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(54) **METHOD AND SYSTEM FOR AN AUTOMATED DISAMBIGUATION**

(76) Inventors: **John M. Martin**, Austin, TX (US); **Hisao M. Chang**, Austin, TX (US); **Sueping Ginny Ying**, Austin, TX (US)

Correspondence Address:
BAKER BOTTS L.L.P.
PATENT DEPARTMENT
98 SAN JACINTO BLVD., SUITE 1500
AUSTIN, TX 78701-4039 (US)

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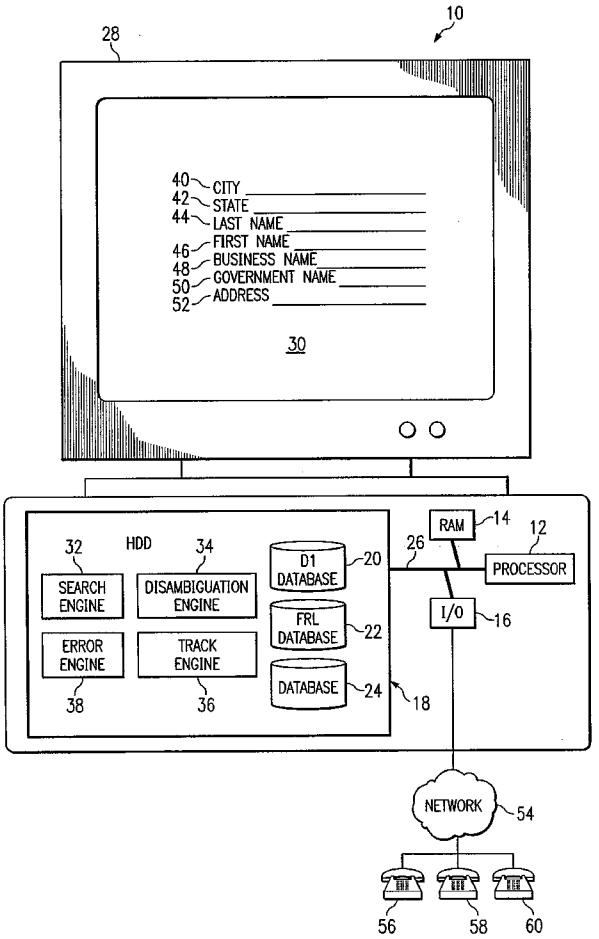
(57) **ABSTRACT**

A method and system for automating the disambiguation of search results includes one or more database including a plurality of records, a search engine, and a disambiguation engine. The search engine allows for the searching of one or more of the databases for one or more search terms provided by a caller. The disambiguation engine differentiates between one or more returned records located by the search engine where the returned records satisfy the search terms. Furthermore, the disambiguation engine disambiguates the returned records based on the number of the returned records. The disambiguation engine disambiguates the returned records by providing a direct choice if the number of returned records is below a low threshold, providing a pick list if the number of returned records is between the low threshold and a high threshold, and requesting additional information if the number of returned records is above the high threshold.



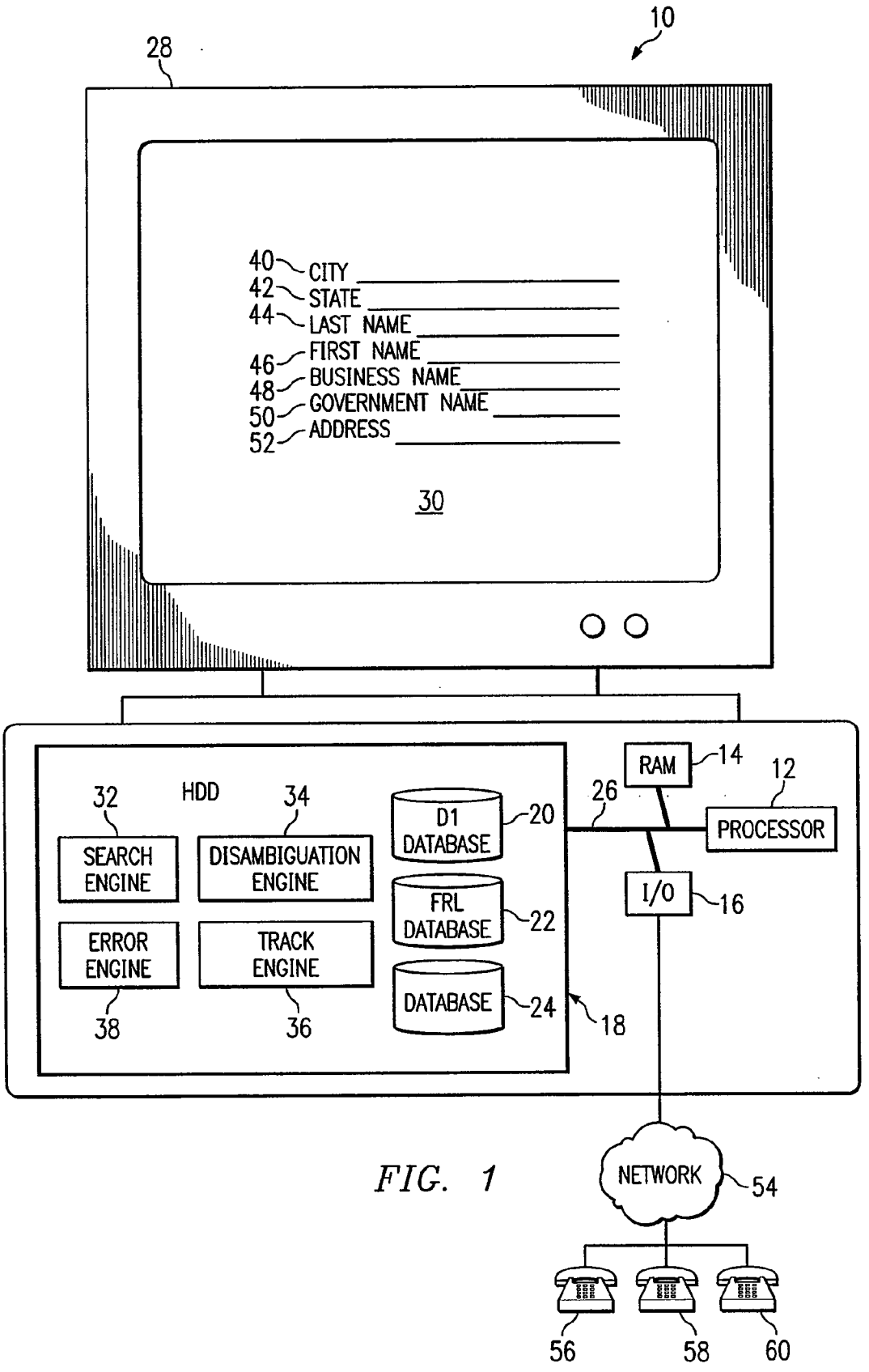

10
28
40 CITY
42 STATE
44 LAST NAME
46 FIRST NAME
48 BUSINESS NAME
50 GOVERNMENT NAME
52 ADDRESS
30
HDD
32
34
SEARCH ENGINE
DISAMBIGUATION ENGINE
ERROR ENGINE
TRACK ENGINE
38
36
D1 DATABASE
20
FRL DATABASE
22
DATABASE
24
18
26
RAM
14
12
PROCESSOR
I/O
16
NETWORK
54
56
58
60

FIG. 1

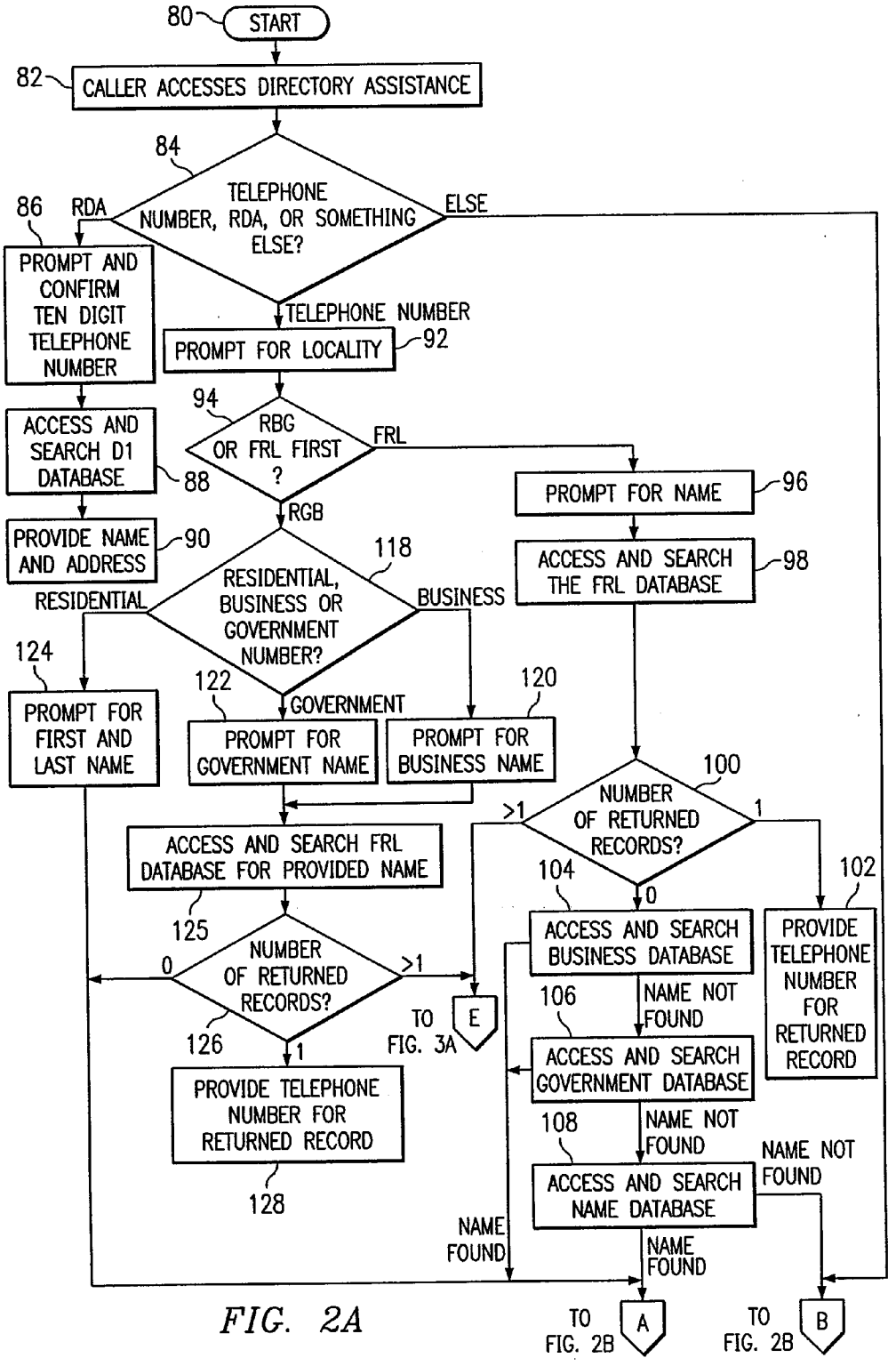

80
START
82
CALLER ACCESSES DIRECTORY ASSISTANCE
84
TELEPHONE NUMBER, RDA, OR SOMETHING ELSE?
86
RDA
ELSE
PROMPT AND CONFIRM TEN DIGIT TELEPHONE NUMBER
TELEPHONE NUMBER
PROMPT FOR LOCALITY
92
ACCESS AND SEARCH D1 DATABASE
88
94
RBG OR FRL FIRST ?
FRL
RGB
PROMPT FOR NAME
96
ACCESS AND SEARCH THE FRL DATABASE
98
PROVIDE NAME AND ADDRESS
90
118
RESIDENTIAL, BUSINESS OR GOVERNMENT NUMBER?
RESIDENTIAL
BUSINESS
GOVERNMENT
124
PROMPT FOR FIRST AND LAST NAME
122
PROMPT FOR GOVERNMENT NAME
120
PROMPT FOR BUSINESS NAME
100
NUMBER OF RETURNED RECORDS?
>1
1
0
ACCESS AND SEARCH FRL DATABASE FOR PROVIDED NAME
125
NUMBER OF RETURNED RECORDS?
0
>1
1
126
TO FIG. 3A
E
104
ACCESS AND SEARCH BUSINESS DATABASE
102
PROVIDE TELEPHONE NUMBER FOR RETURNED RECORD
106
NAME NOT FOUND
ACCESS AND SEARCH GOVERNMENT DATABASE
108
NAME NOT FOUND
ACCESS AND SEARCH NAME DATABASE
NAME NOT FOUND
PROVIDE TELEPHONE NUMBER FOR RETURNED RECORD
128
NAME FOUND
NAME FOUND
TO FIG. 2B
A
TO FIG. 2B
B

FIG. 2A

FIG. 2B

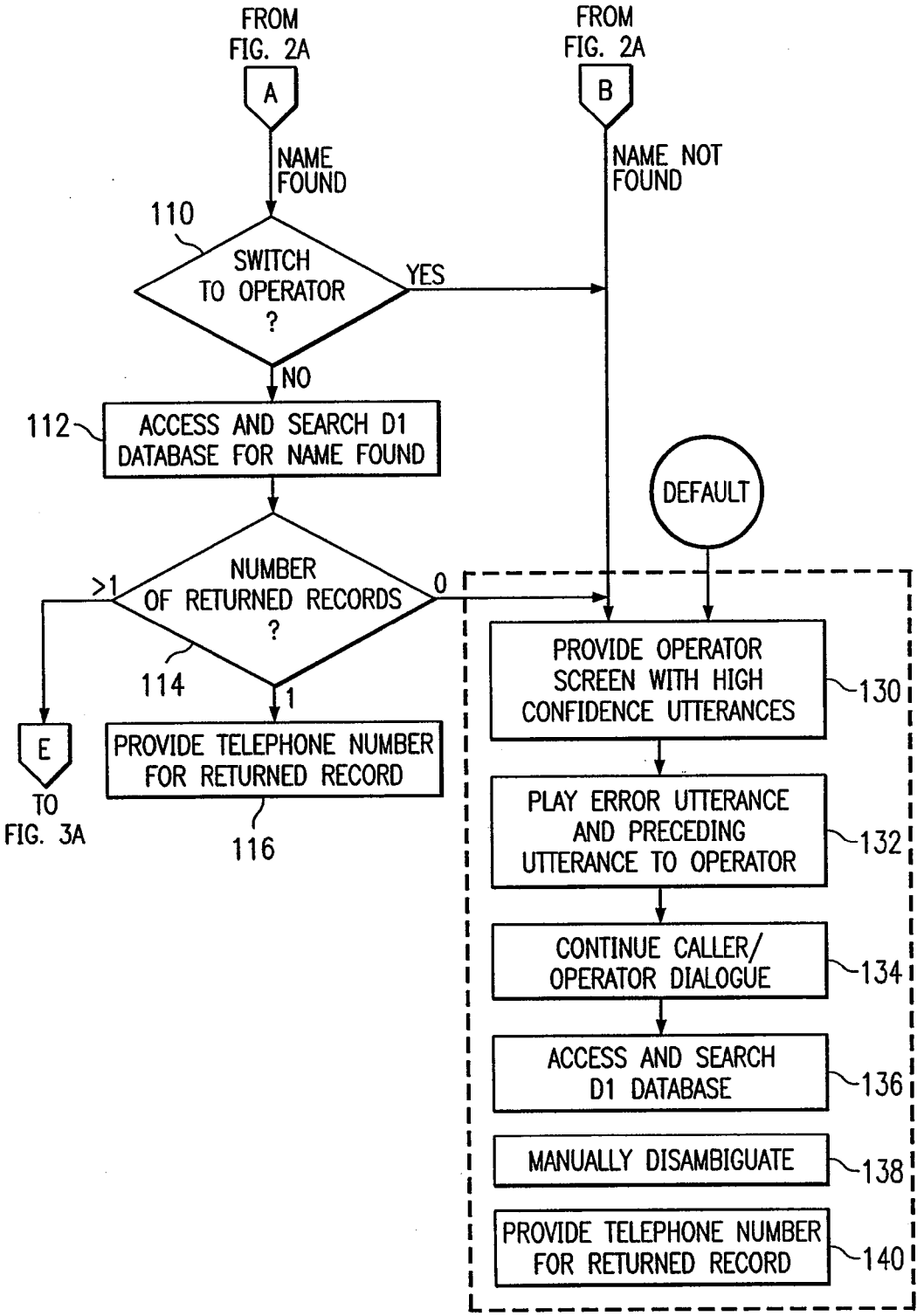
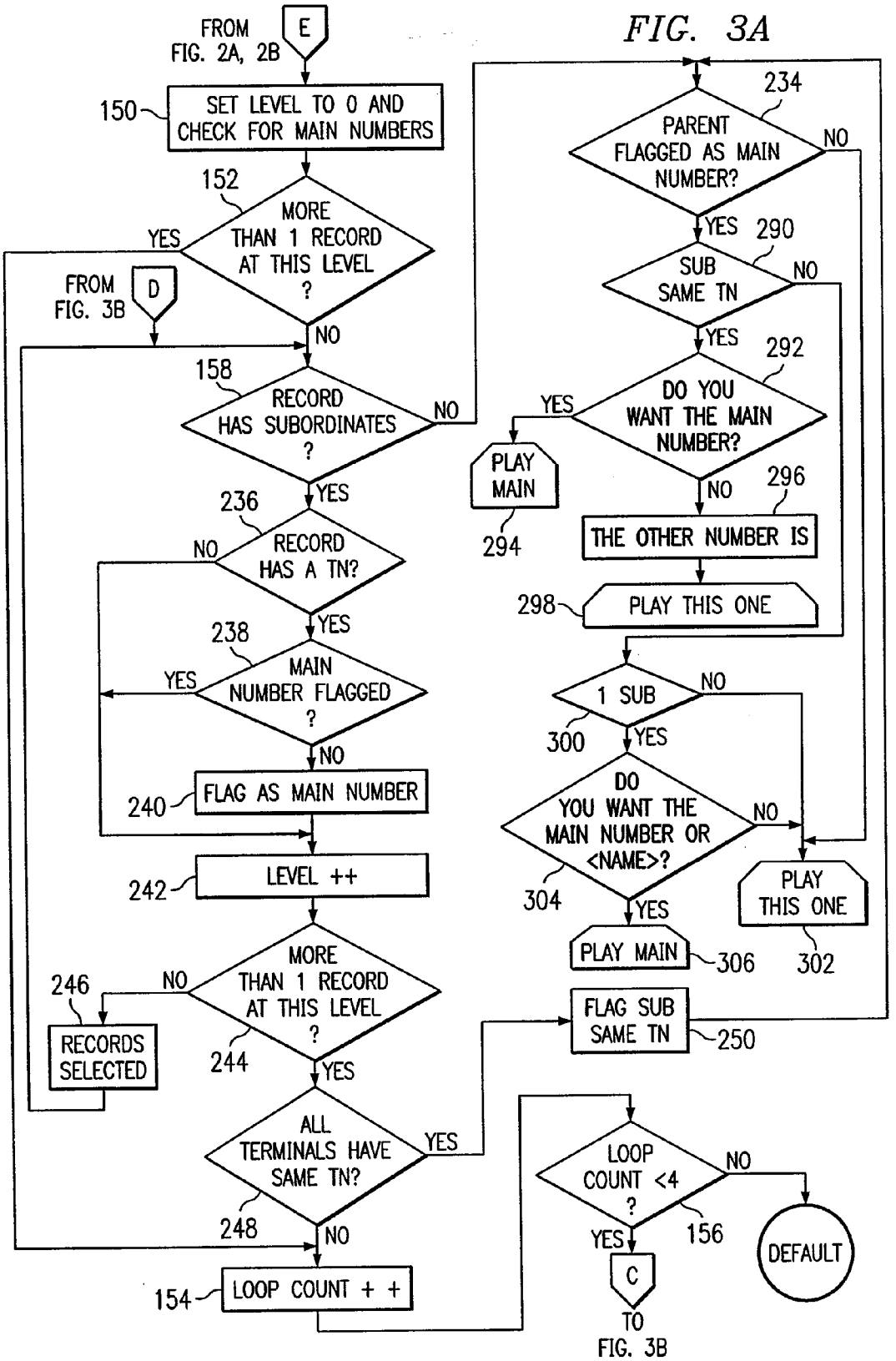

FROM FIG. 2A
A
NAME FOUND
110
SWITCH TO OPERATOR ?
YES
NO
112
ACCESS AND SEARCH D1 DATABASE FOR NAME FOUND
NUMBER OF RETURNED RECORDS ?
>1
0
1
114
E
TO FIG. 3A
PROVIDE TELEPHONE NUMBER FOR RETURNED RECORD
116
FROM FIG. 2A
B
NAME NOT FOUND
DEFAULT
PROVIDE OPERATOR SCREEN WITH HIGH CONFIDENCE UTTERANCES
130
PLAY ERROR UTTERANCE AND PRECEDING UTTERANCE TO OPERATOR
132
CONTINUE CALLER/ OPERATOR DIALOGUE
134
ACCESS AND SEARCH D1 DATABASE
136
MANUALLY DISAMBIGUATE
138
PROVIDE TELEPHONE NUMBER FOR RETURNED RECORD
140

FIG. 3A


FROM FIG. 2A, 2B
E
150
SET LEVEL TO 0 AND CHECK FOR MAIN NUMBERS
152
MORE THAN 1 RECORD AT THIS LEVEL ?
YES
NO
FROM FIG. 3B
D
158
RECORD HAS SUBORDINATES ?
NO
YES
236
RECORD HAS A TN?
NO
YES
238
MAIN NUMBER FLAGGED ?
YES
NO
240
FLAG AS MAIN NUMBER
242
LEVEL ++
246
MORE THAN 1 RECORD AT THIS LEVEL ?
NO
YES
244
RECORDS SELECTED
ALL TERMINALS HAVE SAME TN?
YES
NO
248
154
LOOP COUNT + +
234
PARENT FLAGGED AS MAIN NUMBER?
NO
YES
290
SUB SAME TN
NO
YES
292
DO YOU WANT THE MAIN NUMBER?
YES
NO
PLAY MAIN
294
296
THE OTHER NUMBER IS
298
PLAY THIS ONE
1 SUB
NO
YES
300
DO YOU WANT THE MAIN NUMBER OR <NAME>?
NO
YES
304
PLAY THIS ONE
302
PLAY MAIN
306
FLAG SUB SAME TN
250
LOOP COUNT <4 ?
NO
YES
156
DEFAULT
C
TO FIG. 3B

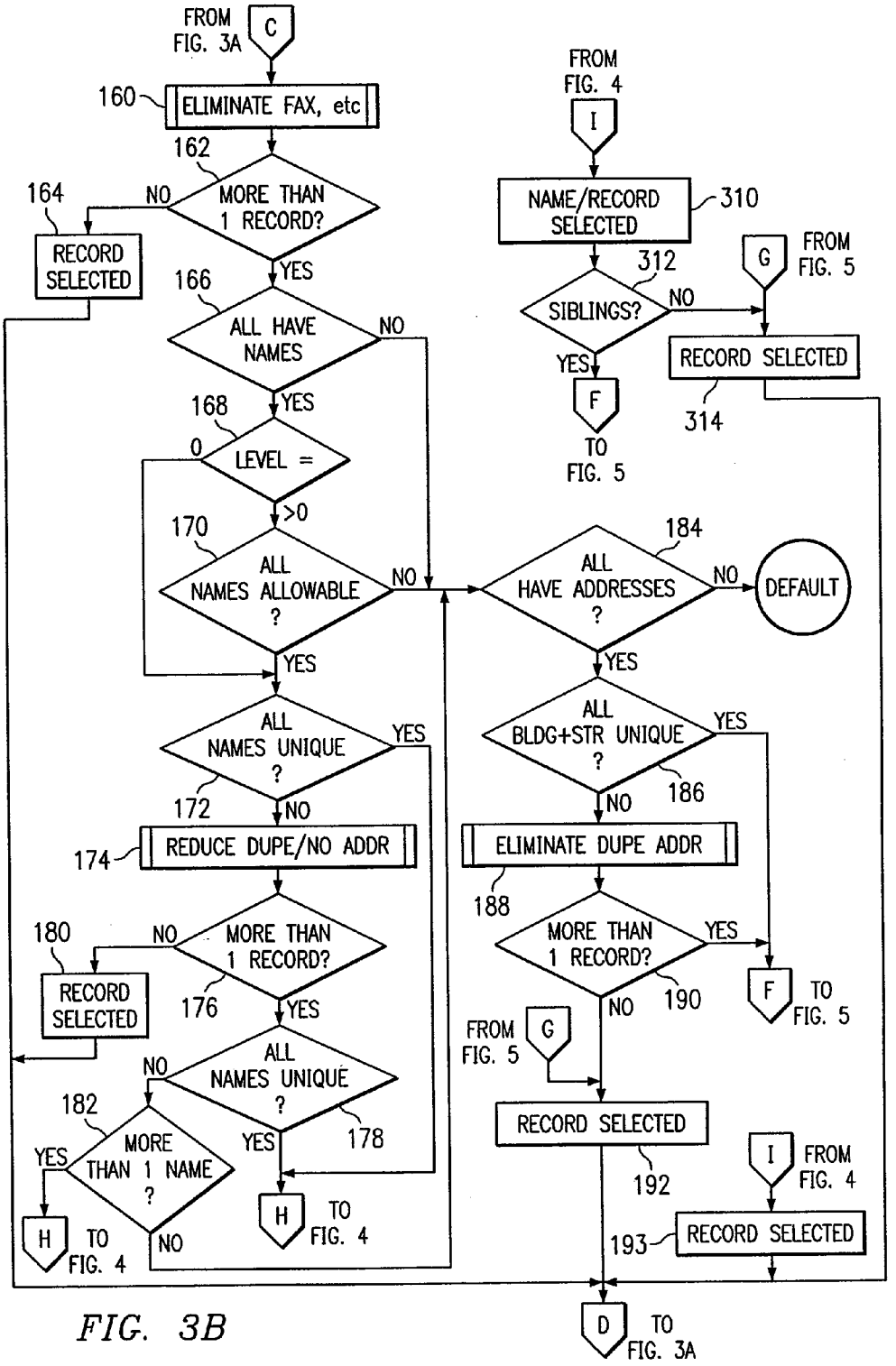

FROM FIG. 3A
C
160
ELIMINATE FAX, etc
162
MORE THAN 1 RECORD?
NO
164
RECORD SELECTED
YES
166
ALL HAVE NAMES
NO
YES
168
LEVEL =
0
>0
170
ALL NAMES ALLOWABLE ?
NO
YES
ALL NAMES UNIQUE ?
YES
172
NO
174
REDUCE DUPE/NO ADDR
180
MORE THAN 1 RECORD?
NO
RECORD SELECTED
176
YES
ALL NAMES UNIQUE ?
NO
182
MORE THAN 1 NAME ?
YES
H
TO FIG. 4
NO
YES
178
H
TO FIG. 4
FROM FIG. 4
I
NAME/RECORD SELECTED
310
312
SIBLINGS?
NO
G
FROM FIG. 5
YES
F
TO FIG. 5
RECORD SELECTED
314
184
ALL HAVE ADDRESSES ?
NO
DEFAULT
YES
ALL BLDG+STR UNIQUE ?
YES
186
NO
ELIMINATE DUPE ADDR
188
MORE THAN 1 RECORD?
YES
F
TO FIG. 5
NO
190
FROM FIG. 5
G
RECORD SELECTED
192
I
FROM FIG. 4
193
RECORD SELECTED
D
TO FIG. 3A

FIG. 3B

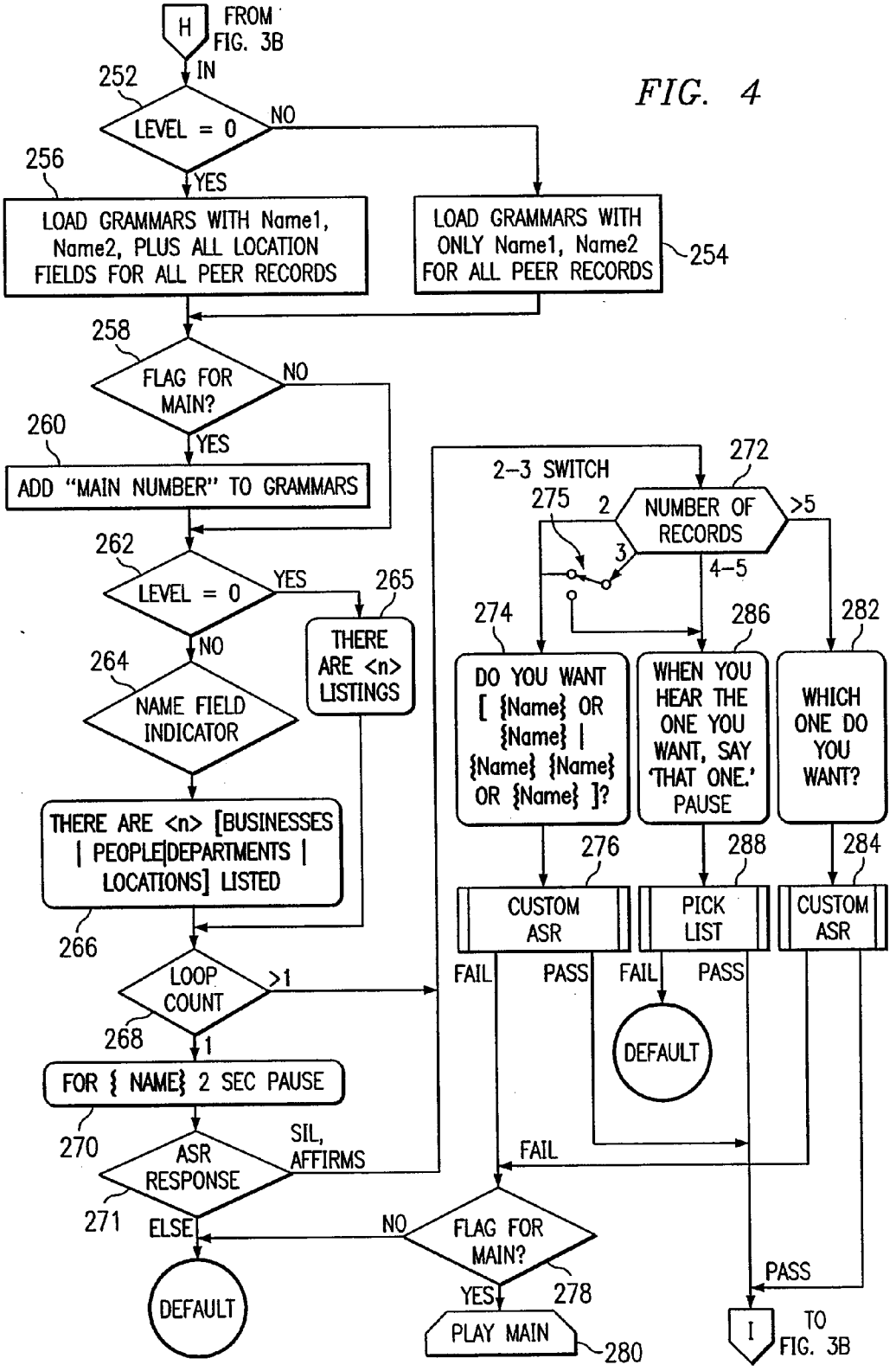
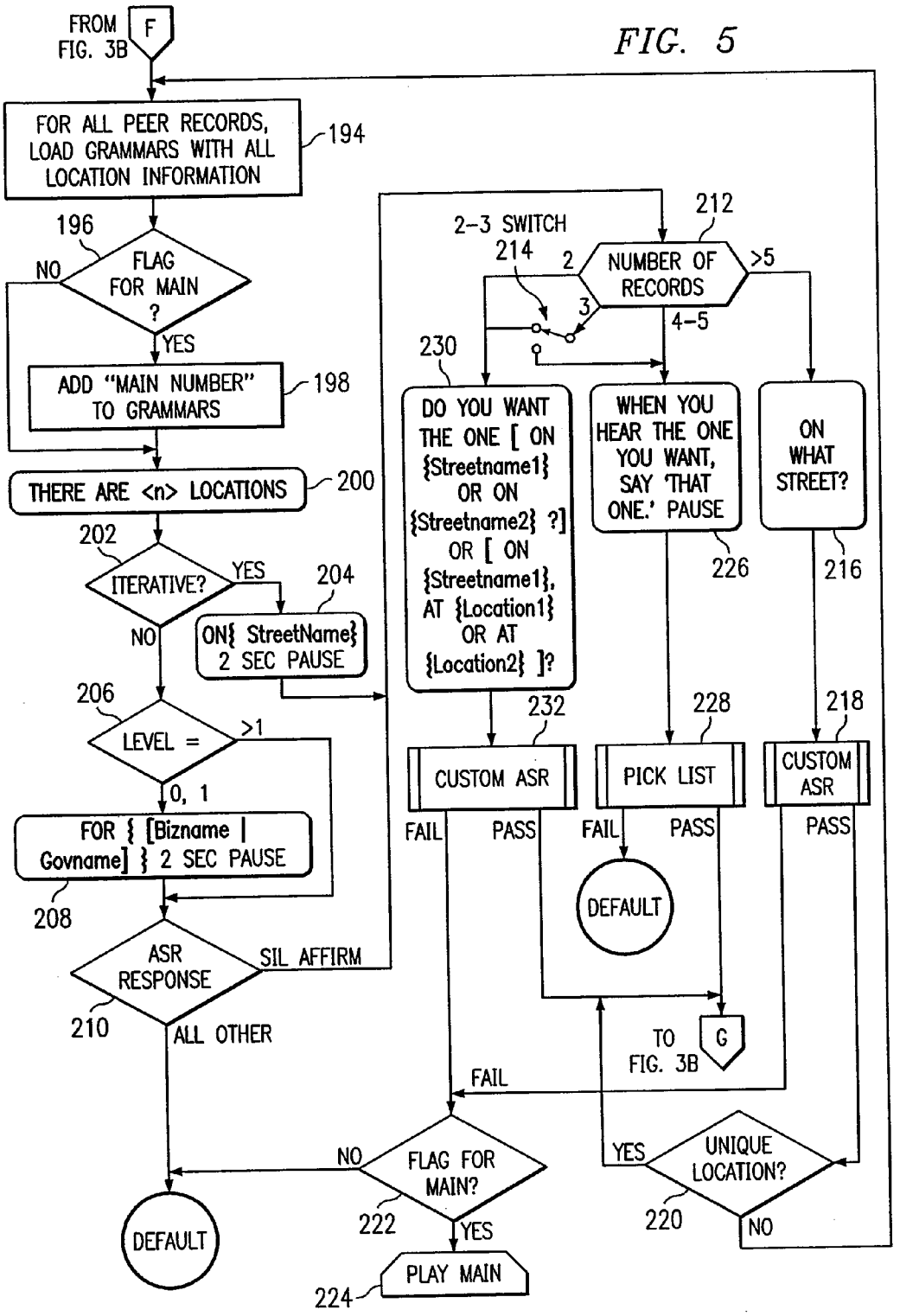

H
FROM FIG. 3B
IN
252
LEVEL = 0
NO
YES
256
LOAD GRAMMARS WITH Name1, Name2, PLUS ALL LOCATION FIELDS FOR ALL PEER RECORDS
LOAD GRAMMARS WITH ONLY Name1, Name2 FOR ALL PEER RECORDS
254
258
FLAG FOR MAIN?
NO
YES
260
ADD "MAIN NUMBER" TO GRAMMARS
262
LEVEL = 0
YES
265
THERE ARE <n> LISTINGS
NO
264
NAME FIELD INDICATOR
THERE ARE <n> [BUSINESSES | PEOPLE|DEPARTMENTS | LOCATIONS] LISTED
266
LOOP COUNT
>1
1
268
FOR { NAME} 2 SEC PAUSE
270
ASR RESPONSE
SIL, AFFIRMS
271
ELSE
DEFAULT
2-3 SWITCH
272
275
2
3
NUMBER OF RECORDS
>5
4-5
274
286
282
DO YOU WANT [{Name} OR {Name} | {Name} {Name} OR {Name}]?
WHEN YOU HEAR THE ONE YOU WANT, SAY 'THAT ONE.' PAUSE
WHICH ONE DO YOU WANT?
276
288
284
CUSTOM ASR
PICK LIST
CUSTOM ASR
FAIL
PASS
FAIL
PASS
DEFAULT
FAIL
NO
FLAG FOR MAIN?
278
YES
PLAY MAIN
280
PASS
I
TO FIG. 3B

FIG. 4

FIG. 5


FROM FIG. 3B
F
FOR ALL PEER RECORDS, LOAD GRAMMARS WITH ALL LOCATION INFORMATION
194
196
FLAG FOR MAIN ?
NO
YES
ADD "MAIN NUMBER" TO GRAMMARS
198
THERE ARE <n> LOCATIONS
200
202
ITERATIVE?
YES
NO
204
ON{ StreetName} 2 SEC PAUSE
206
LEVEL =
>1
0, 1
FOR { [Bizname | Govname] } 2 SEC PAUSE
208
ASR RESPONSE
SIL AFFIRM
210
ALL OTHER
DEFAULT
2-3 SWITCH
214
212
NUMBER OF RECORDS
2
3
4-5
>5
230
DO YOU WANT THE ONE [ON {Streetname1} OR ON {Streetname2} ?] OR [ON {Streetname1}, AT {Location1} OR AT {Location2}]?
WHEN YOU HEAR THE ONE YOU WANT, SAY 'THAT ONE.' PAUSE
226
ON WHAT STREET?
216
232
228
218
CUSTOM ASR
PICK LIST
CUSTOM ASR
FAIL
PASS
FAIL
PASS
PASS
DEFAULT
TO FIG. 3B
G
FAIL
FLAG FOR MAIN?
NO
YES
222
PLAY MAIN
224
UNIQUE LOCATION?
YES
NO
220

METHOD AND SYSTEM FOR AN AUTOMATED DISAMBIGUATION

RELATED PATENT APPLICATION

[0001] This patent application is a co-pending patent application with U.S. patent application Ser. No. _____, entitled Method and System for an Automated Departure Strategy with inventors John M. Martin et al. and filed Oct. 31, 2002.

TECHNICAL FIELD OF THE INVENTION

[0002] The present invention relates generally to telecommunications systems, and more specifically relates to a method and system for an automated disambiguation.

BACKGROUND OF THE INVENTION

[0003] In order to decrease costs and increase efficiency, telephone companies are automating directory assistance systems. An early step toward automation of directory assistance was the use of store and forward technology to assist live operators. A caller was asked for a locality by a pre-recorded prompt. The store and forward system stored a compressed version of the caller's response to the prompt, and brought a live operator onto the line. The operator heard the compressed version of the response and then completed the remaining dialogue with the caller to provide a unique telephone number.

[0004] With the advent of speech recognition, companies have begun adding speech recognition capabilities to directory assistance systems. Automated speech recognition recognizes a locality from the caller's response to a prompt for locality. In a typical system, if the speech recognition is successful, the system prompts the caller for the listing name, puts an operator on the line, populates the operator's workstation display with the recognized locality, and plays a recorded compressed version of the caller's response to the listing question. The operator then conducts the remaining dialogue, searches for the listing, and provides the unique telephone number to the caller. But directory assistance is not totally automated and operator involvement is still required in providing the callers telephone numbers.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] A more complete understanding of the present embodiments and advantages thereof may be acquired by referring to the following description taken in conjunction with the accompanying drawings, in which like reference numbers indicate like features, and wherein:

[0006] **FIG. 1** depicts a block diagram of an automated directory assistance system;

[0007] **FIG. 2** illustrates a flow diagram of a method for the automated disambiguation of search results and automated defaulting to an operator in the directory assistance system;

[0008] **FIG. 3** depicts a flow diagram of a method for automated disambiguation in greater detail;

[0009] **FIG. 4** illustrates an example flow diagram of a method for automated disambiguation by record name; and

[0010] **FIG. 5** depicts an example flow diagram of a method for automated disambiguation by record address.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Preferred embodiments of the present invention are illustrated in the figures, like numerals being used to refer to like and corresponding parts of the various drawings.

[0012] Telephone companies typically have directory assistance systems allowing for callers seeking particular telephone information to receive such information. Callers typically call directory assistance to receive a telephone number for a particular person or business or to locate a corresponding name and address for a telephone number. Generally the caller calls into directory assistance and interacts with a live operator. The operator asks the caller various questions such as the locality (city and state) for the person or business that the caller seeks, the name of the person or business, and possibly the address of the person or business. The caller engages in a dialogue with the operator answering all of the operator's questions until the operator has enough information to perform a database search for the desired telephone number. If the database search returns one record, the operator provides the telephone number to the caller either verbally or more typically by means of a "backend" audio system that utilizes wave files or synthesized human speech. If the database search returns more than one record, the operator asks the caller additional questions in order to eliminate all but the desired returned record. Once the operator has determined the desired returned record, the operator provides the telephone number to caller.

[0013] Operator assisted directory assistance systems, while efficient at locating the desired record and providing a positive caller experience, are costly to the telephone companies due to the costs involved with the operator time and man-power required to interact with the callers. Callers expect a quick response when calling directory assistance and do not like to wait or be put on hold. Hence, there must be enough operators working at all times of the day to insure that the majority of callers can quickly and easily speak with an operator and find the desired telephone number.

[0014] In order to increase efficiency and defray some of the costs associated with directory assistance systems, telephone companies have begun to automate various aspects of the directory assistance systems using a variety of automation techniques. Initially, telephone companies adopted store and forward technology to record the response of a caller and playback the response to an operator. For instance, a prerecorded prompt asked a caller for the city and state for the desired telephone number. The caller speaks the city and state and the store and forward technology records the caller's response. The recorded city and state is then played for the operator and the caller is transferred to the operator so that the operator can ask the caller additional questions about the desired telephone number, perform the search for the telephone number, and provide the telephone number to the caller.

[0015] Telephone companies further automated directory assistance systems with the use of speech recognition capabilities. As with store and forward, the directory assistance system uses a prerecorded prompt to ask the caller for the locality and the caller speaks the city and/or state. If the directory assistance system successfully recognizes and understands the caller's utterance, the caller's utterance is recorded and another prerecorded prompt plays asking the

caller for the listing name. When the caller speaks the listing name, the directory assistance system records the listing name, populates an operator screen with the recognized locality, and plays back to the operator the recorded listing name. The caller is then transferred to the operator where the caller and operator continue the remaining dialogue and the operator performs a database search and provides the desired telephone number to the caller.

[0016] Typically, the directory assistance systems are not completely automated because the callers must still interact with live operators and operators still perform the database searches in order to locate the desired telephone number. In addition, the likelihood of failed speech recognition requires that the directory assistance systems be capable of defaulting to an operator upon such a failure. Generally, the call defaults to a live operator after a failed attempt at speech recognition. In addition, further operator and caller involvement is required when a database search returns more than one record and the operator must disambiguate between the returned records so that the caller receives the desired telephone number.

[0017] Telephone companies have attempted to increase the automation by utilizing speech recognition deeper into the operator and caller dialogue. But speech recognition success rates and the callers' opinions towards speech recognition systems have slowed the automation of directory assistance systems utilizing speech recognition. Typically when the directory assistance system utilizing speech recognition does not understand an utterance of the caller, the system asks the caller to repeat the utterance. But callers do not like having to repeat themselves when interacting with speech recognition systems and quickly grow frustrated and dissatisfied with directory assistance systems if they constantly have to repeat themselves. In addition, if the speech recognition is not functioning correctly and the call defaults to the operator, the operator generally does not know what the caller has been trying to accomplish and must re-ask questions that the caller has already answered or attempted to answer when interacting with the automated system utilizing speech recognition. Therefore, the caller becomes even more frustrated and dissatisfied because the caller now has to repeat utterances to the operator.

[0018] By contrast, the example embodiment described herein allows for an automated directory assistance system including automated disambiguation strategy of search results utilizing speech recognition. The example embodiment allows for the disambiguation of returned telephone records without the intervention of a live operator. Time and money is saved because operators are no longer required to interact with callers to disambiguate the returned records when more than one record satisfies one or more search terms provided by the caller with respect to the desired telephone number. Therefore, employees' and operators' time may be better utilized in interacting with callers experiencing difficulties as well as in other revenue generating projects since less man-power is required to disambiguate returned records in the directory assistance system.

[0019] Referring now to **FIG. 1**, a block diagram depicts directory assistance system **10**. In the example embodiment, directory assistance system **10** may include respective software components and hardware components, such as processor **12**, memory **14**, input/output ports **16**, hard disk drive (HDD) **18** including databases **20**, **22**, and **24**, and those components may work together via bus **26** to provide the desired functionality. In alternate embodiments, HDD **18** may contain more than three or less than three databases. The various hardware and software components may also be referred to as processing resources. Directory assistance system **10** may be a personal computer, a server, or any other appropriate computing device. Directory assistance system **10** may further include display **28** for presenting operator screen **30** and input devices such as a mouse and a keyboard. Directory assistance system **10** also includes search engine **32**, disambiguation engine **34**, track engine **36**, and error engine **38**, which reside in memory such as HDD **18** and are executable by processor **12** through bus **26**. Directory assistance system **10** may further include an automated speech recognition (ASR) engine and a text to speech (TTS) engine that enable directory assistance system **10** to utilize a speech recognition interface with the callers. The ASR engine allows directory assistance system **10** to recognize the speech or utterances provided by the callers in response to prompts while the TTS engine allows directory assistance system **10** to playback to the callers in prompts variable data, such as data returned from a database search.

[0020] Display **28** presents operator screen **30** which allows for the input of various search terms into directory assistance system **10** to automatically disambiguate and for automated departure to an operator upon an error. Shown in **FIG. 1** is an example operator screen **30**. Operator screen **30** includes seven information fields **40**, **42**, **44**, **46**, **48**, **50**, and **52** allowing for the individual input of various specific caller utterances and search terms such as locality (city field **40** and state field **42**), name (last name field **44**, first name field **46**, business name field **48**, and government name field **50**), and address field **52**. In alternate embodiments, operate screen **30** may include more than seven or less than seven information fields and the information fields may be for different information than those shown in **FIG. 1**.

[0021] The callers interface with directory assistance system **10** using telephones **56**, **58**, and **60**. Telephones **56**, **58**, and **60** communicate with directory assistance system **10** via network **54** and I/O port **16**. Network **54** may be a public switched telephone network, the Internet, or any other appropriate type of communication network. Although three telephones **56**, **58**, and **60** are shown in **FIG. 1**, in alternate embodiments directory assistance system **10** may interface with more than three or less than three telephones.

[0022] Directory assistance system **10** allows for the automated searching and returning of telephone directory information such as telephone numbers, listing names, and listing addresses. Although the example embodiment is described in reference to automated speech recognition as the interface between directory assistance system **10** and the callers, in alternate embodiments the callers may also interface with directory assistance system **10** utilizing touch-tone input, a combination of speech recognition and touch-tone, or any other appropriate method of interfacing.

[0023] **FIG. 2** illustrates a flow diagram of a method for the automated disambiguation of search results in directory assistance system **10** and automated defaulting to an operator within directory assistance system **10**. **FIGS. 3, 4**, and **5** provide more detail with respect to the automated disambiguation strategy.

[0024] The method begins at step **80** and at step **82** a caller accesses directory assistance system **10** by calling a telephone number for directory assistance such as "1+411." In response to the caller dialing directory assistance, a dialog with the caller begins between the caller and directory assistance system **10** utilizing automated speech recognition. At any step, if the speech recognition is not successful, the call defaults to a live operator where such defaulting to the operator is described in greater detail below.

[0025] At step **84**, directory assistance system **10** prompts the caller by playing a prompt asking the caller if the caller is interested in locating a telephone number where the caller has a name, performing a reverse directory assistance ("RDA") look-up where the caller has a telephone number and wants to determine a corresponding name and address, or if the caller is interested in something else. In response to the prompt, the caller speaks a response or utterance depending on the caller's reason for calling directory assistance. For example, if the caller is interested in finding a telephone number, the caller says "telephone number" in response to the prompt. Whenever the caller responds to any prompt, track engine **36** tracks and stores the caller's response or utterance in database **24**. For example, if at step **84** the caller's utterance is "telephone number" in response to the prompt, track engine **36** stores "telephone number" in database **24**.

[0026] If at step **84** the caller responds that he is interested in an RDA look-up, then at step **86** directory assistance system **10** prompts the caller for the telephone number including area code. The caller speaks the telephone number and directory assistance system **10** confirms the telephone number. Once directory assistance system **10** successfully recognizes the ten digit telephone number, at step **88** directory assistance system **10** accesses and searches D**1** database **20** in order to locate a name and address that correspond with the telephone number provided by the caller. D**1** database **20** is a real world directory of names, addresses, and telephone numbers for individuals, businesses, and the government created and maintained by Nortel Networks Limited. Whenever a search is performed in D**1** database **20**, the search terms used to search D**1** database **20** have already been successfully recognized utilizing an ASR engine. Although D**1** database **20** is shown within directory assistance system **10** in the embodiment of **FIG. 2**, in alternate embodiment D**1** database **20** may be remotely located remotely with respect to directory assistance system **10** and accessed via a network connection. Furthermore, directory assistance system **10** may search other name, address, and telephone number databases in place of or in addition to D**1** database **20**.

[0027] If at step **88** directory assistance system **10** locates a corresponding name and address, directory assistance system **10** checks a non-publication list and if the telephone number is not on the non-publication list provides the name and address to the caller. The non-publication list is a list of telephone customers who have paid a fee so that their name, address, and telephone number will not be given out to callers by directory assistance. Before directory assistance system **10** provides any telephone information to the caller, directory assistance system **10** must always first check to see if the information is for an entity that is on the non-publication list. If the telephone number is on the non-publication list, directory assistance system **10** informs the caller that the owner of the telephone number has requested that their information not be provided and therefore does not provide the corresponding name and address to the caller. If there is no corresponding name and address, directory assistance system **10** informs the caller that no name and address matches the telephone number provided and directory assistance system **10** may end the call, provide a different telephone number, or default to the operator.

[0028] If at step **84** the caller wants something else besides a telephone number or a RDA look-up, track engine **36** tracks and stores the caller's utterance and then the caller is transferred to a live operator so that the operator may assist the caller with the inquiry.

[0029] If the caller wants to find a telephone number at step **84**, then at step **92** the caller is prompted for the locality of the entity for which the caller seeks the telephone number. Depending on what information number the caller calls, the caller may be prompted for both the city and state or just the city. The caller responds to the prompt for locality by speaking the city and/or state and track engine **36** tracks and stores the caller's utterance. At step **94**, directory assistance system **10** must determine if the search for the telephone number is going to initially proceed through frequency requested database ("FRL") database **22** using only a name provided by the caller or if directory assistance system **10** prompts the caller for additional information regarding the type of entity for the telephone number sought such as residential, business, or government ("RBG") before searching FRL database **22**.

[0030] FRL database **22** is a database created and maintained by directory assistance system **10**. FRL database **22** includes telephone listings that are frequently requested by callers accessing directory assistance. Directory assistance system **10** monitors the records provided to the callers and how frequently each record is requested by the callers in order to determine a frequency of request for each record. The records requested the most are stored in FRL database **22** for quick access and thereby allow directory assistance system **10** to quickly and easily provide the telephone number to the caller when the caller requests information for a record in FRL database **22**. In the embodiment shown in **FIG. 2**, FRL database **22** is located within directory assistance system **10**. In alternate embodiments, FRL database **22** may be remotely located with respect to directory assistance system **10** and accessed via a network connection.

[0031] FRL database **22** may be partitioned with respect to the record type in order to shorten search times. For example, records for businesses may be stored in one partition of FRL database **22** while records for government listings may be stored in a different partition of FRL database **22**. This allows for quicker search times when search engine **32** has the record type as one of the search terms. If search engine **32** is looking for a business listing, search engine **32** searches just the business record partition of FRL database **22** and only searches the business records in FRL database **22**. Therefore time is not wasted searching the government records when directory assistance system **10** is already aware that the caller is only interested in a telephone number for a business entity.

[0032] When records are added to FRL database **22**, directory assistance system **10** adds an indicator to each record to indicate whether the name in the record is for a

family name, a business name, a department name, or any other appropriate type of name pertaining to a telephone listing. In addition, FRL database **22** may only include business and government listing records and not residential listing records due to callers generally requesting a telephone number for a business or government entity when accessing directory assistance and infrequently requesting a residential telephone number.

[**0033**] Whether directory assistance system **10** follows the FRL route or the RBG route depends on the goals and level of caller satisfaction desired by the owner and operator of directory assistance system **10**. The RBG route allows for an additional caller prompt versus the FRL route where the additional prompt extracts from the caller if the desired telephone number is for a business, government office, or residence. With the additional information, search engine **32** has a narrower search space, a quicker search, and returned records that are more likely to correctly satisfy the search terms. For example, the caller is prompted for business, residential, or government. If the caller responds "business," then search engine **32** searches only the business partition of FRL database **22** and does search any of the government or residential records. Typically caller satisfaction decreases with each additional prompt that the caller has to respond to. Therefore the RBG route trades lower caller satisfaction for quicker and more accurate searches.

[**0034**] The FRL route, on the other hand, offers one less prompt versus the RBG route which correlates to greater caller satisfaction but less accurate searching. The FRL route prompts the caller for the desired name and begins a search for records matching the provided name without asking the caller if the name is for a business, government office, or a residence. Because the FRL route includes one less prompt than the RBG route, search engine **32** has less search terms to search with (name only and no entity type) and therefore the search space is much broader than the search space in the RBG route. For example, search engine **32** searches both the business and government partitions of FRL database **22** for the name provided by the caller. The larger search space and fewer search terms result in a greater chance of returning a returned record that does not correctly satisfy the search terms. The FRL route and RBG route allow for owners and operators of directory assistance systems to customize their directory assistance systems with respect to their callers and business goals based on caller satisfaction levels, search times, and accuracy of searches.

[**0035**] If at step **94** directory assistance system **10** follows the FRL route, then at step **96** the caller is prompted for the name of the entity for which the caller desires the telephone number. Track engine **36** stores the caller's utterance regarding the name and at step **98** search engine **32**, using the name provided by the caller as well as the locality information provided by the caller at step **92** as search terms, searches FRL database **22** for any records that satisfy the name and locality provided by the caller.

[**0036**] At step **100**, search engine **32** returns a number of records that satisfy the search the terms. The number of returned records can be zero, one, or more than one where a returned record is a record satisfying the search terms including a single name and single telephone number. If a returned record includes a name followed by departments or divisions each having a unique telephone number, then that returned record is considered as more than one returned record. For example, if a search for "Steve's Grocery" returns the following record, the returned record for "Steve's Grocery" is considered as more than one returned record because of the multiple names and telephone numbers.

Steve's Grocery	549 Bull Creek	512-555-2522
Deli		512-555-2533
Produce		512-555-2544

[**0037**] If only one record satisfies the search terms at step **100**, then at step **102** directory assistance system **10** checks to see if the returned record is on any non-publication lists and if not, provides the telephone number for the returned record to the caller. In addition to the telephone number, directory assistance system **10** may also provide the name and address of the returned record to the caller. For instance, if the caller wanted the number for "Bob's Wholesale Tools," when providing the telephone number directory assistance system **10** may provide the telephone number by stating, "The telephone number for Bob's Wholesale Tools at 2341 54th Street is 555-1475." Providing the name and address in addition to the telephone number implicitly confirms to the caller that he is receiving the correct telephone number especially in situations where the caller has not provided any address information. Furthermore, it provides assurances to the callers who are sometimes uneasy in dealing with fully automated systems because they know they are getting the correct telephone number for the right location.

[**0038**] If at step **100** search engine **32** returns more than one record satisfying the search terms, then the process continues to **FIG. 3** where directory assistance system **10** automatically disambiguates the returned records. This process is described below in greater detail with respect to **FIGS. 3, 4**, and **5**.

[**0039**] If at step **100** search engine **32** finds zero records satisfying the search terms, then search engine **32** accesses and searches one or more name databases in order to locate a name corresponding with the name provided by the caller at step **96**. The name databases include names only and do not include any telephone listing information such as telephone number or address. Such telephone information changes frequently and therefore it is very expensive to constantly update databases containing both names and telephone information. But name information changes less frequently and therefore it is relatively inexpensive to frequently update the name information in the name databases. Search engine **32** utilizes the name databases as grammars when recognition of the name supplied by the caller fails using FRL database **22**.

[**0040**] At step **104** search engine **32** accesses a database containing only business names (and not business listings) and searches for any business names satisfying the name provided by the caller at step **96**. If search engine **32** locates a business name matching the name provided by the caller, then the process proceeds to step **110**. If search engine **32** does not find any business names matching the name provided by the caller, then at step **106** search engine accesses a database containing only government names (and not government listings) and searches for any government

names that match the name provided by the caller at step **96**. If search engine **32** locates a government name that matches the name provided by the caller, then the process continues to step **110**. But if search engine **32** does not locate any government names matching the name supplied by the caller, then at step **108** search engine **32** accesses a database containing only residential names (and not residential listings) and searches for any residential names that matches the name provided by the caller. If search engine **32** locates a residential name then the process continues to step **110**. If search engine **32** does not locate a residential name that matches the name provided by the caller at step **108**, then the call defaults to a live operator where the procedure for defaulting to a live operator is described in greater detail below.

[**0041**] At step **110**, search engine **32** has located a name that matches the name provided by the caller at step **96**. Depending on the desired level of automation, at step **110** the caller may default to a live operator or continue interacting with directory assistance system **10**. If the caller switches to the live operator, then the live operator assists the caller in locating the desired telephone number and such procedure is described below.

[**0042**] If the caller does not switch to the live operator, then at step **112** search engine **32** accesses and searches D**1** database **20** using the name located at step **104**, **106**, or **108** as the search term. D**1** database **20** includes the majority of telephone listings and not just the most frequently requested listing like FRL database **22** so when a search of FRL database **22** does not return any records, a search of D**1** database **20** has a greater probability of returning a record. At step **114**, search engine **32** determines how many returned records satisfy the search term. If the search of D**1** database **20** returns no returned records, then the call defaults to the live operator and the operator assists the caller as described below. If search engine **32** locates more than one returned record, then directory assistance system **10** automatically disambiguates the returned records as described in **FIGS. 3, 4**, and **5**. If search engine **32** locates one returned record, then at step **116** directory assistance system **10** provides the telephone number to the caller in the same manner as described above so long as the returned record is not listed on a non-publication list.

[**0043**] If at step **94** directory assistance system **10** follows the RBG route, then at step **118** directory assistance system **10** prompts the caller to determine if the telephone number the caller is seeking is for a business, a residence, or a government office and the caller provides an utterance in response to the prompt. If the caller utters "business," then at step **120** directory assistance system **10** prompts the caller for the business name. If the caller utters "government," then at step **122** directory assistance system **10** prompts the caller for the government name. If the caller utters "residential," then at step **124** directory assistance system **10** prompts the caller for the first and last name of the person for whom the caller seeks the telephone number.

[**0044**] Where the caller desires a business or government number, then at step **125** search engine **32** accesses FRL database **22** and searches FRL database **22** for the business or government name provided in step **120** or **122**. At step **125** search engine **32** searches only a partition of FRL database **22**. If the caller desires a telephone number for a business, then search engine **32** searches only the business partition of FRL database **22**. If the caller desires a telephone number for a government entity, then search engine **32** searches only the government partition of FRL database **22**. If the caller seeks a residential telephone number, then the process continues to step **110** where the caller is either transferred to a live operator or remains in the automated system where search engine **32** accesses and searches D**1** database **20** at step **112** for the first and last name provided by the caller at step **124**. The caller then continues to step **114** as described above. In alternate embodiments, FRL database **22** includes telephone numbers for residential telephone numbers in addition to business and government listings and a search for the residential first and last name may also be performed in FRL database **22** at step **125** instead of D**1** database **20** at step **112**.

[**0045**] Search engine **32** searches FRL database **22** for the entity type and name provided by the caller. At step **126**, search engine **32** determines how many returned records from FRL database **22** satisfy the search terms. If search engine **32** locates zero returned records, then the process continues to step **110** as described above. If search engine **32** locates more than one returned record, then directory assistance system **10** automatically disambiguates the returned records as described with respect to **FIGS. 3, 4**, and **5**. If search engine **32** locates one returned record satisfying the search terms, then at step **128** directory assistance system **10** provides the telephone number and corresponding information to the caller unless the returned record is listed on a non-publication list.

[**0046**] **FIGS. 3, 4**, and **5** illustrate a method for automated disambiguation when search engine **32** locates more than one returned record satisfying the search terms. **FIG. 3** depicts a flow diagram of the method for automated disambiguation in greater detail. **FIG. 4** illustrates an example flow diagram of a method for automated disambiguation by record name. **FIG. 5** depicts an example flow diagram of a method for automated disambiguation by record address.

[**0047**] There are many different forms or types of records each having one or more data fields. One record type is a stand-alone or straight line record which includes a name (first and last), address, and telephone number. An example stand-alone record is "Smith, John, 1213 Main Street, 512-555-1234." For the above record, the name data field is "Smith, John" and the address data field is "1213 Main Street." More specifically, "Smith" is the Name1 data field which is for the family name on a residential record and "John" is the Name2 data field which is for the given name on a residential record. Another record type is a straight line under set record which includes both a parent record and one or more child or subordinate records where both the parent record and the child records each have a telephone number. An example straight line under set record is as follows:

Johnson Auto Mart	2715 N. Umbridge	512-555-8700
Sales		512-555-8710
Service		512-555-8720
Trucks		512-555-8730
Used Cars	2750 N. Umbridge	512-555-8740

[**0048**] where "Johnson Auto Mart" is the parent record and "Sales,""Service,", "Trucks," and "Used Cars" are the

child or subordinate records. Yet another type of record is a caption set record which includes both a parent record and one or more subordinate records but the parent record does not have a telephone number associated with it and each subordinate record does have a telephone number. An example caption set record is as follows:

Smith Foods		
Store No. 1	125 Main Street	512-555-8500
Store No. 2	7865 Pine	512-555-9514
Store No. 3	7895 N. Research	512-555-7532

[0049] The records are analyzed based on hierarchical levels. The stand-alone and parent level is referred to as Level 0. The first child or subordinate level is Level 1 and a subordinate record of a subordinate record is referred to as Level 2. Records at the same hierarchical level are referred to as peer records while peer records that have the same parent record are sibling records. At Level 0, peer records are a combination of stand-alone records and parent records. For the purposes of automated disambiguation, a threshold level or tier may need to be established whereby returned records having a hierarchy level higher than the threshold level or tier will not be subject to the automated disambiguation. For the embodiment shown in **FIG. 3**, the threshold level has been set to three levels or tiers of record hierarchy. Shown below are three sample records illustrating the three tiers of records.

Tier One
Parent
- Child 1
- Child 2
- Child 3
- Child 4

Tier Two
Parent
- Child 1
  - Subordinate 1.1
  - Subordinate 1.2
- Child 2
  - Subordinate 2.1
  - Subordinate 2.2

Tier Three
Stand-Alone 1
Stand-Alone 2
Parent 1
- Child 1.1
  - Subordinate 1.1.1
- Child 1.2
  - Subordinate 1.2.1
  - Subordinate 1.2.2

Parent 2
- Child 2.1
- Child 2.2
  - Subordinate 2.2.1
  - Subordinate 2.2.2
- Child 2.3
  - Subordinate 2.3.1

With respect to disambiguation and the three levels or tiers, disambiguation occurs first among the parent or stand-alone level, next among the child level, and last among the subordinate level. In alternate embodiments, the number of levels of record hierarchy may be less than three or more than three. The addition of a tier or level requires an additional dialogue or prompt between directory assistance system **10** and the caller and the caller's satisfaction decreases with each additional prompt because the caller is spending longer than the caller desires to spend interacting with an automated system.

[0050] For discussion of **FIGS. 3, 4**, and **5**, assume that the caller is seeking information regarding Johnson Auto Mart. Search engine **32** has performed a search of FRL database **22** and/or D1 database **20** using "Johnson Auto Mart" as the search term and returned the following returned records:

Johnson Auto Mart	2715 N. Umbridge	512-555-8700
Sales		512-555-8710
Service		512-555-8720
Trucks		512-555-8730
Used Cars	2750 N. Umbridge	512-555-8740
Johnson Auto Mart	325 E. Beanna	512-555-9600
Parts		512-555-9640
Service		512-555-9630

[0051] The automated disambiguation strategy takes into account the hierarchical structure and relationships of and among the returned records. Starting at the lowest level and continuing through successively higher levels, directory assistance system **10** and disambiguation engine **34** disambiguate among returned records either by a name field or an address field.

[0052] When automatically disambiguating between more than one returned record, disambiguation engine **34** first determines which one of the stand-alone and parent (Level 0) records is desired by the caller. If the caller's target is a parent record having more than one child record, disambiguation engine **34** then selects the child and finally the child's subordinate record if there is one.

[0053] Disambiguation engine **34** attempts to disambiguate a set of returned records by the name field provided each of the returned records have a name and that name is unique. If each name is not unique, then disambiguation engine **34** disambiguates the returned records using the address data field using street name or street name and building number if each street name is not unique. Returned records where the name data field identifies the entity only by store number are not used so that disambiguation would first be by address.

[0054] When search engine **32** returns more than one returned record at step **100**, **114**, or **126**, the process continues to step **150** with automated disambiguation. At step **150**, disambiguation engine **34** takes the hierarchical level of the topmost record as the initial level (Level 0) on which to disambiguate returned records. For example, disambiguation engine **34** takes "Johnson Auto Mart" as Level 0. In addition, disambiguation engine **34** also checks each returned record to see if any telephone numbers are flagged as the main telephone number. At step **152**, disambiguation engine **34** scans each of the returned records in order to determine if the first returned record stands alone or has peers. If there is more than one record at this level, then the process continues to step **154** where the loop count is incremented by one. For example, there are two returned records at Level 0 so the process continues to step **154**. If search engine **32** had only returned the first Johnson Auto Mart record, then at step **152** the process would continue to

step **158**. At step **156** disambiguation engine **34** checks to see if the loop count exceeds four and if it does, the call defaults to a live operator. But if the loop count does not exceed four, then the process continues to step **160**.

[**0055**] At step **160**, disambiguation engine **34** checks each returned record for particular record information and if found, omits the particular record information from the returned record. For example, disambiguation engine **34** removes from the returned records listings within the returned records such as "Fax No.,""If No Answer Dial,""If Busy Dial,""Toll-Free Dial," or any other appropriate extra listing information. Disambiguation engine **34** checks each record for professional designation or name information that indicates a medical or emergency response personnel or facility and does not omit the above telephone numbers for those records. At step **162** disambiguation engine **34** determines if omitting returned record information at step **162** reduces the number of returned records to one. If the number of records is reduced to one at step **162**, then disambiguation engine **34** selects the remaining returned record at step **164** and the process continues to step **158**.

[**0056**] If the number of returned records is not reduced to one at step **162**, then at step **166** disambiguation engine **34** checks each returned record to determine if each returned record has a name in the name data field. If each returned record does not have a name in the name data field, then the process continues to step **184**. If each returned record does have a name, then at step **168** disambiguation engine **34** checks to see what hierarchical level the returned records are at. If the level is Level 0, then the process continues to step **172**. Given the example of Johnson Auto Mart, the hierarchical level is Level 0. If the level is greater than Level 0, the process continues to step **170** where disambiguation engine **34** checks each name to determine if the name is an allowable name for disambiguation. Some records include in the name data field a "Store No. XX" or "No. XX" as the name and since generally most callers do not know individual store numbers, it would not be very helpful to the caller to disambiguate by store number. Therefore if the name data fields contain non-allowable names such as "Store No.," the process continues to step **184** where disambiguation engine **34** disambiguates the returned records using address or department information.

[**0057**] When all names are allowable, at step **172** disambiguation engine **34** determines if the name in the name data field is unique for each returned record. If each name is unique, then disambiguation engine **34** proceeds to disambiguate using the name data field as shown in **FIG. 4**. If each record does not have a unique name at step **172**, as with Johnson Auto Mart, then the process continues to step **174** where disambiguation engine **34** checks the returned records having identical names in order to determine if the returned records having identical names are duplicate records. If the returned records having identical names are duplicate records, then disambiguation engine **34** retains the first record and discards all other duplicate records. For Johnson Auto Mart the returned records are not duplicative because even though the records have the same name, the records have different addresses and different phone numbers. At step **176**, disambiguation engine **34** checks the number of returned records to determine if the duplicative actions taken at step **174** have reduced the number of returned records to one. If the number of returned records is reduced to one, then at step **180** disambiguation engine **34** selects the remaining returned record and the process continues to step **158**.

[**0058**] If there are still more than one returned records at step **176**, at step **178** disambiguation engine **34** checks again to see if the returned records each have a unique name. If the returned records have unique names, then the process continues to **FIG. 4** where disambiguation engine **34** disambiguates using the name data field. With Johnson Auto Mart the returned records do not have unique names so the process continues to step **182** where disambiguation engine **34** determines if any name occurs more than once among the current set of returned records. If there is more than one name at step **182**, then disambiguation engine **34** disambiguates among the returned records using the name data field as shown in **FIG. 4**.

[**0059**] For Johnson Auto Mart there is not more than one name at step **182**, so the process continues to step **184** where disambiguation engine **34** checks each returned record to determine if each returned record has an address. If each returned record does not have an address, then at step **184** the call defaults to a live operator. But if each returned record has an address, then at step **186** disambiguation engine **34** determines if each returned record has a unique address. Disambiguation engine **34** determines if each address is unique by looking at both the street name and building number of the address data field. For Johnson Auto Mart, each returned record has a unique address because one Johnson Auto Mart is located at 2715 N. Umbridge and the other one is located at 325 Beanna. Therefore, the process continues to step **194** of **FIG. 5**. If the returned records do not have unique addresses at step **186**, then at step **188** disambiguation engine **34** checks each returned record to determine if the returned records having the same address are duplicates and can therefore be eliminated as was done above with respect to duplicate names. At step **190** disambiguation engine **34** determines the number of returned records remaining after eliminating any duplicate returned records if only one returned record is left, disambiguation engine **34** selects that returned record at step **192**. If at step **190** more than one returned record remains, then the process continues to step **194** of **FIG. 5**.

[**0060**] At step **194** disambiguation engine **34** loads one or more grammars for speech recognition into directory assistance system **10** for the locations for each returned record at the current hierarchical level. The grammars allow for an ASR engine to recognize the correct response to a prompt provided by the caller. For instance, if the caller is to select a business on Elm Street or Main Street by speaking the desired street name, the grammars allow the ASR engine to determine if the caller utters "Elm" or "Main." Disambiguation engine **34** checks each of the returned records for a main number at step **196** and if disambiguation engine **34** locates a main number, the phrase "main number" is also added to the grammars at step **198** so that the ASR engine will correctly recognize "main number" if the caller requests the main telephone number.

[**0061**] Disambiguation engine **34** begins playing the disambiguation prompts to the caller at step **200**. At step **200**, disambiguation engine **34** checks the number of returned records at the current hierarchical level and at step **202** checks to determine if the returned records are on the same street or are on different streets. If the returned records are

on different streets, then at step **206** disambiguation engine **34** checks the hierarchical level and proceeds to step **208** if the hierarchical level is Level 0 or Level 1. If the returned records are on the same street, then at step **204** disambiguation engine **34** plays a prompt and the caller hears a prompt such as, "There are two locations on Main Street." If the returned records are on different streets, as with Johnson Auto Mart, then at step **208** disambiguation engine **34** plays a prompt and the caller hears, "There are two locations for Johnson Auto Mart." At step **210** if the caller provides any response or utterance other than an affirming response ("Yes") to the playing of the entity name, here Johnson Auto Mart, the call defaults to a live operator.

[**0062**] After step **204** and if the caller is silent or affirms at step **210**, the process continues to step **212** where disambiguation engine **34** determines the number of returned records to disambiguate. How disambiguation engine **34** presents and disambiguates the returned records to the caller depends on the number of returned records using a low threshold and a high threshold. In the embodiment shown in **FIG. 5** (as well as **FIG. 4**), the high threshold is set at five returned records and the low threshold is set at two or three returned records. Switch **214** allows disambiguation engine **34** to vary the low threshold. In the example embodiment disambiguation engine **34** can vary the low threshold between two and three. In alternate embodiments, the high threshold may be higher or lower than five and the low threshold maybe lower than two or higher than three.

[**0063**] If there are more than five returned records at step **212**, then disambiguation engine **34** prompts the caller for additional information at step **216**. Since disambiguation is occurring by address, at step **216** disambiguation engine **34** prompts the caller for the street name for the listing the caller is desiring. For example, if there are six listings for Bob's Wholesale Tools and the caller wants the telephone number for the location on Elm Street, at step **216** disambiguation engine **314** prompts the caller for the street name and the caller responds with "Elm Street." At step **218** disambiguation engine **34** receives the additional information from the caller utilizing speech recognition and at step **220** determines if the street name provided by the caller is a unique location corresponding with one of the returned records.

[**0064**] If the street provided by the caller is unique, then disambiguation engine **34** selects the returned record having the street name matching the street name provided by the caller at step **192**. If the street name provided by the caller is not a unique location among the returned records, then the process returns to step **194** and the steps following step **194** are repeated with respect to the street name provided by the caller until there is a successful disambiguation or until the call defaults to the operator. If the street name provided by the caller at step **218** does not match any of the street names of the returned records, the process continues to step **222** where disambiguation engine **34** checks to see if there is a main telephone number. If there is a main telephone number, disambiguation engine **34** provides the main telephone number to the caller at step **224** so long as the main telephone number is not on a non-publication list. If there is not a main telephone number at step **222**, then the call defaults to a live operator.

[**0065**] If the number of returned records at step **212** is between the low threshold and the high threshold, then at step **226** disambiguation engine **34** provides to the caller a pick list of the locations that were loaded in the grammar. Disambiguation engine **34** plays a prompt listing the name and address for each returned record and prompts the caller to pick the desired returned record when the caller hears it by saying "that one." The caller picks the desired returned record at step **228**. If the caller hears the desired returned record in the pick list, the process continues to step **192** where disambiguation engine **34** selects the returned record selected by the caller at step **228**. If the caller does not hear the desired returned record in the pick list, the call defaults to a live operator.

[**0066**] For instance, if there are four returned records for John Smith, disambiguation engine **34** plays the following pick list for the caller: "There are four locations for John Smith. When you hear the one you want, say 'that one:' on Cedar {pause}, on Shoal Creek {pause}, on 30th Street {pause}, or on Congress {pause}." If the caller wants John Smith on Cedar, then after the caller hears "John Smith on Cedar" the caller says "that one" and does not hear the rest of the choices in the pick list. The caller may also say "on Cedar" or "the first one" instead of "that one."

[**0067**] If the number of returned records at step **212** is below the low threshold, then at step **230** disambiguation engine **34** provides the caller a direct choice. For the Johnson Auto Mart example, disambiguation engine **34** plays the following prompt: "Do you want the one on Umbridge or on Beanna" and the caller responds with either "Umbridge" or "Beanna." At step **232** the caller selects the desired returned record by stating the street name of the one the caller wants. When the caller correctly selects a returned record, disambiguation engine **34** selects that returned record at step **192**. For example, the caller is looking for the phone number for the Johnson Auto Mart on Umbridge so in response to the prompt, the caller says "Umbridge" and disambiguation engine **34** selects the returned record for Johnson Auto Mart on Umbridge. If the caller does not hear the location that the caller desires or the caller is not aware of more than one location and therefore does not know which location to pick at step **232**, then at step **222** disambiguation engine **34** checks to see if there is a main telephone number and provides the main telephone number to the caller at step **224**. Since there is no main telephone number for Johnson Auto Mart, if the caller fails the disambiguation at step **232**, the call defaults to a live operator at step **222**.

[**0068**] Once disambiguation engine **34** selects a returned record, the process returns to step **158**. At step **158** disambiguation engine **34** determines if the selected returned record includes any subordinate records. If the returned record has no subordinate records, then the process continues to step **234**. But if the returned record has one or more subordinate records, as with Johnson Auto Mart on Umbridge, the process continues to step **236** where disambiguation engine **34** determines if the parent record has an associated telephone number. If the parent record does not have a telephone number, then the process continues to step **242**. If the parent record has a telephone number, as with Johnson Auto Mart, then at step **238** disambiguation engine **34** determines if a main telephone number has already been flagged for the selected returned record. If no main number

has been flagged, then at step **240** disambiguation engine **34** flags the telephone number of the parent record as the main number.

[**0069**] Once the main telephone number has been identified and/or flagged, at step **242** disambiguation engine **34** increments the hierarchical level one level, in this example to Level 1, and at step **244** disambiguation engine **34** determines if there are more than one records at hierarchical Level 1. If there is only one record at this hierarchical level, then at step **246** disambiguation engine **34** selects this returned record and the process returns to step **158**. If there is more than one record at step **244**, as with Johnson Auto Mart, then at step **248** disambiguation engine **34** determines if each of the subordinate records at this level have the same telephone number. If the subordinate records all the have the same telephone number, then disambiguation engine **34** flags the subordinate records as having the same telephone number and the process continues to step **234**. If at step **248** the subordinate records do not have the same telephone number, then the loop count is incremented and checked at steps **154** and **156** and the process continues to step **160** where step **160** through step **166** are repeated as described above.

[**0070**] For Johnson Auto Mart on Umbridge, disambiguation engine **34** determines that all the returned records have names at step **166**, the names are allowable at step **170**, and that the names are all unique at step **172**. Since the names are all unique at step **172**, the process continues to step **252** and **FIG. 4**.

[**0071**] At step **252** disambiguation engine **34** determines the current hierarchical level. If the current level is Level 0, then at step **256** disambiguation engine **34** loads the grammar with the names and the addresses for the peer returned records. If the current level is Level 1, as with Johnson Auto Mart, disambiguation engine **34** loads the grammar with only the names of the peer returned records at hierarchical Level 1 at step **254**. At step **258** disambiguation engine **34** checks for a main telephone number and adds the phrase "main number" to the grammars at step **260** if there is a main telephone number. There is a main telephone number for Johnson Auto Mart which is flagged as the main telephone number at step **240**.

[**0072**] Disambiguation engine **34** again determines the hierarchical level at step **262** and if the level is not Level 0, disambiguation engine **34** checks for any indicators in the name data field of the returned records at step **264**. The "Sales,""Service," Trucks," and "Used Cars" names include department indicators with respect to the name data field so that at step **266** disambiguation engine **34** plays the following prompt to the caller: "There are four departments listed." The name field indicator allows disambiguation engine **34** to know whether the returned records are for department names, individuals first or last names, business names, or any other appropriate name indication. Because the name indicator is department for Johnson Auto Mart, disambiguation engine **34** uses "department" in the prompt at step **266**. Because the loop count is greater than one and the caller has already been through one disambiguation to select the location and is aware of the returned record entity name, there is no need to provide the entity name at step **270**.

[**0073**] Once disambiguation engine **34** plays the prompt and as long as the caller does not respond (implicit confirmation) or affirms ("Yes"), the process continues to step **272**. If the caller negates ("No") or says anything else (out of grammar) which would cause directory assistance system **10** to look up a wrong listing, the call defaults to a live operator.

[**0074**] At step **272**, disambiguation engine **34** determines the number of returned records and disambiguates in the same manner as described with respect to steps **212** through **232**. If the number of returned records is below the low threshold determined using switch **275**, then at step **274** disambiguation engine **34** provides the caller a direct choice between the returned records. If the caller hears the desired returned record at step **274** and successfully selects it at step **276**, then disambiguation engine **34** selects the desired returned record at step **193**. If the caller does not successfully select the desired returned record at step **276**, then at step **278** disambiguation engine **34** checks for a main telephone number and provides the main telephone number to the caller at step **280** if there is a main telephone number or defaults to a live operator if there is not a main telephone number.

[**0075**] If the number of returned records at step **272** is greater than the high threshold, then at steps **282** and **284** disambiguation engine **34** requests additional information from the caller in order to determine which returned record is desired by the caller. If the caller provides additional information (such as one of the names loaded in the grammar) that allows disambiguation engine **34** to determine which returned record is desired by the caller at step **284**, then disambiguation engine **34** selects the desired returned record at step **193**. If the caller does not provide additional information that allows disambiguation engine **34** to select the desired returned record at step **284**, disambiguation engine **34** checks for a main telephone number at step **278** and provides the main telephone number if there is one at step **280** or defaults to a live operator if there is not a main telephone number.

[**0076**] If the number of returned records is between the low and the high threshold, then disambiguation engine **34** provides a pick list based on the names that were loaded in the grammar. At step **286** disambiguation engine **34** plays each name followed by a pause. The pause allows for time for the caller to select the desired returned record. For Johnson Auto Mart for example, disambiguation plays the following prompt: "When you hear the one you want, say 'that one:' Sales {pause}, Service {pause}, Trucks {pause}, or Used Cars {pause}." At step **288** the caller responds with "that one" when the caller hears the department that the caller is interested in. If the caller wants the telephone number for service, then after the caller hears "Service," the caller says "that one,""Service," or "the second one." Disambiguation engine **34** recognizes the caller's response and selects the returned record at step **193** correlating to the caller's response. If the caller does not successfully pick a returned record from the pick list, the call defaults to a live operator.

[**0077**] Once disambiguation engine **34** selects the desired returned record at step **193**, the process returns to step **158** where disambiguation engine **34** determines if the selected returned record has any subordinate records. If the caller desired the number for the Service Department at Johnson Auto Mart then that returned record has no subordinate records and the process continues to step **234**.

[0078] At step **234**, disambiguation engine **34** determines if there is a parent record for the selected returned record and if so, if the parent record is flagged as the main telephone number. With Johnson Auto Mart, the parent record is flagged as the main telephone number so at step **290** disambiguation engine **34** checks if all the subordinate records have the same telephone number. If the subordinate records all have the same telephone number, disambiguation engine **34** offers the caller the main number at step **292** and plays the main telephone number for the caller (if not on a non-publication list) at step **294** if the caller responds that he wants the main telephone number. If the caller does not want the main telephone number at step **292**, then disambiguation engine **34** provides the telephone number selected at step **193** to the caller at steps **296** and **298**.

[0079] If at step **290** the subordinate records do not have the same telephone number, as with Johnson Auto Mart, then at step **300** disambiguation engine **34** determines if the number of subordinate records is greater than one. If there are more than one subordinate records at step **300**, then at step **302** disambiguation engine **34** provides the telephone number to the caller for the returned record selected at step **193** as long the returned record is not on a non-publication list. If there is only one subordinate record at step **300**, at step **304** disambiguation engine **34** offers the caller the option of the main telephone number or the telephone number for the one subordinate record. If the caller wants the main telephone number, disambiguation engine **34** plays the main telephone number at step **306** so long as it is not on a non-publication list. Disambiguation engine **34** plays the subordinate record telephone number at step **302** if the caller does not want the main telephone number at step **304**.

[0080] The disambiguation process occurs instantaneously with respect to the caller. When the caller calls directory assistance and states that he wants the number for Johnson Auto Mart, the next prompt the caller hears is "There are two locations for Johnson Auto Mart. Do you want the one on Umbridge or on Beanna?" When the caller responds "Umbridge," the next prompt the caller hears is "There are four departments listed. When you hear the one that you want, say 'that one:' Sales {pause}, Service {pause}, Trucks {pause}, or Used Cars {pause}." The caller responds "that one" after hearing "Service" and the next prompt the caller hears is "The telephone number for the Service department for Johnson Auto Mart on 2715 N. Umbridge is 512-555-8720." When providing the desired telephone number and corresponding location, the building number for the location may be included if there are two or more locations on the same street.

[0081] Despite the ease of use of directory assistance system **10** and the automated disambiguation strategy, there are instances when a caller experiences difficulty in dealing with directory assistance and needs the assistance of a live operator. Directory assistance system **10** incorporates automated procedures for defaulting to a live operator when a caller experiences particular errors within directory assistance.

[0082] Throughout all the process described above, track engine **36** tracks and stores in database **24** each utterance spoken by the callers interacting with directory assistance. In addition, error engine **38**, in association with track engine **36**, determines when an utterance spoken by the caller initiates an error condition. Upon the occurrence of the error condition, error engine **38** puts the caller on hold, connects to a live operator, plays for the operator the utterance causing the error condition (the error utterance) and the utterance preceding the error utterance (the preceding utterance), and then the operator is connected to the caller.

[0083] As shown in **FIGS. 3, 4**, and **5**, there are instances when the caller fails to successfully respond to a disambiguation prompt and the call defaults to the operator. In addition to those instances, error engine **38** also allows for the call to default to the operator when the caller fails to successfully reply to any prompt at any stage within directory assistance.

[0084] Directory assistance system **10** utilizes speech recognition to interact with the callers. When a caller provides input using speech, the speech recognition software recognizes the caller's utterance with a certain degree or level of confidence. Caller's utterances can be recognized with a high level of confidence, a medium level of confidence, and a low level of confidence. Unique methods may be used to establish and maintain the threshold levels for what is the high confidence level, the medium confidence level, and the low confidence level. Callers' utterances recognized with a medium or low level of confidence may be enough for error engine **38** to transfer the callers to the operator. When track engine **36** tracks and stores each utterance, track engine **36** may also store the confidence level with which the utterance was recognized.

[0085] When the caller provides an utterance, track engine **36** stores the utterance in database **24** and error engine **38** monitors the utterance to determine if the utterance causes an error condition. An error condition is an event causing an error in interacting with directory assistance and results in the caller transferring to a live operator. Error engine **38** has different requirements for what types of caller utterances will cause an error condition and caller utterances in response to a prompt may be in error for different reasons. For example, a caller might say nothing in response to a prompt (TO—no speech time out), begin speaking before the prompt is done playing (STE—spoke too early), speak for so long that there is too much speech for the speech recognition software to recognize (TMS—too much speech), say something that the speech recognition software cannot understand (OOG—out of grammar), or try to respond using touch-tone input instead of speaking (TTD—touch tone digit). An error condition occurs on the occurrence of any permutation of two TO or STE results or on the single occurrence of a TMS, a TTD, or an OOG result. For example, directory assistance system **10** prompts the caller for residential, business, or government and the caller presses buttons trying to spell business in response to the prompt. Error engine **38** recognizes this as a TTD result and defaults the caller to the operator. In alternate embodiments, additional events or conditions as well as various permutation and numbers of errors may cause an error condition.

[0086] When the caller satisfies an error condition either as described above or within the disambiguation process as shown in **FIGS. 3, 4**, and **5**, at step **130** error engine **38** populates operator screen **30** with the caller's utterances spoken before the error utterance that were recognized with high confidence. For example, at step **120** directory assistance system **10** cannot understand the caller's utterance in response to the prompt for business name. Error engine **38**

recognizes this as a condition satisfying an error condition and therefore transfers the caller to the operator. But prior to the error at step **120**, the caller had successfully interacted with directory assistance system **10** and provided locality information at step **92** and "business" at step **118**. Track engine **36** stored the caller's utterance to the locality prompt and the RBG prompt. Error engine **38** accesses database **24** and populates city field **40** and state field **42** with the information provided by the caller's utterances. Because the caller had made it to step **120** in the automated system, all the caller's utterances up to the error had to have been recognized with a high confidence level. By populating operator screen **30** with information from the caller's utterances recognized with high confidence, the operator knows some of what the caller is seeking and does not have to ask the caller to repeat what the caller has already successfully provided.

[**0087**] In addition to populating operator screen **30** with information from the utterances recognized with high confidence, at step **132** error engine **38** plays to the operator the preceding utterance, which was recognized with high confidence and no error, and the error utterance causing the error condition. Playing of both the error utterance and the preceding utterance allows the operator to understand the intention of the caller's inquiry and where the inquiry went wrong without having to re-ask the caller numerous questions the caller may have already answered.

[**0088**] Error engine **38** does not provide the immediately preceding utterance if the preceding utterance is a generic utterance. A generic utterance is an utterance that has little meaning to the operator outside of the prompt to which the generic utterance was in response to. Generic utterances include such utterances as "that one, "yes,", or "no" when following a pick list or a "which one" prompt or in response to a confirmation prompt. When the immediately preceding utterance is a generic utterance, error engine **38** omits the generic utterance and plays to the operator the error utterance and the most immediately preceding utterance that is not a generic utterance. For instance, the caller is prompted for the locality and responds "Austin." The following prompt asks the caller to say "yes" if Austin is the desired locality. The caller says "yes" and the caller is prompted for business, residential, or government. The caller responds "I need a plumber." The caller's response to the RBG prompt is in error and the "I need a plumber" utterance is the error utterance. The utterance preceding the error utterance is "yes" but since that is a generic utterance, error engine **38** goes back one utterance to "Austin" and plays to the operator: "Austin. I need a plumber."

[**0089**] For an error condition occurring during disambiguation for a pick list, error engine **38** populates operator screen **30** with the search terms provided by the caller and omits and does not play for the operator the "that one" utterance in response to the pick list because it would be meaningless to the operator. For a default during disambiguation for either a direct choice or a request for additional information, error engine **38** populates operator screen **30** with the search terms and plays the error utterance and preceding utterance because both of those utterances will have meaning to the operator since those utterances will not be generic utterances.

[**0090**] In addition to omitting generic utterances, error engine **38** can also combine two utterance into one utterance for operator playback purposes. For example, a prompt may ask for the city, and another prompt for the state. The caller replies with two utterances—one for the city and one for the state. If the both the city and state utterances are recognized with high confidence and no error, then error engine **38** may combine the city and state utterances into one utterance when playing back utterances to the operator on the occurrence of an error condition. For example, the caller is prompted for the city and replies "Austin" and is prompted for the state and replies "Texas." The caller is next prompted for the name and the caller replies "business." The error utterance is "business" and error engine **38** combines the "Austin" utterance with the "Texas" utterance into one utterance and plays "Austin, Texas, Business" to the operator.

[**0091**] In addition to city and state utterances, error engine **38** may also combine a first name utterance and a last name utterance into a single utterance for playback to the operator. For instance, if the caller provides the last name and then the first name in two separate utterances and then an error occurs on the next utterance, error engine **38** plays to the operator the combined first and last name as the preceding utterance.

[**0092**] Before error engine **38** begins to play the error utterance and the preceding utterance to the operator, error engine **38** plays a first tone to the operator to alert the operator that the error utterance and the preceding utterance are preparing to play. Error engine **38** plays a second tone when the error utterance and the preceding utterance finish playing and when error engine **38** is preparing to bring the caller online with the operator. The second tone signals the operator to begin speaking with the caller so that caller does not think the line is dead and therefore hangs up.

[**0093**] Once error engine **38** populates operator screen **30** and plays the error utterance and the preceding utterance for the operator, at step **134** the caller is brought online with the operator and the operator and caller continue the dialogue that the caller started with the automated directory assistance. Before error engine **38** connects the caller to the operator, error engine **38** highlights the information fields **40-52** in operator screen **30** that error engine **38** populated with information from the caller's utterances. Error engine **38** also highlights the information fields **40-52** in operator screen **30** that need to be filled in with information from the caller before the operator can perform a search for the desired returned record and telephone number. Therefore, the operator immediately knows what additional information to elicit from the caller. The populated operator screen **30** allows the operator to know what questions the caller has already answered and prevents the operator from asking the caller to repeat answers which callers typically hate to do. In addition, playing the error utterance and the preceding utterance allows the operator to know what the caller is trying to accomplish and where the caller ran into trouble. Because the operator knows all this before the caller connects with the operator, less time is required in the caller/operator dialogue because the operator knows exactly what questions to ask and does not have to repeat any questions that have already been successfully answered.

[**0094**] When the operator has gathered from the caller all the necessary information to perform a search, at step **136** the operator access and searches D**1** database **20** and locates zero or one or more returned records. If the operator locates

more than one returned record matching the search terms, the operator manually disambiguates at step **138** by asking the caller additional questions and the caller selects the desired returned record. Once the caller has selected the desired returned record, at step **140** the operator provides the telephone number to the caller as long as the returned record is not on a non-publication list.

[**0095**] For example, when a caller calls directory assistance wanting the number for Auto Tech, the caller is prompted for city locality and the caller responds "Austin." Track engine **36** stores "Austin" in database **24**. The caller is prompted for state locality, the caller replies "Texas," and track engine **36** stores "Texas" in database **24**. The caller is then prompted for business, residential, or government, the caller replies "business," and track engine **36** stores "business." The caller is prompted for the business name, the caller replies "Auto Tech," track engine **36** stores "Auto Tech," and search engine **32** locates two returned records for Auto Tech—one on Main Street and the other on Elm Street. The caller is offered a direct choice between "Main" and "Elm" and the caller responds with "Oak Street." Error engine **38** recognizes "Oak Street" as an error utterance and defaults the caller to the operator. But before the caller connects with the operator, error engine **38** plays to the operator "Auto Tech. Oak Street" and populates city field **40** with "Austin," state field **42** with "Texas," and business name field **48** with "Auto Tech." Once the utterances have played and operator screen **30** populated, the operator begins speaking with the caller and assisting the caller with locating the desired telephone number.

[**0096**] Although the present invention has been described in detail, it should be understood that various changes, substitutions and alterations can be made hereto without the parting from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A method for the automated disambiguation of directory assistance search results utilizing speech recognition, the method comprising:

prompting a caller for at least one search term;

searching one or more databases for the search terms, the databases including a plurality of records;

returning a number of the records that satisfy the search terms;

determining if each of the returned records has a unique name data field;

automatically differentiating between the returned records based on each of the unique name data fields;

automatically differentiating between the returned records based on an address data field when each returned record does not have a unique name data field;

providing a direct choice between the returned records when the number of returned records is below a low threshold;

providing a pick list of the returned records when the number of returned records is between the low threshold and a high threshold;

requesting additional information when the number of returned records is above the high threshold;

defaulting to an operator when the database search returns no returned records;

determining if the returned record is included in a non-publication list before providing the returned record to the caller; and

providing a telephone number to the caller corresponding with a returned record selected by the caller.

2. A method for the automated disambiguation of search results, the method comprising:

searching one or more databases for one or more search terms, the databases including a plurality of records;

returning a number of the records that satisfy the search terms;

automatically differentiating between the returned records based on one or more data fields within each returned record;

providing a direct choice between the returned records when the number of returned records is below a low threshold;

providing a pick list of the returned records when the number of returned records is between the low threshold and a high threshold; and

requesting additional information when the number of returned records is above the high threshold.

3. The method of claim 2 further comprising defaulting to an operator when the database search returns no returned records.

4. The method of claim 3 wherein defaulting to the operator comprises populating an operator screen with one or more utterances provided by a caller.

5. The method of claim 2 further comprising prompting one or more callers for the search terms.

6. The method of claim 2 wherein the database comprises a frequently requested listings database.

7. The method of claim 2 wherein the database comprises a D**1** database.

8. The method of claim 2 wherein automatically differentiating between the returned records comprises determining if each of the returned records has a unique name data field.

9. The method of claim 8 wherein automatically differentiating between the returned records comprises differentiating between the returned records based on each of the unique name data fields.

10. The method of claim 8 wherein automatically differentiating between the returned records comprises differentiating between the returned records based on an address data field when each of the returned records does not have a unique name data field.

11. The method of claim 2 further comprising searching a D**1** database if a search of a frequently requested listings database returns no returned records.

12. The method of claim 2 further comprising utilizing an automated speech recognition system to gather the search terms and provide the returned records.

13. The method of claim 2 wherein automatically differentiating between the returned records comprises determining if each of the returned records includes one or more subordinate records.

14. The method of claim 2 further comprising providing to a caller a telephone number corresponding to a returned record satisfying the search terms.

15. The method of claim 14 wherein providing a telephone number comprises providing to the caller a name and an address corresponding to the telephone number.

16. The method of claim 2 wherein providing a direct choice between the returned records comprises:

individually identifying each of the returned records; and

prompting a caller to directly choose one of the identified returned record.

17. The method of claim 2 wherein providing a pick list of the returned records comprises:

providing a list of the returned records; and

prompting a caller to select a desired returned record from the list of the returned records when the caller hears the desired returned record.

18. The method of claim 2 wherein requesting additional information comprises prompting the caller to provide one or more additional search terms in order to further limit the returned records.

19. The method of claim 2 further comprising determining if the returned record is included in a non-publication list before providing the returned record to a caller.

20. A system for the automated disambiguation of search results, the system comprising:

one or more databases including a plurality of records;

a search engine associated with the databases, the search engine operable to search one or more of the databases for one or more search terms; and

a disambiguation engine associated with the search engine, the disambiguation engine operable to differentiate between one or more returned records satisfying the search terms and automatically disambiguate the returned records based on the number of returned records.

21. The system of claim 20 wherein the disambiguation engine provides a direct choice between the returned records when the number of returned records is below a low threshold.

22. The system of claim 20 wherein the disambiguation engine provides a pick list of the returned records when the number of returned records is between a low threshold and a high threshold.

23. The system of claim 20 wherein the disambiguation engine requests additional information when the number of returned records is above a high threshold.

24. The system of claim 20 wherein the database comprises a frequently requested listings database.

25. The system of claim 20 wherein the database comprises a D1 database.

26. The system of claim 20 wherein the disambiguation engine is further operable to determine if each of the returned records has a unique name data field.

27. The system of claim 26 wherein the disambiguation engine differentiates between the returned records based on each of the unique name data fields.

28. The system of claim 26 wherein the disambiguation engine differentiates between the returned records based on an address data field when each of the returned records does not have a unique name data field.

29. The system of claim 20 wherein the search engine searches a D1 database if the search engine locates no returned records satisfying the search terms in a frequently requested listings database.

30. The system of claim 20 wherein the disambiguation engine is further operable to provide to a caller a telephone number for a returned record satisfying the search terms.

31. The system of claim 20 wherein the search engine is further operable to default to an operator when the search engine locates no returned records satisfying the search terms.

32. The system of claim 20 wherein the disambiguation engine determines if each of the returned records includes one or more subordinate records.

33. The system of claim 20 wherein the disambiguation engine determines if the returned record is included in a non-publication list before providing the returned record to a caller.

34. Software for automating disambiguation of search results, the software embodied in a computer-readable medium and operable to:

search one or more databases for one or more search terms, the databases including a plurality of records;

return a number of the records that satisfy the search terms;

automatically differentiate between the returned records based on one or more data fields within each returned record;

provide a direct choice between the returned records when the number of returned records is below a low threshold;

provide a pick list of the returned records when the number of returned records is between the low threshold and a high threshold; and

request additional information when the number of returned records is above the high threshold.

35. The software of claim 34 further operable to default to an operator when the database search returns no returned records.

36. The software of claim 35 wherein defaulting to the operator comprises populating an operator screen with one or more utterances provided by a caller.

37. The software of claim 34 further operable to prompt one or more callers for the search terms.

38. The software of claim 34 wherein the database comprises a frequently requested listings database.

39. The software of claim 34 wherein the database comprises a D1 database.

40. The software of claim 34 wherein automatically differentiating between the returned records comprises determining if each of the returned records has a unique name data field.

41. The software of claim 40 wherein automatically differentiating between the returned records comprises differentiating between the returned records based on each of the unique name data fields.

42. The software of claim 40 wherein automatically differentiating between the returned records comprises differentiating between the returned records based on an address data field when each of the returned records does not have a unique name data field.

43. The software of claim 34 further operable to search a D**1** database if a search of a frequently requested listings database returns no returned records.

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