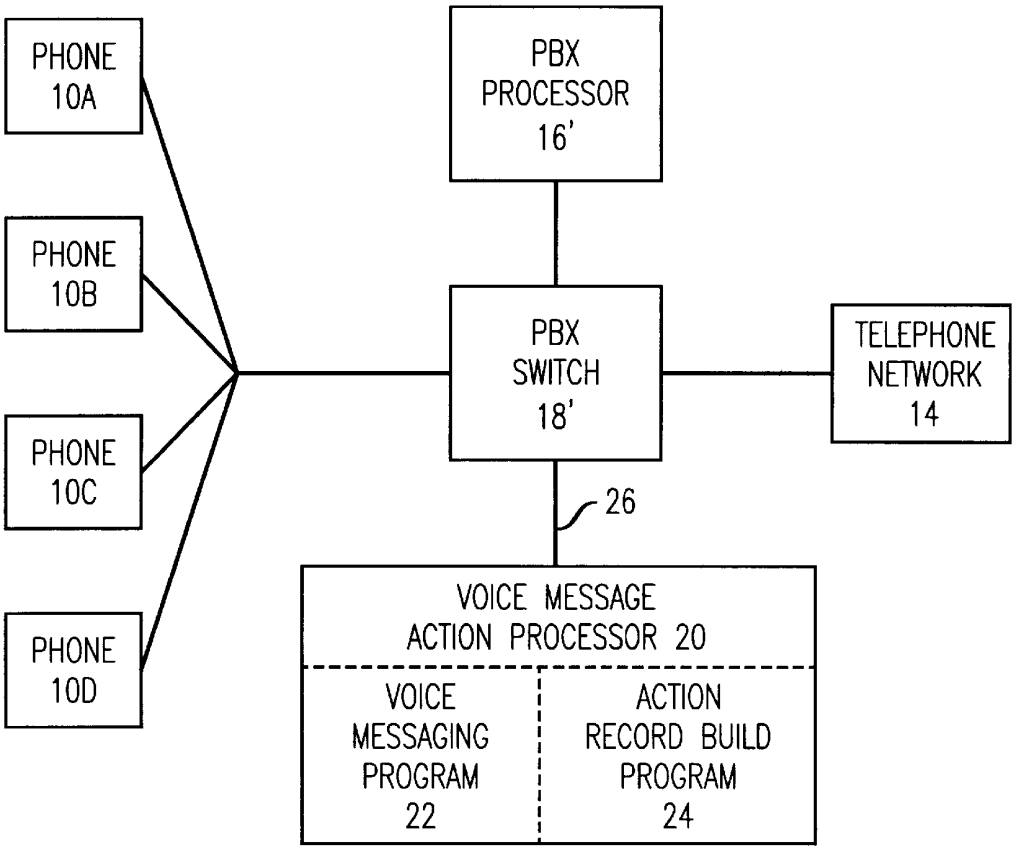

FIG. 1B

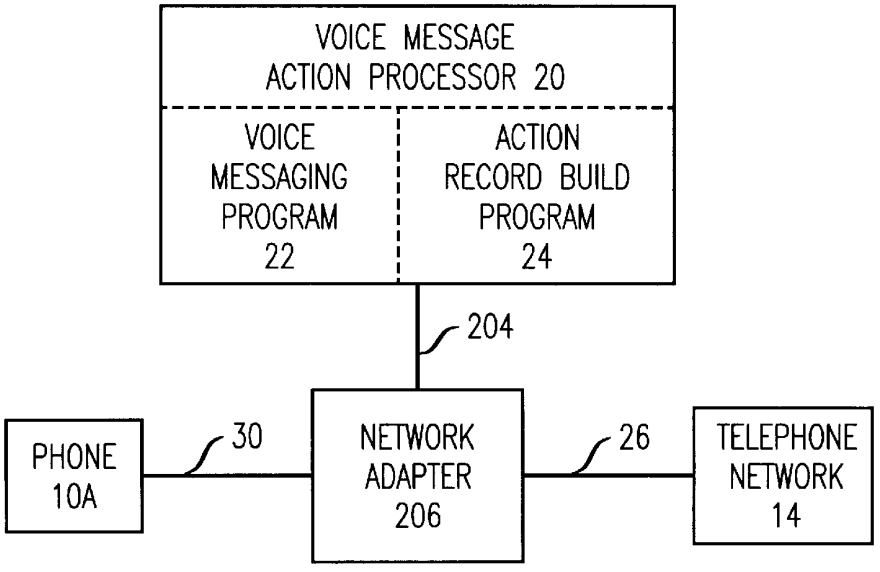

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FIG. 2

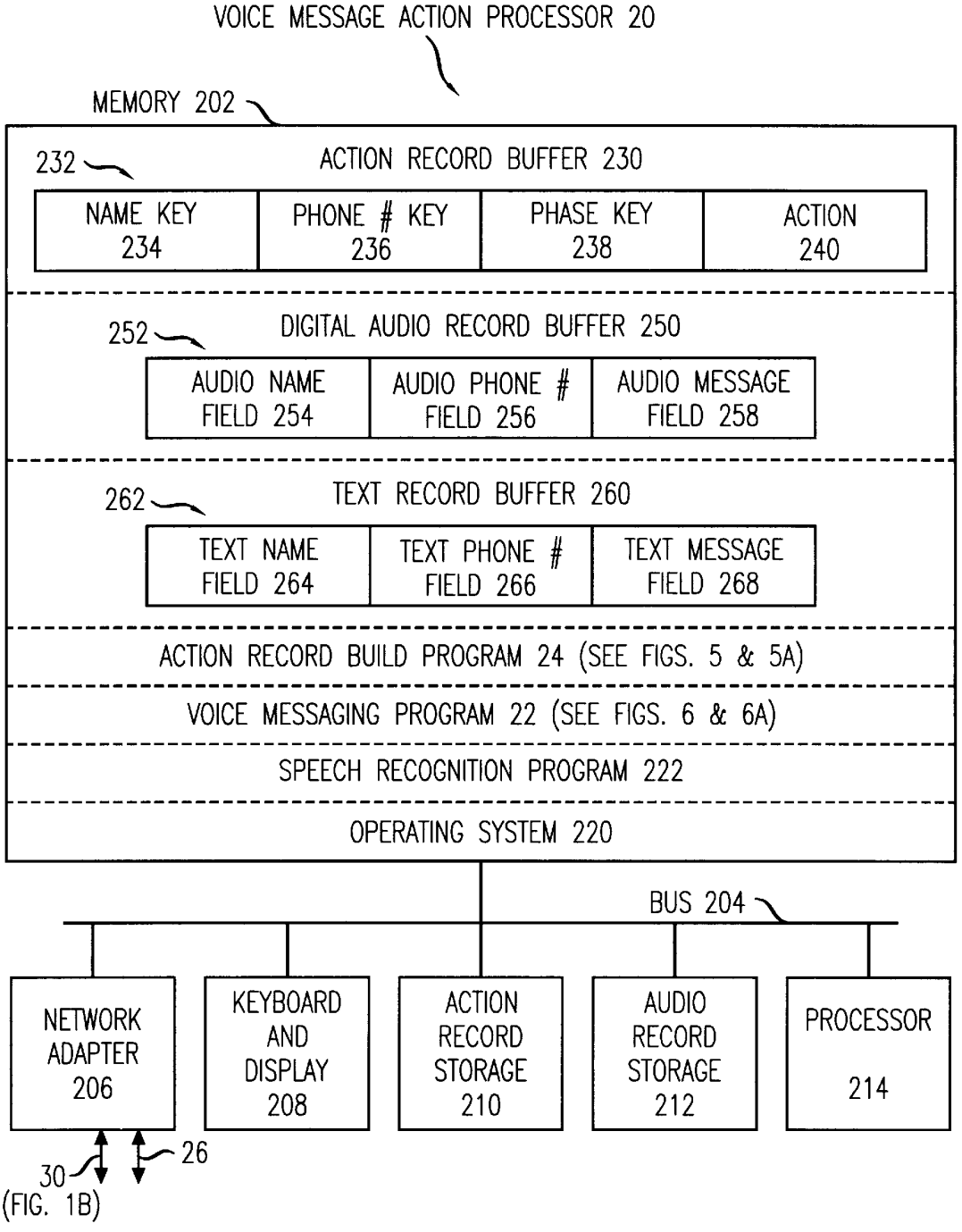

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FIG. 3

ACTION RECORD 232

NAME KEY 234	PHONE # KEY 236	PHASE KEY 238	ACTION 240

FIG. 4A

DIGITAL AUDIO RECORD 252

AUDIO NAME FIELD 254	AUDIO PHONE # FIELD 256	AUDIO MESSAGE FIELD 258

FIG. 4B

TEXT RECORD 262

TEXT NAME FIELD 264	TEXT PHONE # FIELD 266	TEXT MESSAGE FIELD 268

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FIG. 5

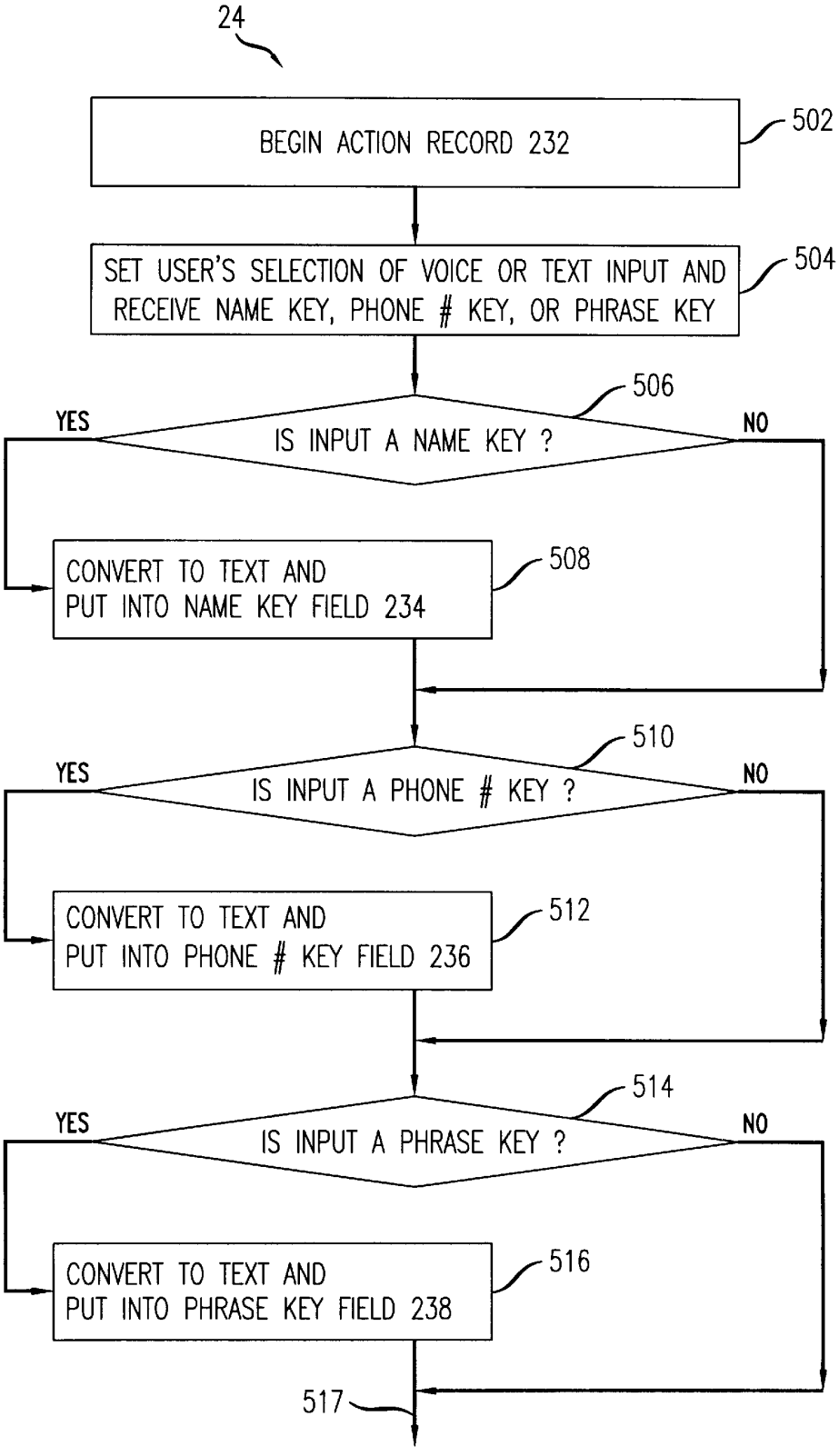

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FIG. 5A

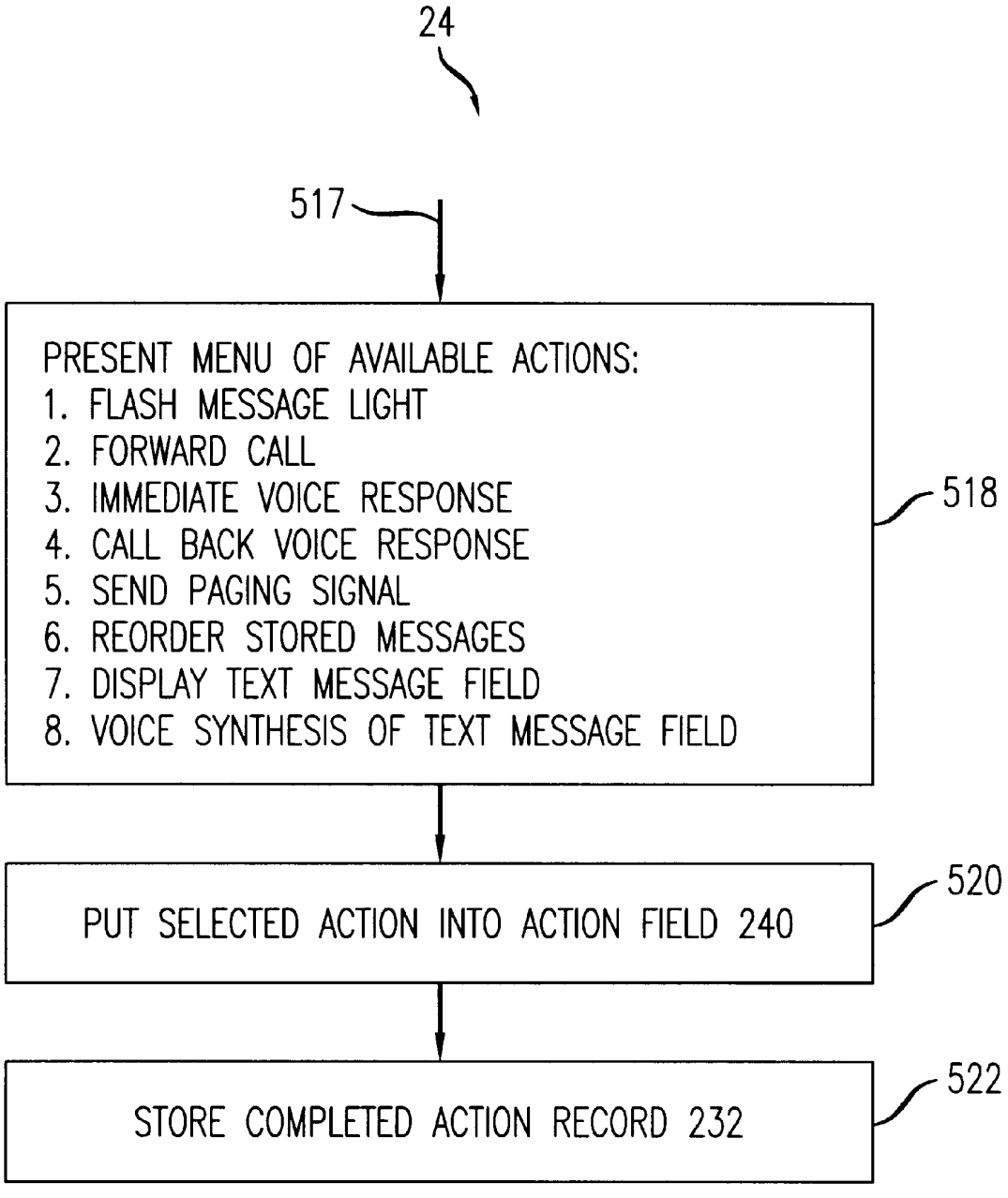

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FIG. 6

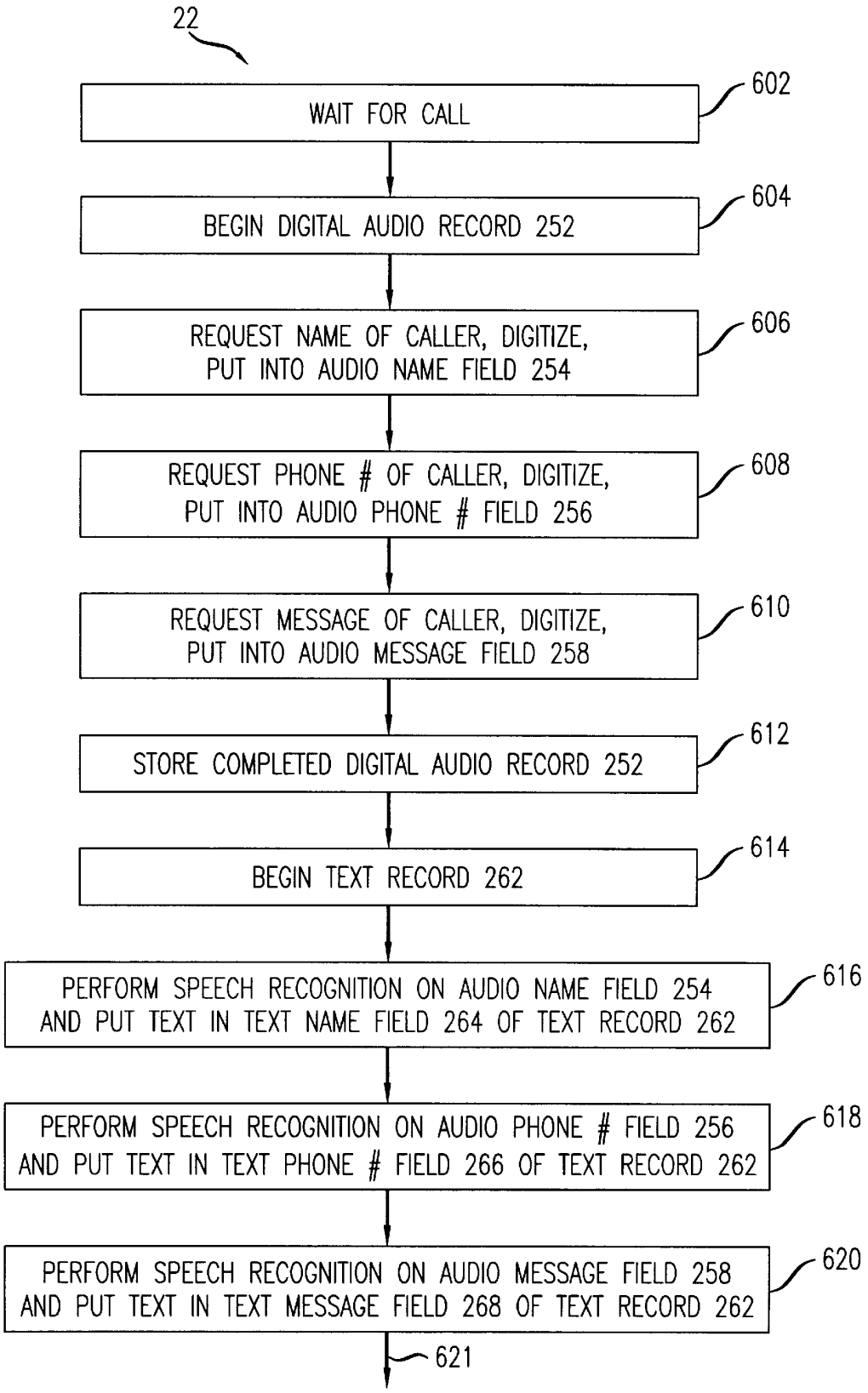

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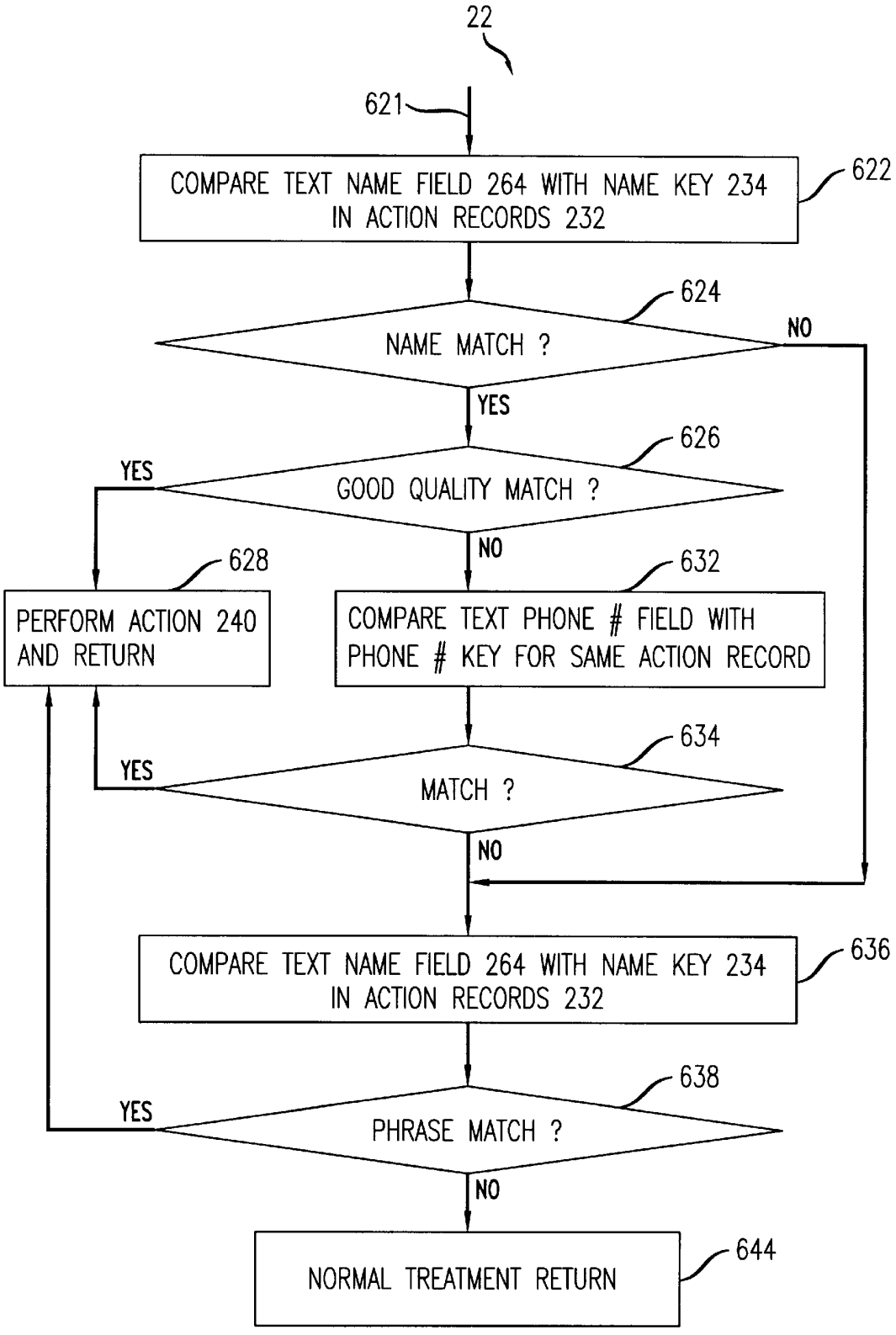
FIG. 6A



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BACKGROUND SPEECH RECOGNITION FOR VOICE MESSAGING APPLICATIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention disclosed broadly relates to communication systems and more particularly relates to a system and method for speech recognition in voice messaging applications.

2. Description of the Related Art

The automatic recording of telephone voice messages is a convenience to both the caller and to the called party. The caller may conveniently call a business office telephone during non-business hours and record a message that may be played back by the called party during the following business day. One problem with this convenience is the accumulation of unsolicited sales calls. The called party must listen through the duration of such calls before clearing them from the accumulated recorded messages. Similarly, the hearing of important recorded telephone messages must oftentimes be delayed while the called party plays back previously recorded calls of lesser importance.

SUMMARY OF THE INVENTION

Recorded telephone messages may be automatically handled as specified by the called party by means of the background speech recognition invention disclosed herein. A computer method is provided in a server for a telephone network, a private branch exchange, or a personal computer telephone manager, to automatically manage voice messages from callers. The called party initializes the method by storing multiple action records in the computer, each containing a key word and an action description. Key words include caller names, caller telephone numbers, and phrases that are considered by the called party to be significant. The called party wishes that messages that include such key words or phrases be handled by actions that the called party specifies, such as call forwarding, pre-recorded voice response, paging, reordering or prioritizing the sequence of message playback, and the like.

Incoming telephone messages can then be automatically processed as follows. The computer receives at least a portion of a voice message from a caller. The caller's name, telephone number, and message are recorded in an audio record. Then each of the portions of the audio record is subjected to a speech recognition program to produce a text record. The computer then compares the various portions of the text record with the corresponding key words in the previously prepared action records. The name of the caller is compared with name keys in the action records. If a match is found, but the quality of the match is suspect, the phone number of the caller is compared with the phone number key in the same action record. The phrases in the message of the caller are compared with phrase keys in the action records. When a match is found, the action specified in the action record bearing the matching key words, is performed. In this manner, recorded telephone messages may be automatically handled and prioritized as specified by the called party.

DESCRIPTION OF THE FIGURES

FIG. **1** is a network diagram showing the invention as used in a telephone network.

FIG. **1**A is a network diagram showing the invention as used in a private branch exchange (PBX) network.

FIG. **1**B is a system block diagram showing the invention used in a personal computer.

FIG. **2** is a functional block diagram of the voice message action processor **20**.

FIG. **3** is a format diagram of the action record **232**.

FIG. **4**A is a format diagram of the digital audio record **252**.

FIG. **4**B is a format diagram of the text record **262**.

FIG. **5** and FIG. **5**A is a flow diagram of the sequence of operational steps in the action record build program **24**.

FIG. **6** and FIG. **6**A is a functional block diagram of the sequence of operational steps in the voice massaging program **22**.

DISCUSSION OF THE PREFERRED EMBODIMENT

FIG. **1** shows a telephone network within which the invention can be applied. Telephones **10**A, **10**B, **10**C and **10**D are connected to a network switch **12** which is connected through the network **14** to the network switch **18**. The network switch **18** can be connected to other switches **28** in the network. The network switch **18** is controlled by network processor **16** and is connected by line **26** to the voice message action processor **20** which embodies the invention. The voice message action processor **20** includes the voice messaging program **22**, and the action record build program **24**. Background speech recognition can be achieved for voice messaging applications by means of the voice message action processor **20**, in conjunction with the voice messaging program **22** and the action record build program **24**. In operation, the action record build program **24** enables a subscriber at a telephone **10**A, for example, to store keywords such as the names or telephone numbers of persons whose messages are of particular importance to the subscriber. Associated with each keyword is an action mode assigned by the subscriber, such as the launching of a paging signal to the subscriber or the reordering or prioritizing of the messages received from other callers. An action is executed in response to the detection of a message containing the corresponding keyword. After the interval for setting up keywords and associated action modes using the action record build program **24**, the subscriber invokes the voice messaging program **22** to begin monitoring messages received from the telephone network **14**. The voice messaging program **22** receives and records analog audio messages, digitizing those messages for storage. The voice messaging program **22** then performs wordspotting against the stored set of keywords in an attempt to identify the presence of a keyword in any audio message. If a keyword is spotted, the voice messaging program **22** then takes the predetermined action which has been specified by the subscriber. In this manner, voice messages received by the subscriber are more effectively managed and more immediately so that important messages have an appropriate disposition automatically made.

FIG. **1**A illustrates another application of the invention, wherein the voice message action processor **20** is connected by means of line **26** to a private branch exchange (PBX)

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switch **18'**. The PBX processor **16'** controls the PBX switch **18'**, which is connected to the telephones **10**A–**10**D and is also connected to the telephone network **14**.

FIG. **1**B illustrates another application of the invention wherein the voice message action processor **20** is embodied as a personal computer which is connected by means of bus **204** to the network adapter **206** which in turn is connected to the telephone **10**A by means of line **30** and is connected to the telephone network **14** by means of the line **26**.

Turning now to FIG. **2**, a functional block diagram is shown of the voice message action processor **20**. The voice message processor **20** includes the memory **202** which is connected by means of the bus **204** to the network adapter **206**, the keyboard and display **208**, the action record storage **210**, the audio record storage **212**, and the processor **214**. The network adapter **206** is connected by means of line **26** to the telephone network **14**, as is shown in FIGS. **1**, **1**A, and **1**B. In the personal computer application of FIG. **1**B, line **30** shown in FIG. **2** connects the network adapter **206** to the telephone **10**A. The memory **202** includes the operating system **220**, the speech recognition program **222**, the voice messaging program **22**, the action record build program **24**, the action record buffer **230**, the digital audio record buffer **250**, and the text record buffer **260**. The voice messaging program **22** can be seen in greater detail in the flow diagrams of FIGS. **6** and **6**A. The action record build program **24** is shown in greater detail in the flow diagrams of FIGS. **5** and **5**A. The action record buffer **230** stores the action record **232**. The action record **232** includes the name key **234**, the phone number key **236**, the phrase key **238**, and the action **240** for a particular action record **232**. The digital audio record buffer **250** contains the digital audio record **252** which includes the audio name field **254**, the audio phone number field **256**, and the audio message field **258**. The text record buffer **260** includes the text record **262**, which includes the text name field **264**, the text phone number field **266**, and the text message field **268**. The programs stored in the memory **202** are sequences of executable instructions which, when executed by the processor **214**, carry out the operations of the voice message action processor **20**. FIG. **3** shows a format diagram of the action record **232** with its respective fields. The name key **234**, the phone number key **236**, the phrase key **238**, and action **240** are the fields of the action record **232**. FIG. **4**A shows a format diagram of the digital record **252** which includes the audio name field **254**, the audio phone number field **256**, and the audio message **258**. FIG. **4**B illustrates a format of the text record **262**, which includes the text name field **264**, the text phone number field **266**, and the text message field **268**.

FIG. **5** and FIG. **5**A is flow diagram of the action record build program **24**, in accordance with the invention. The program **24** begins with step **502** which begins an action record **232** whenever an incoming message appears. Then step **504** sets the user's selection to either voice or text input. Step **504** then receives the name key, phone number key, or phrase key. For example, voice input can be by means of the user using the telephone **10**A to speak the respective name key, phone number key, or phrase key, which is converted by the speech recognition program **222** into a corresponding character string of ASCII characters. The character string for the name key **234**, the phone number key **236**, or the phrase key **238**, would be the text format stored in the action record **232**. Step **506** of FIG. **5** determines whether the user has input a name key. If yes, then step **508** converts the spoken word for the name key into a text string and puts the text string into the name key field **234**. Alternately, if the user has typed in the name key on the keyboard **208**, for example, then the text string is directly put into the name key field **234**. Step **510** of FIG. **5** then determines if the user has input a phone number key. If yes, then step **512** converts the spoken word for the phone number key into text and puts the text for the phone number key into the field **236**. Once again, if the user has elected to type in the phone number on the keyboard **208**, for example, the text string is directly put into the phone number key field **236**. The flow diagram of FIG. **5** then passes to step **514** which determines if the user has input a phrase key. A phrase is any word or sequence of words which the user believes is significant and desires to have flagged for the invocation of a particular action. If step **514** results in a yes, then step **516** converts the spoken phrase into text and puts the text string into the phrase key field **238**. Once again, if the user elects to type in the text on the keyboard **208**, the text is directly input to the phrase key field **238**. The flow diagram of FIG. **5** then passes over path **517** to FIG. **5**A. In FIG. **5**A, the action record build program **24** passes to step **518** which presents a menu of available actions to the user by means of the display **208**. The menu can include typical actions such as actions numbered **1**–**8** in step **518**. The example actions include action **1**: flash a message light, action **2**: forward a call, action **3**: an immediate voice response, action **4**: a call back voice response, action **5**: send a paging signal, action **6**: reorder the stored messages that are presently stored in the audio record storage **212**, action **7**: display the text message field **268** on the display **208**, and action **8**: produce a voice synthesis of the text message field **268** on a voice synthesizer (not shown) connected to the bus **204** in FIG. **2**. Once the user has selected one of the actions in step **518**, then step **520** puts the selected action into the action field **240** of the action record **232**. The program then passes to step **522** which stores the completed action record **232** in the action record storage **210** of the voice message action processor of FIG. **2**.

FIG. **6** and **6**A show the flow diagram for the sequence of operational steps in the voice messaging program **22**. Program FIG. **6** begins at step **602** which waits for an incoming call to the subscriber. Step **604** begins the digital audio record **252**. Step **606** provides a voice response to make a request for the name of the caller. The caller's spoken name is sampled and digitized using pulse code modulation, for example, and a digital form put into the audio name field **254** of the digital audio record **252**. Then step **608** provides a voice response request to the caller to state the caller's telephone number and this spoken sequence of numbers is digitized and put into the audio phone number field **256**. Then step **610** provides a voice request to the caller to state the caller's message and then that spoken series of words is digitized and put into the audio message field **258**. Step **612** then stores the completed digital audio record **252** in the audio record storage **212**.

The voice messaging program **22** can now begin analyzing the digital audio record **252** and begin the text record **262** in step **614**. Then in step **616**, the program performs speech

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recognition using the speech recognition program **222**, on the audio name field **254** and puts the resultant text in the text name field **254** of the text record **262**. Then step **618** performs speech recognition on the audio phone number field **256** and puts the resultant text in the text phone number field **266** of the text record **262**. Then in FIG. **6**, step **620** performs speech recognition on the audio message field **258** and puts the resultant text in the text message field **268** of the text record **262**. Then the flow diagram **22** of FIG. **6** passes over the path **621** to FIG. **6**A. In FIG. **6**A, the voice messaging program **22** continues with step **622** which compares the text name field **224** with the name key **234** in the action records **232** accessed consecutively from the action record storage **210** of FIG. **2**. Then step **624** determines if there is a name match. If the answer is yes, then step **626** determines if the match is a good quality match. If it is, then step **628** performs the action specified in the action field **240** of the action record **232** corresponding to the name match for the name key **234**. The program then returns to wait for another call at step **602**. Alternately, if step **624** does not have a name match, then the program passes to step **636**. Also alternately, if step **626** determines that there is not a good quality match for the name which satisfied the match **624** then step **626** passes to step **632**. Step **632** compares the text phone number field **266** with the phone number key **236** for the same action record **232** with which the name key **234** successfully made a match in step **624**. Then step **634** determines if the match in step **632** is successful, and if so then the program passes to step **628** which performs the action **240**. Alternately, if step **634** determines that the text phone number field **266** does not match the phone number key **236** for the same action record, then the program passes to step **636**. Step **636** compares the text message field **268** with the phrase key **238** in the action records **232** which are accessed from the action record storage **210**. Step **638** determines if there is a phrase match. If there is a phrase match, then the program flows to step **628** which performs the action **240**. However, if there is no phrase match in step **638**, then the program flows to step **644** for normal treatment of the incoming call message. Step **644** returns the program to the step **602** to await the next call. In this manner voice messages are automatically handled so that the desired actions are performed.

Although a specific embodiment of the invention has been disclosed, it will be understood by those having skill in the art that changes can be made to that specific embodiment without departing from the spirit and the scope of the invention.

What is claimed is:

1. A method for managing voice messages for use on a voice messaging system, the method comprising the steps of:

receiving from a user of the voice messaging system a spoken phrase;

creating an association between the spoken phrase and an action description, which is selected by the user; and

subsequently processing a voice message as a function of the created association by

(1) searching for a match between portions of the voice message and the spoken phrase, and

(2) if a match is found, performing the action, a priori associated with the action description, on the voice message.

2. The method of claim **1**, wherein the creating step includes the steps of creating an action record comprising a name key field for representing name information of a calling party, a phone key field for representing information about a calling party number, a phrase key field for storing text representing the spoken phrase, and the action description.

3. The method of claim **1** wherein the searching step also searches for matches in the name key field and the call party number field for performing the associated action.

4. A method for managing voice messages for use on a voice messaging system, which provides a voice messaging service to a number of users, the method comprising the steps of:

enabling each user to edit their own action records in the voice messaging system, each action record comprising a representation of a spoken phrase, provided by the user, and an action description, selected by the user, such that each user can define their own association between a representation of a spoken phrase and an action description independent of other user's defined action records;

subsequently processing received voice messages for the users as a function of their respective action records by:

(1) searching for a match between portions of each received voice message for each user and the corresponding portions of each user's action records representing spoken phrases; and

(2) if a match is found for one of the user's action records, performing an action, a priori associated with the action description, on the corresponding voice message.

5. A method for managing voice messages for use on a voice messaging system, which provides a voice messaging service to a number of users, the method comprising the steps of:

enabling each user to edit their own action records in the voice messaging system, each action record comprising a name key field for representing name information of a calling party, a phone key field for representing information about a calling party number, a phrase key field for storing text representing a spoken phrase, and an action description, wherein contents of the name key field, phone key field, and phrase key field are created by each user and the action description is selected, from one of a number of selections provided by the voice messaging system, by each user such that each user can define their own association between the key fields and a selected action description independent of other user's defined action records;

subsequently processing received voice messages for the users as a function of their respective action records by:

(1) searching for matches between calling party name, calling party number, and spoken phrases of each received voice message for each user and the corresponding key fields of each user's action records; and

(2) if a match is found for one of the user's action records, performing an action, a priori associated with the action description of the matched action record, on the corresponding voice message.

6. A method for managing voice messages for use on a voice messaging system, which provides a voice messaging service to a number of users, the method comprising the steps of:

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enabling each user to edit their own action records in the voice messaging system, each action record comprising a name key field for representing name information of a calling party, a phone key field for representing information about a calling party number, a phrase key field for storing text representing a spoken phrase, and an action description, wherein contents of the name key field, phone key field, and phrase key field are created by each user and the action description is selected, from one of a number of selections provided by the voice messaging system, by each user such that each user can define their own association between the key fields and a selected action description independent of other user's defined action records;

subsequently processing each user's received voice messages as a function of their respective action records by:

(1) searching for a match between a calling party name of each received voice message, and contents of the name key field of each user's action records;

(2) if a match is found for one of the user's action records, checking a quality level of the match;

(3) if the checked quality level is above a predetermined threshold, performing an action, a priori associated with the action description of the matched action record, on the corresponding voice message;

(4) if the checked quality level is not above a predetermined threshold, comparing content of the phone key field of the matched action record with a calling party number of the corresponding received voice message; and

(5) if the content of the phone key field matches the calling party number, performing the action, a priori associated with the action description of the matched action record, on the corresponding voice message.

7. The method of claim **6** further comprising the steps of:

(6) if there is no match of the name key field, searching for a match between portions of the received voice message and content of the phrase key field; and

(7) if a match is found, performing the action, a priori associated with the action description of the matched action record, on the corresponding voice message.

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