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This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (c).

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□ *Additional inventors are being named on page 2 attached hereto*

TITLE OF THE INVENTION (280 characters max)

SEARCH-ON-THE-FLY WITH MERGE FUNCTION

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ENCLOSED APPLICATION PARTS *(check all that apply)*

☒ Specification	*Number of Pages*	**38**	□ Small Entity Statement
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METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT *(check one)*

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The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government.

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□ Yes, the name of the U.S. Government agency and the Government contract number are: ____________

Respectfully submitted,

SIGNATURE John K. Harrop

Date August 24, 2000

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SEARCH-ON-THE-FLY WITH MERGE FUNCTION

Related Applications

This application is a continuation-in-part of Application Serial Number 09/513,340, filed February 25, 2000, entitled Search-On-The-Fly/Sort-On-The-Fly Search Engine, which is hereby incorporated by reference.

Technical Field

The technical field is information management systems, interfaces, and mechanisms, and methods for searching one or more databases.

Background

In the most general sense, a database is a collection of data. Various architectures have been devised to organize data in a computerized database. Typically, a computerized database includes data stored in mass storage devices, such as tape drives, magnetic hard disk drives and optical drives. Three main database architectures are termed hierarchical, network and relational. A hierarchical database assigns different data types to different levels of the hierarchy. Links between data items on one level and data items on a different level are simple and direct. However, a single data item can appear multiple times in a hierarchical database and this creates data redundancy. To eliminate data redundancy, a network database stores data in nodes having direct access to any other node in the database. There is no need to duplicate data since all nodes are universally accessible. In a relational database, the basic unit of data is a relation. A relation corresponds to a table having rows, with each row called a tuple, and columns, with each column called an attribute. From a practical standpoint, rows represent records of related data and columns identify individual data elements. The order in which the rows and columns appear in a table has no significance. In a relational database, one can add a new column to a table without having to modify older applications that access other columns in the table. Relational databases thus provide flexibility to accommodate changing needs.

All databases require a consistent structure, termed a schema, to organize and manage the information. In a relational database, the schema is a collection of tables. Similarly, for each table, there is generally one schema to which it belongs. Once the schema is designed, a tool, known as a database management system (DBMS), is used to build the database and to operate on data within the database. The DBMS stores, retrieves and modifies data associated with the database. Lastly, to the extent possible, the DBMS protects data from corruption and unauthorized access.

A human user controls the DBMS by providing a sequence of commands selected from a data sublanguage. The syntax of data sublanguages varies widely. The American National Standards Institute (ANSI) and the International Organization for Standardization (ISO) have adopted Structured English Query Language (SQL) as a standard data sublanguage for relational databases. SQL comprises a data definition language (DDL), a data manipulation language (DML), and a data control language (DCL). The DDL allows users to define a database, to modify its structure and to destroy it. The DML provides the tools to enter, modify and extract data from the database. The DCL provides tools to protect data from corruption and unauthorized access. Although SQL is standardized, most implementations of the ANSI standard have subtle differences. Nonetheless, the standardization of SQL has greatly increased the utility of relational databases for many applications.

Although access to relational databases is facilitated by standard data sublanguages, users still must have detailed knowledge of the schema to obtain needed information from a database since one can design many different schemas to represent the storage of a given collection of information. For example, in an electronic commerce system, product information, such as product SKU, product name, product description, price, and tax code, may be stored in a single table within a relational database. In another electronic commerce system, product SKU, product name, description, and tax code may be stored in one table while product SKU and product price are stored in a separate table. In this situation, a SQL query designed to retrieve a product price from a database of the first electronic commerce system is not useful for retrieving the price for the same product in the other electronic system's database because the differences in schemas require the use of different SQL queries to retrieve product price.

As a consequence, developers of retail applications accessing product information from relational databases may have to adapt their SQL queries to each individual schema. This, in turn, prevents their applications from being used in environments where there are a wide variety of databases having different schemas, such as the World Wide Web.

A further problem with conventional search engines is a tendency to return very large amounts of data, or to require the search parameters to be narrowed. When large amounts of data are presented, the display may take many "pages" before all data is seen by the user. The time and expense involved in such a data review may be significant.

Summary

A Sort-on-the-Fly/Search-on-the-Fly search engine (hereafter, search-on-the-fly search engine) provides an intuitive means for searching databases, allowing a user to access data in the database without having to know anything about the database structure. A user selects a desired search term, and a database manager searches the database for all instances of the desired term, even if a specific file or table does not contain the instance. For example, if a user wants to search the database using the name of a specific individual as a database entry point, the database manager will search the database using the desired name, and will organize the search results so that all entries associated with that name are displayed. The database need not have a specific file (in a flat database) or a table (in a relational database) of names. The user may perform further on-the-fly searches to narrow or focus the search results, or for other reasons. For example, given search results for all names that include the name "Smith," the user may then decide to search for all "Smiths" that include an association to an address in New Jersey. The search-on-the-fly search engine then conducts a further search using this criteria and produces a second search result. Further narrowing or broadening of the search are permitted, with the search-on-the-fly search engine returning results based on any new criteria.

In an embodiment, the search-on-the-fly search engine uses graphical user interfaces (GUIs) and one or more icons to make the search process as efficient as possible. The GUIs may incorporate one or more pull down menus of available search terms. As a user selects an item from a first pulldown menu, a subsequent pulldown menu displays choices that are available for searching. The process continues until the search engine has displayed a discrete data entry from the database. The pulldown menus are not pre-formatted. Instead, the pulldown menus are created "on-the-fly" as the user steps through the search process. Thus, the search-on-the-fly search engine is inherently intuitive, and allows a user with little or no knowledge of the database contents, its organization, or a search engine search routine to execute comprehensive searches that return generally accurate results.

The search-on-the-fly search engine also searches on key words specified by the user. The search-on-the-fly search engine can be used to exclude certain items. The search-on-the-fly search engine incorporates other advanced features such as saving search results by attaching a cookie to a user's computer, and associating icons with the search results.

The search-on-the-fly search engine may be used with both internal and external databases. For example, the search-on-the-fly search engine may be used with a company internal database and one or more databases accessible through the Internet.

The search-on-the-fly search engine is user-friendly. With one interface, many different types of databases or database schemas may be searched or sorted.

Finally, the search-on-the-fly technique, and other techniques discussed above may be used in conjunction with a method of doing business, particularly a business method that uses the Internet as a communications backbone.

Description of the Drawings

The detailed description will refer to the following figures, in which like numerals refer to like objects, and in which:

Figure 1 is a block diagram of a system that uses a search-on-the-fly/sort-on-the-fly search engine;

Figure 2 is another overall block diagram of the system of Figure 1;

Figure 3 is a detailed block diagram of the search engine used with the system of Figure 2;

Figure 4 is an example of a search-on-the-fly using the search engine of Figure 3;

Figures 5 - 9 are detailed block diagrams of components of the search engine of Figure 3;

Figure 10 is another example of a search-on-the-fly using the search engine of Figure 3;

Figures 11 - 15b are additional examples of a search-on-the-fly using the search engine of Figure 3;

Figures 16 - 20 are flow charts illustrating operations of the search engine of Figure 3;

Figure 21 illustrates a further function of the search engine of Figure 3 in which results of more than one search are combined;

Figures 22 - 26 illustrate graphical user interfaces that may be displayed in conjunction with operation of the system of Figure 1;

Figure 27 is a flowchart illustrating an alternate operation of the query generator;

Figure 28 is a flowchart illustrating an alternate operation of the truncator;

Figures 29 - 36 illustrate user interfaces with search results from a search on the fly and a merge function;

Figures 37 - 39 illustrate a keyword search result form a search on the fly with the merge function; and

Figures 40-49 illustrate additional search results.

Detailed Description

Ordinary search engines place constraints on any search. In particular, a partial ordering of available search criteria limits application of the search engine only to certain search sequences. The user is given a choice of search sequences, and the order in which individual search steps in the search sequence become available limits the direction of the search. A user who desires to take a vacation cruise may use an Internet search engine to find a desired vacation package. The search begins with presentation of a list of general categories, and the user clicks on "travel," which produces a list of subcategories. The user then clicks on "cruises" from the resulting list of subcategories, and so on in a cumulative narrowing of possibilities until the user finds the desired destination, date, cruise line, and price. The order in which choices become available amounts to a predefined "search tree," and the unspoken assumption of the search engine designer is that the needs and thought processes of any user will naturally conform to this predefined search tree.

To an extent, predefined constraints are helpful in that predefined constraints allow a search engine to logically and impersonally order the user's thoughts in such a way that if the user has a clear idea of what object the user wants, and if the object is there to be found, then the user is assured of finding the object. Indeed, the user may want to know that choosing any available category in a search sequence will produce an exhaustive and disjunctive list of subcategories from which another choice can be made. Unfortunately, an unnecessarily high cost is too often paid for this knowledge: The user is unnecessarily locked into a limited set of choice sequences, and without sufficient prior knowledge of the object being sought, this limitation can become a hindrance. Specifically, where prescribed search constraints are incompatible with the associative relationships in the user's mind, a conflict can arise between the thought processes of the user and the function of the search engine.

At one time, such conflicts were written off to the unavoidable differences between computers and the human mind. However, some "differences" are neither unavoidable nor problematic. In the case of search engine design, the solution is simple: upon selecting a category or entering a keyword, the user can be given not only a list of subcategories, but the option to apply previously available categories as well. In slightly more technical terms, the open topology of the search tree can be arbitrarily closed by permitting search sequences to loop and converge. Previous lists can be accessed and used as points of divergence from which new sub-sequences branch off, and the attributes corresponding to distinct sub-sequences can later be merged.

A sort-on-the-fly/search-on-the-fly search engine (hereafter, search-on-the-fly search engine) provides an intuitive means for searching various types of databases, allowing a user to access data in the database without having to know anything about the database structure. A user selects a desired search term, and a database manager searches the database for all instances of the desired term, even if a specific file or table does not contain the instance. For example, if a user wants to search the database using the name of a specific individual as a database entry point, the database manager will search the database using the desired name, and will organize the search results so that all entries associated with that name are displayed. The database need not have a specific file (in a flat database) or a table (in a relational database) of names. The user may perform further on-the-fly searches to narrow the search results, or for other reasons. The search engine then conducts a further search using this criteria and produces a second search result. Further narrowing or broadening of the search are permitted, with the search engine returning results based on any new criteria.

Figure 1 is a block diagram of a system 10 that uses the search-on-the-fly search engine. In Figure 1, a database 12 is accessed using a hardware/software interface device 100 to provide data to a user terminal 14. Additional databases 13 and 15 may also be accessed by the terminal 14 using the device 100. The databases 12, 13 and 15 may use different schemas, or may use a same schema. As will be described later, the device 100 may include the search-on-the-fly search engine. In an alternative embodiment, the search-on-the-fly search engine may be co-located with the terminal 14. In yet another embodiment, the search-on-the-fly search engine may be incorporated into the structure of one or more of the databases 12, 13 and 15. The device 100 may interface with any one or more of the databases 12, 13 and 15 using a network connection such as through the Internet, for example. Other communications mediums may also be used between the terminal 14, the device 100 and any one or more of the databases 12, 13 and 15. These mediums may include the public switched telephone network (PSTN), cable television delivery networks, Integrated Services Digital Networks (ISDN), digital subscriber lines (DSL), wireless means, including microwave and radio communications networks, satellite distribution networks, and any other medium capable of carrying digital data.

The system shown in Figure 1 is but one of many possible variations. The search-on-the-fly search engine could also be incorporated within a single computer, such as a personal computer, a computer network with a host server and one or more user stations, an intranet, and an Internet-based system, as shown in Figure 2. Referring again to Figure 2, the terminal 14 may be any device capable of displaying digital data including handheld devices, cellular phones, geosynchronous positioning satellite (GPS) devices, wrist-worn devices, interactive phone devices, household appliances, televisions, television set top boxes, handheld computers, and other computers.

Figure 3 is a detailed block diagram of an exemplary search-on-the-fly search engine 125. The search engine 125 includes a request analyzer 130 that receives search requests 114 from the terminal 14 (not shown in Figure 3) and sends out updated requests 115 to a query generator 150. A status control 140 receives a status update signal 116 and a request status control signal 118 and sends out a request status response 119 to the request analyzer 130. The status control 140 also keeps track of search cycles, that is, the number of search iterations performed. The query generator 150 receives the updated requests 115 from the request analyzer 130 and sends a database access signal 151 to a database driver 170. The query generator 150 receives results 153 of a search of the database 12 (not shown in Figure 3) from the database driver 170. The query generator 150 provides a display signal 175 to the terminal 14. The database driver 170 sends a database access signal 171 to the database 12. Finally, a database qualifier 160 receives information 161 from the database driver 170 and provides a list 163 of available data fields from the database 12. As will be described later, the list of available data fields 163 may be displayed to a user at the terminal 14, and may be sorted and processed using the request analyzer 130 in conjunction with the database qualifier 160. The database qualifier 160 also receives search information and other commands 131 from the request analyzer 130.

The search engine 125 may identify a database schema by simply using a trial and error process. Alternatively, the search engine 125 may use other techniques know in the art. Such techniques are described, for example, in U.S. Patent 5,522,066, "Interface for Accessing Multiple Records Stored in Different File System Formats," and U.S. Patent 5,974,407, "Method and Apparatus for Implementing a Hierarchical Database Management System (HDBMS) Using a Relational Database Management System (RDBMS) ad the Implementing Apparatus," the disclosures of which is hereby incorporated by reference.

The search engine 125 provides search-on-the-fly search capabilities and more conventional search capabilities. In either case, the search engine 125 may perform a preliminary database access function to determine if the user has access to the database 12. The search engine 125 also determines the database schema to decide if the schema is compatible with the user's data processing system. If the database schema is not compatible with the user's processing system, the search engine 125 may attempt to perform necessary translations so that the user at the terminal 14 may access and view data in the database 12. Alternatively, the search engine 125 may provide a prompt for the user indicating incompatibility between the terminal 14 and a selected database.

The search engine 125 may conduct a search using one or more search cycles. A search cycle includes receipt of a request 114, any necessary formatting of the request 114, and any necessary truncation steps. The search cycle ends when a result list 175 is provided to the terminal 14. The search engine 125 may retain a status of each past and current search cycle so that the user can modify the search at a later time. The user may also use this feature of retaining a status of past and current search cycles to combine results of multiple searches, using, for example, a Boolean AND function, a Boolean OR function, or other logic function. The above listed functions will be described in more detail later.

The search-on-the-fly function of the search engine 125 begins by determining available data fields of the database 12. The database 12 may have its data organized in one or more data fields, tables, or other structures, and each such data field may be identified by a data field descriptor. In many cases, the data field descriptor includes enough text for the user at the terminal 14 to determine the general contents of the data field. The list of data fields may then be presented at the terminal 14, for example, in a pull down list. An example of such a data field result list is shown in Figure 4, which is from a federal database showing data related to managed health care organizations. This database is available at http://tobaccopapers.org/dnld.htm. In Figure 4, the first data field listed is "PlanType," which is shown in result list 156. Other data field descriptors show the general categories of data in the database.

Using the terminal 14, the user may select one of the data field descriptors to be searched. For example, the user could select "city." If a number of entries, or records, in the city data field is short, a further result list of complete city names may be displayed. If the entries are too numerous to be displayed within a standard screen size, for example, the search engine 125 may, in an iterative fashion, attempt to reduce, or truncate, the result list until the result list may be displayed. In the example shown in Figure 4, entries in the city data field are so numerous (the database includes all U.S. cities that have a managed health care organization) that the search engine 125 has produced a result list 157 that shows only a first letter of the city. Based on the available database data fields, the user may then perform a further search-on-the-fly. In this case, the user may choose cities whose first initial is "N." The search engine 125 then returns a result list 158 of cities whose names start with the letter "N." Because in this instance the result list 158 is short, no further truncation is necessary to produce a manageable list.

Figure 5 is a more detailed block diagram of the request analyzer 130. A protocol analyzer 133 receives the request 114 and provides an output 135 to a constraint collator 136. The protocol analyzer 133 examines the received request 114, determines a format of the request 114, and performs any necessary translations to make the request format compatible with the database to be accessed. If the database to be accessed by the terminal 14 is part of a same computer system as the terminal 14, then the protocol analyzer 133 may not be required to perform any translations or to reformat the request 114. If the database to be accessed is not part of the same computer system as the terminal 14, then the protocol analyzer 133 may be required to reformat the request 114. The reformatting may be needed, for example, when a request 114 is transmitted over a network, such as the Internet, to a database coupled to the network.

The constraint collator 136 provides the updated request 115 (which may be an initial request, or a subsequent request) to the query generator 150. The constraint collator 136 is responsible for interpreting the request 114. The constraint collator 136 performs this function by comparing the request 114 against information stored in the status control 140. In particular, the constraint collator 136 sends the request status control signal 118 to the status control 140 and receives the request status response 119. The constraint collator 136 then compares the request status response 119 to constraint information provided with the request 114 to determine if the constraint status should be updated (e.g., because the request 114 includes a new constraint). In an embodiment, the constraint collator 136 compares constraint information in a current request 114 to constraint information residing in the status control 140, and if the current request 114 includes a new constraint, such as a new narrowing request (for example, when the user clicks, touches or points over a field shown in a last search cycle), then the constraint collator 136 adds the updated information and sends the updated request 115 to the query generator 150. If the constraint status should be updated, the constraint collator 136 sends the status update 118 to the status control 140. If the request 114 is a refresh request, the constraint collator 136 sends a reset command 131 to the database qualifier 160. The updated request 115 (possibly with a new constraint) is then sent to the query analyzer 150 for further processing.

Figure 6 is a block diagram of the query generator 150. The overall functions of the query generator 150 are to scan a database, such as the database 12, using the database driver 170, and to collect search results based on constraints supplied by the request analyzer 130. The query generator 150 then returns the search results 175 to the terminal 14.

The query generator 150 includes a truncator 152 and a dispatcher 154. The truncator 152 receives the updated request 115, including a new constraint, if applicable. The truncator 152 creates new queries, based on new constraints, and applies the new requests 151 to the database 12 using the database driver 170. The truncator 152 may include a variable limit 155 that is set, for example, according to a capacity of the terminal 14 to display the search results 175. If data retrieved from the database 12 exceed the limit value, the truncator 152 adjusts a size (e.g., a number of entries or records) of the data until a displayable result list is achieved. One method of adjusting the size is by cycling (looping). Other methods may also be used to adjust the size of the result list. For example, the terminal 14 may be limited to displaying 20 lines of data (entries, records) from the database 12. The truncator 152 will cycle until the displayed result list is at most 20 lines. In an embodiment, the truncation process used by the truncator 152 assumes that if the user requests all values in a particular data field from the database 12, and there are no other constraints provided with the request 114, and if the size of the resulting result list is larger than some numeric parameter related to a display size of the terminal 14, then the constraints may be modified by the truncator 152 so that the result list can accommodated (e.g., displayed on one page) by the terminal 14. For example, instead of a full name of a city, some part of the name - the first n letters - is checked against the database 12 again, and n is reduced until the result list is small enough for the capacity of the terminal 14. If the maximum number of displayable results is three (3), and the database 12 contains the names of six cities "Armandia, Armonk, New Orleans, New York, Riverhead, Riverdale," then the first attempt to "resolve" the result list will stop after a result list display is created with the full name of the cities:

Armandia, Armonk, New Orleans... (the limit was reached)

Try again with 7 characters:

Armandia, Armonk, New Orl, New Yor, (limit reached again)

Again with 5 characters:

Armandia, Armonk, New O, New Y, (limit reached again)

Again with 3 characters:

Arm (...), New (...), Riv (...). These results may now be displayed on the terminal 14. The display of Arm, New, Riv can then be used to conduct a further search-on-the-fly. For example, a user could then select Riv for a further search-on-the-fly. The result list returned would then list two cities, namely Riverhead and Riverdale.

In another embodiment, a fixed format is imposed such that all queries generated against a database will have preset limits corresponding to the capacity of the terminal 14.

In yet another embodiment, the truncator 152 may adjust the field size by division or other means. For example, if the display limit has been reached, the truncator 125 may reduce the field size, X by a specified amount. In an embodiment, X may be divided by two. Alternatively, X may be multiplied by a number less than 1, such as 3/4, for example. Adjusting the field size allows the search engine 125 to perform more focused searches and provides more accurate search results.

In still another embodiment, the user may select a limit that will cause the truncator 152 to adjust the field size. For example, the user could specify that a maximum of ten entries should be displayed.

For certain data fields, a terminal 14, such as a hand-held device for example, may have a very limited display capacity. Alternatively a user may specify a limit on the number of entries for display. In these two illustrated cases, the search engine 125 may return a result list 175 of the request 114 on multiple display pages, and the user may toggle between these multiple display pages. As an example, if the terminal 14 is limited to displaying a maximum of ten entries, and if the request 114 results in a return of a data field comprising the 400 largest cities in the United States, the truncator 152 will produce a list of 23 entries comprising 23 alphabetical characters (no cities that begin with Q, Y or Z - see Figure 4). The search engine 125 may then display the results on three pages. Alternatively, the truncator 152 could produce a list of letter groups into which the cities would fall, such as A-D, E-G, H-M, N-R, and R-X, for example. In another alternative, the search engine 125 may send a notice to the terminal that the request 114 cannot be accommodated on the terminal 14 and may prompt the user to add an additional constraint to the request 114, so that a search result may be displayed at the terminal 14.

Adjusting the data field size also provides more convenient search results for the user. For example, if a user were to access an Internet-based database for books for sale, and were to request a list of all book titles beginning with the letter "F," a common search engine might return several hundred titles or more, displaying perhaps twenty titles (entries) at a time. The user would then have to look through each of many pages to find a desired title. This process could be very time-consuming and expensive. Furthermore, if the search results were too large, the common search engine might return a notice saying the results were too large for display and might prompt the user to select an alternative search request. However, performing the same search using the search engine 125 allows the truncator 152 to reduce the size of the information displayed to a manageable level. In this example, if the request 114 includes the constraint "F," the truncator 152 will loop through the data in a data field that includes book titles starting with the letter "F" until a list is available that can fit within the display limits of the terminal 14, or that fits within a limit set by the user, for example. The first list returned to the terminal 14 as a result of this request 114 may be a two letter combination with "F" as the first letter and a second letter of a book title as the second letter. For example, the fist list may include the entries "Fa," "Fe," "Fi," "Fo," and "Fu," all of which represent titles of books. The user could then select one of the entries "Fa," "Fe," "Fi," "Fo," and "Fu" to perform a further search, continuing the process until one or more desired titles are displayed. An example of a similar truncation result is shown in Figure 14.

When a parameter related to the search results is adequately truncated, the parameter is directed to the dispatcher 154, which retrieves the data from database 12 using the database driver 170. The dispatcher 154 then directs the final, truncated search results 175 back to the terminal 14 as a response to the request 114.

Figure 7 is a block diagram showing the status control 140, which is responsible for monitoring the status of a current search. Due to the nature of the search engine 125, the user can choose any combination of constraints, fields or keywords, including those from past and current search cycles. The status control 140 may keep track of all past cycles of the search, as well as all information necessary to return to any of those past search cycles. The status control 140 includes a status data module 142, and an index module 144. The status data module 142 contains data related to each such search cycle, including the constraint(s) entered during the search cycle, any truncation steps taken, and the results of such truncation, for example. The index module 144 provides access to these data. When the request 114 is being analyzed by the request analyzer 130, the constraint collator 136 sends a request status query 116 to the index module 144. The status data module 142 contains information related to all past and current search cycles, which are referenced by the index module 144, and delivers a status response 119 for the most recent search cycle to the constraint collator 136. When a new constraint is sent to the query generator 150, the status data module 142 is updated 118 by the constraint collator 136. Specific structures of the request 114, the request status query 116, the status response 119 and the request status control 118 will be provided later.

The status data module 142 may be reset by the database qualifier 160 with all available fields when a refresh function is used. In an embodiment, the refresh function may be used to clear all past search cycles and the current search cycle from the status control 140. In such an event, the search results, such as the search results shown in Figure 4, will no longer be displayed at the terminal 14, and data related to the past and the current search cycles may not be used for future search cycles. In effect, the refresh function may cause the entire search to be discarded. The refresh function may be activated when a user selects a refresh button (see Figure 4) on a displayed result list, or on another portion of a GUI. Alternatively, the refresh function may discard selected search cycles. In this alternative embodiment, the user may, for example, move a cursor to a desired result list from a past search cycle and activate a refresh, reset, back, or drop button. All data associated with search cycles subsequent to the selected search cycle, including all displayed result lists may then be discarded.

Figure 8 is a block diagram showing the database qualifier 160. The database qualifier 160 provides data field information at the start of a search or when the search engine 125 is refreshed. A field assessor 162 access the database 12 using the database driver 170, and identifies and accesses discrete data fields and other information in the database 12. A field converter 164 structures the data field information into a usable (searchable/sortable) structure and sends 163 the formatted data field information to the status control 140. Techniques for identifying and accessing the data fields, and for formatting the data field information are well known in the art. Such techniques are described, for example, in U.S. Patent 5,222,066, Interface for Accessing Multiple Records Stored in Different File System Formats, the disclosure of which is hereby incorporated by reference.

Figure 9 is a block diagram of the database driver 170. The database driver 170 is the universal interface with the database 12, which can be a local or a remote database.

Figure 10 is an example of a search-on-the-fly using the search engine 125. In Figure 10, a database 200 includes information related to a number of individuals. The information in the database 200 may be presented at the terminal 14 using a series of screens or menus 201 - 230. The user first accesses the database 200 and is presented with a list 201 of the information or data fields contained in the database 200. The result list 201 is generated by the field assessor 162, and is provided for display at the terminal 14 by the query generator 150. As shown in Figure 10, a user has selected the data field "City" for display of information. However, the number of "cities" listed in the database 200 is too large to conveniently display at one time (i.e., on one page) at the terminal 14. Accordingly, the truncator 152 will loop a required number of times until an adequate display is available. In Figure 10, the menu 203 shows the results of the truncation with only the first letter of a city name displayed.

Using the menu 203, the user has selected cities beginning with the letter "A." The results are shown in menu 205. Now, the user elects to conduct another search-on-the-fly, by selecting the "sort-on-the-fly" option 206. The query generator 150 displays all the information fields available from the database 200, except for the information field already displayed, namely "City." The results are displayed in menu 207. The user then elects to further search on the data field "State." The query generator 150 returns the requested information as displayed in menu 209, listing five states by their common two-letter abbreviation. The user then chooses New York from the menu 209, and the query generator 150 returns a list of cities in New York, menu 211.

Next, the user elects to conduct another search-on-the-fly, option 212, and the query generator 150 returns only the remaining data fields for display in menu 215. From the menu 215, the user selects "Address" for the next data field to search, and the query generator 150 returns an menu 217 showing only first letters of the address. This signifies that the data field "Address" was too large to be easily displayed on the terminal 14. The user then elects to search on all addresses that begin with "C." The query generator 150 returns a list of addresses by displaying only street names, menu 219.

The user then elects to conduct a further search-on-the-fly, option 220, and the remaining two data fields, "Name" and "Phone" are displayed as options in menu 221. The user selects name, and the query generator returns a further breakdown of the data by last name and by first name, menu 223. This process continues, with further menus being used to select a last name and a first name from the database 200. When the final selection is made, information from the database 200 related to the individual is displayed in window 230.

In the example shown in Figure 10, the user could have refreshed the search engine 125 at any time, and the search would have recommenced at the beginning. Alternatively, the user could, by simply selecting a prior menu, such as the menu 215, have changed the course of the search. In this alternative, if the user had gone back to the menu 215 and instead of selecting "Address" selected "Phone," then the menus 217 - 229 would be removed from display at the terminal 14, and the search would begin over from the point of the menu 215.

Figures 11 - 15 illustrate exemplary searches of a remote database, such as the database 13 shown in Figure 1. The database in the illustrated example is for an Internet website 232 that sell books. The examples illustrated are based on a Barnes & Noble website. In Figure 11, the user has applied the search engine 125 to the website 232 database, and the query generator 150 has returned a list 233 of data fields from which the user may select to access data from the website 232 database. The list 233, and other lists described below, may be displayed as overlays on the website 232. In the example illustrated, the user selects "Title" for the first search cycle. Because the list of titles is too large to easily display at the terminal 14, the truncator 152 loops until an alphanumeric list 234 is created. The list 234 is then returned to the terminal 14. For the next search cycle, the user selects titles that begin with the letter "C." Again, the data field contains too many entries to conveniently display at the terminal 14, and the truncator 152 loops as appropriate until list 235 is created. The process continues with subsequent lists 236 and 237 being returned to the terminal 14.

Figures 12 - 15b illustrate alternate searches that may be completed using the website 232 database.

For the search results shown in Figures 11 - 15a, the status control 140 may iterate as follows:

Status Control Started...

Key: Title1 Option: Title Level: 1 Filter: Field: Title

Key: A2 Option: A Level: 2 Filter: SUBSTRING([Title],1,1) = 'A' Field: Title

Key: AA3 Option: AA Level: 3 Filter: SUBSTRING([Title],1,2) = 'AA' AND SUBSTRING([Title],1,1) = 'A' Field: Title

Key: F4 Option: F Level: 4 Filter: SUBSTRING([Title],1,1) = 'F' Field: Title

Key: Fa5 Option: Fa Level: 5 Filter: SUBSTRING([Title],1,2) = 'Fa' AND SUBSTRING([Title],1,1) = 'F' Field: Title

Key: Favo6 Option: Favo Level: 6 Filter: SUBSTRING([Title],1,4) = 'Favo' AND SUBSTRING([Title],1,2) = 'Fa' AND SUBSTRING([Title],1,1) = 'F' Field: Title

Key: C7 Option: C Level: 7 Filter: SUBSTRING([Title],1,1) = 'C' Field: Title

Key: Ce8 Option: Ce Level: 8 Filter: SUBSTRING([Title],1,2) = 'Ce' AND SUBSTRING([Title],1,1) = 'C' Field: Title

Key: Cells9 Option: Cells Level: 9 Filter: SUBSTRING([Title],1,5) = 'Cells' AND SUBSTRING([Title],1,2) = 'Ce' AND SUBSTRING([Title],1,1) = 'C' Field: Title

Key: Cellula10 Option: Cellula Level: 10 Filter: SUBSTRING([Title],1,7) = 'Cellula' AND SUBSTRING([Title],1,2) = 'Ce' AND SUBSTRING([Title],1,1) = 'C' Field: Title

Key: CC11 Option: CC Level: 11 Filter: SUBSTRING([Title],1,2) = 'CC' AND SUBSTRING([Title],1,1) = 'C' Field: Title

Status Control Terminated.

Figure 15b shows the results for a search for a low-fat cookbook using the search engine 125 as applied to a remote database. In this example, the remote database is coupled to a Barnes & Noble web page. The first query, and resulting message strings, are illustrated by the following:

Query Analyzer

Message Received: ACK

Status Control: Refresh

Dispatcher

Message Sent: Categories~-~Title~-~Author~-~ISBN~SubTitle~Format~Date Published~Stock Status~Recommended Age~Pages~Ratings~Price~Retail~Savings~-~Publisher

Query Analyzer

```
Message Received: CLK#0#1#Categories
Status Control received an update:
Key: Categories1 Option: Categories Level: 1 Filter:  Field: Categories
Query Generator
Request is not cached, processing
Generated Query: SELECT DISTINCT [Categories] FROM Books ORDER BY
[Categories]
Number of Matching Records: 2032
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,82) FROM Books
ORDER BY SUBSTRING([Categories],1,82)
Number of Matching Records: 2022
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,61) FROM Books
ORDER BY SUBSTRING([Categories],1,61)
Number of Matching Records: 1995
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,45) FROM Books
ORDER BY SUBSTRING([Categories],1,45)
Number of Matching Records: 1751
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,33) FROM Books
ORDER BY SUBSTRING([Categories],1,33)
Number of Matching Records: 1251
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,24) FROM Books
ORDER BY SUBSTRING([Categories],1,24)
Number of Matching Records: 799
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,18) FROM Books
ORDER BY SUBSTRING([Categories],1,18)
Number of Matching Records: 425
```

```
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,13) FROM Books
ORDER BY SUBSTRING([Categories],1,13)
Number of Matching Records: 319
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,9) FROM Books
ORDER BY SUBSTRING([Categories],1,9)
Number of Matching Records: 147
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,8) FROM Books
ORDER BY SUBSTRING([Categories],1,8)
Number of Matching Records: 111
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,7) FROM Books
ORDER BY SUBSTRING([Categories],1,7)
Number of Matching Records: 78
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,6) FROM Books
ORDER BY SUBSTRING([Categories],1,6)
Number of Matching Records: 44
Generated Query: SELECT DISTINCT SUBSTRING([Categories],1,5) FROM Books
ORDER BY SUBSTRING([Categories],1,5)
Number of Matching Records: 26
Truncator finished, took 15 seconds to make 13 iterations
Caching this request...
Dispatcher
Message Sent: Afric~Art, ~Biogr~Busin~Compu~Cooki~Engin~Enter~Ficti~Histo~Home
~Horro~Kids!~Law:
~Medic~Mind,~Nonfi~Paren~Poetr~Refer~Relig~Scien~Small~Sport~Trave~Write~
Query Analyzer
Message Received: CLKCategories
```

In the example illustrated by Figure 15b and the above-listed message strings, an initial request would have returned 2032 book titles for cook books. This number of entries may be too large. Accordingly, the truncator 152, through 13 iterations, reduces the entries in a result list to 26. The entries in the truncated result list can then be easily reviewed by the user, and further searches may be performed to identify a desired book. As can be seen above, the user has selected "Categories" as a data field to search. As is also shown in Figure 15b, the search engine 125 may display other information windows, such as book availability, ordering and shipping information windows. With a simple drag-and-drop cursor operation, for example, the user may then order and pay for the desired book.

Figure 16 - 20 are flow charts illustrating operations of the search engine 125. Figure 16 is a flowchart of an overall search routine 250. The process starts in block 251. The request analyzer 130 receives the request 114, block 252. The request 114 may be made using a hierarchical menu-based display or a graphical user interface, with one or more layers. Using either the menu or the GUI, the user may enter specific details by typing, selection of iconic symbols or pre-formatted text, and by using well-known data entry techniques, for example. The request 114 may also comprise a simple text or voice query. Use of voice recognition may be particularly useful in mobile environments, and to speed access to the database 12. Use of voice recognition may include simple commands, such as UP, DOWN, and SELECT, to select search terms from a pre-formatted list that is presented to the user at the terminal 14. More sophisticated use of voice recognition may include actually speaking letters or numbers, or full search terms, such as speaking a key word for a key word search, for example.

The protocol analyzer 133 provides an output 135 to the constraint collator 136, and the constraint collator 136 determines the nature of the request, block 254. If the request 114 is a refresh request (i.e., a command to initiate the refresh function), the constraint collator 136 sends a reset command 131 to the database qualifier 160. The updated request 115 (possibly with a new constraint) is then sent to the query analyzer 150 for further processing, including analyzing the database 12, retrieving field descriptors, and formatting, block 256. The result of the data field descriptor retrieval and formatting are shown as an available data fields result list, block 258, and is returned to the terminal 14, block 260.

In block 254, if the request 114 is not a refresh request, the constraint collator 136 provides the updated request 115 (which may be an initial request, or a subsequent request) to the query generator 150, block 264. The constraint collator 136 compares the request 114 against information stored in the status control 140. In particular, the constraint collator 136 sends the request status control signal 118 to the status control 140 and receives the request status response 119. The constraint collator 136 then compares the request status response 119 to constraint information provided with the request 114 to determine if the constraint status should be updated (e.g., because the request 114 includes a new constraint). If the constraint status should be updated, the constraint collator 136 calls create new constraint subroutine 270, and creates new constraints.

The create new constraints subroutine 270 is shown as a flowchart in Figure 17. The subroutine starts at 272. In block 274, the constraint collator 136 determines if the request is for a sort-on-the-fly operation. If sort-on-the-fly has been selected, field assessor 162 prepares a new set of data fields, block 280. The new set of data fields are then sent to the query generator 150, block 284, and the subroutine 270 ends, block 286.

In block 274, if sort-on-the-fly was not selected, the request analyzer 130 may receive a key word constraint, block 276. The query generator 150 will then generate an input window in which the user may enter a desired key word, block 282. Alternatively, the query generator 150 may prompt the user to enter a key word using voice recognition techniques, or any other way of entering data. The process then moves to block 284. In block 276, if a key word search option was not selected, the constraint collator 136 enters the new constraint to the existing list of constraints, block 278. The process then moves to block 284.

Returning to Figure 16, the constraint collator 136 next updates the status control 140, block 290. In block 292, using the updated constraints, the query generator 150 generates a next query of the database 12, block 292. The database driver 170 then extracts the result list from the database 12, according to the latest query, block 294. In block 296, the truncator 152 determines if the result list may be displayed at the terminal 14. If the result list cannot be displayed, the process moves to block 298, and a truncation routine is executed. The process then returns to block 294. If the result list in block 296 is small enough, the result list is provided by the dispatcher 154 to the terminal 14, block 258.

As noted above, the request analyzer 130 determines the nature of the request, including any special commands. A special command may include a command to conduct a search-on-the-fly. Alternatively, the search engine 125 may adopt a search-on-the-fly mechanism as a default value. The search engine 125 also may incorporate other special search commands, such as a Boolean search, for example.

Figures 18 - 20 are flowcharts illustrating alternate truncation subroutines 298. In Figure 18, the subroutine 298 adjusts a size of a data field by decrementing a parameter TP related to entries in a selected data field. For example, if the data field comprises a list of U.S. cities by name, the parameter TP may be the number of alphabetical characters in a name. The results of such a truncation is shown in the example of Figure 4. The subroutine 298 starts at block 301. In block 303, the parameter TP is set to equal a size of the data field being searched. The truncator 152 then determines the list of records sized by the parameter TP, block 305. In block 307, the truncator 152 determines if the result list can be displayed at the terminal 14. If the result list cannot be displayed at the terminal 14, the truncator 152 decrements the parameter TP, block 309. Processing then returns to block 305, and the truncator 152 gets a reduced result list using the truncated parameter TP. If the result list can be displayed at the terminal 14, the process moves to block 311 and the subroutine 298 ends.

Figure 19 is a flowchart illustrating an alternate truncation routine 298. The process starts in block 313. In block 315, the truncator 152 sets the parameter TP to a size of the data field being searched. In block 317, the truncator 152 determines the list of records sized by the parameter TP. In block 319, the truncator 152 determines if the result list can be displayed at the terminal 14. If the result list cannot be displayed, the truncator 152 adjusts the size of the data field by dividing the parameter TP by a set amount, for example, by dividing the parameter TP by two, block 321. Processing then returns to block 317, and repeats. If the result list can be displayed at the terminal 14, the process moves to block 323 and the subroutine ends.

Figure 20 shows yet another alternative truncation subroutine 298. The process starts in block 325. In block 327, the truncator 152 sets the parameter TP to equal the size of the data field being searched. In block 329, the truncator 152 determines the list of records sized by the parameter TP. The truncator 152 then determines if the result list can be displayed at the terminal 14, block 331. If the result list cannot be displayed at the terminal 14, the truncator 152 determines if the parameter TP is less then ten, block 333. If the parameter TP is not less than ten, the truncator 152 adjusts the parameter TP by multiplying the parameter TP by a number less than one, block 337. In an embodiment, the number may be 3/4. The process then returns to block 329 and repeats. In block 333, if the value of the parameter TP is less than ten, the truncator 152 decrements the parameter TP by one, block 335. Processing then returns to block 329 and repeats. In block 331, if the list can be displayed at the terminal 14, the process moves to block 339 and the subroutine 298 ends.

The examples illustrated in Figures 18 - 20 are but a few examples of the truncations subroutine. One of ordinary skill in the art could conceive of other methods to adjust the field size. In addition to using a truncation subroutine, the user may specify a limit for the field size.

As noted above, the search engine 125 may be used for multiple searches and may be used to search multiple databases, including databases with different schemas. The results of individual searches, including the control data provided in the status control 140, are saved. The search engine 125 may then be used to further sort (search), or otherwise operate on, the results of these multiple searches. In an embodiment, the search engine 125 may perform a Boolean AND operation on two search results. The result of the Boolean AND operation would be a list of records, or entries, that are common to the two search results. Figure 21 illustrates such a Boolean AND operation.

In Figure 21, a GUI 400 displays local database selections 410, including a database of recordings (compact discs - CDs) 412 and a database of contacts 414. The databases 412 and 414 may be shown by text descriptions and an appropriate icon, for example. The database selections in this example are resident on a user's terminal, such as the terminal 14 shown in Figure 1. Also displayed on the GUI 400 is a remote database selection 420 that represents databases, such as the databases 13 and 15 shown in Figure 1, that are located remotely from the terminal 14. In the example shown in Figure 21, the remote database selection 420 includes a database 422 for online record sales, which is represented by an icon (a CD) and a text title of the online retailer. The remote databases shown in the remote database selection 420 may include those databases for which the user has already established a link. In the example shown, the user may already have entered an Internet address for the online retailer. In addition to any returned web pages from the online retailer, the terminal 14 may then display a representation of the database 422.

Continuing with the example, the user may use the search engine 125 to conduct a search-on-the-fly of the recordings database 412 and the virgin records database 422. The user may search both databases 412 and 422 for titles of recordings that are classified as "blues." The search engine 125 may return search results 416 and 424 for searches of both databases 412 and 422, respectively. The search results 416 and 424 may be displayed in a window section 430 of the GUI 400. The results 416 and 424 may also be represented by CD icons, such as the icons 432 and 434. The search results 416 and 424 may be stored as lists in one or more temporary databases, as represented by the windows 417 and 427. The search results 416 and 424 may also be stored in a scratch pad database 418. At this point, the user may wish to determine which recordings from the list 424 are contained in the list 416. The search engine may support this function by performing a Boolean AND operation of the lists 416 and 424. The results of the Boolean AND operation are represented by the icon 436 displayed in the window 430. To execute the Boolean AND operation, the user may simply drag the icon 432 over the icon 434, and then select AND from a pop-up menu 438 that appears when the icons 432 and 434 intersect. Other techniques to execute the Boolean AND (or another Boolean function) may include typing in a command in a window, using voice recognition techniques, and other methods. In addition, other Boolean functions may be used.

The result represented by the icon 436 of the Boolean AND operation may then be stored in a database at the terminal 14, such as in the scratch pad database 418 or may be stored at another location. The result may then be subjected to further search-on-the-fly operations.

Also shown in Figure 21 is an online-purchase module 435 that may be used to consummate purchase of a product referenced in an online database such as the database 422. To initiate such a purchase, the user may drag an iconic or text representation of a desired product listed in the search result 424 over an icon 436 in the online-purchase module 435. This drag-and-drop overlaying these icon may initiate and complete the online purchase for the desired product.

Use of the search engine 125 may be facilitated by one or more GUIs that are displayed on the terminal 14. Figures 22 - 26 are examples of such GUIs. In Figure 22, a GUI 450 includes a display section 452 and one or more database sections such as local database section 470 and remote database section 460. The local database section 470 includes databases local to the terminal 14. In the example shown, the local databases include a patients database 472, a general contacts database 474, a pharmacy database 476, a medicines database 478 and a scratch pad database 480. The remote databases include an Amazon.com database 462, an online record retailer database 464, a Physician's Desk Reference database 466 and an American Medical Association (AMA) online database 468. The remote and local databases may be represented by a text title and an icon, both contained in a small window as shown. A user may access one of the remote or local databases by moving a cursor over the desired window and then selecting the database. In the example shown, the local medicines database 478 has been selected, and a list 490 of data fields in the medicines database 478 is displayed in the display section 452. Also included on the display section 452 is a keyword button 492 that may be used to initiate a key word search of the medicines database 478.

Figure 23 shows the GUI 450 with a user selection of a category data field from the list 490. The category data field is indicated as selected by an arrow adjacent to the data field name. When the category data field is selected, a category list 494 is displayed on display section 452. The category list 494 includes four entries, as shown.

The user may continue to search the medicines database 478 using key word techniques and search-on-the-fly techniques. Figure 24 shows the GUI 450 with results of several search cycles displayed.

Figure 25 illustrates a search of the PDR database 466. Such a search may be initiated by dragging a cursor to the window having the PDR 466 symbol (text or icon), and then operating a "select" button. Figure 26 shows a search of the Amazon database 462. This search may also be initiated by a "drag-and-drop" operation.

The SOTF search engine 125 may accommodate merging of one or more sets of search results. The multiple search results may be derived from a common database, or from more than one database. A search using the search engine 125 may be controlled through a user interface by one or more icons that can represent (1) filters or (2) the images of filters. Thus, the icon may represent spatial or temporal attributes, or sets of objects or procedures. Merging the icons thus has two interpretations corresponding to (1) and (2): either filters are added ("apply every filter in every icon to every image to which it can be applied"), or image sets are added. In an alternative embodiment, the addition (union or join) operator may be any other relational operator, e.g. divide, difference.

Use of the merge function may be explained by reference to Boolean lattices. A collection of entities can have attributes A or B or both. If {A} is the set of all A entities and {B} is the set of all B entities; the set whose elements all possess both attributes A and B may now be written {A and B}, and the set whose elements all possess either attribute A or attribute B or both may be written {A or B}. The elements of {A and B} can be considered to possess a new, less inclusive or specific attribute C, and the elements of {A or B} to possess a new, more inclusive or general attribute D. In a lattice, the nodes are attributes; the most inclusive attribute (in this case D) is always at the top and is called the join of those attributes (nodes) immediately below it, and the most exclusive attribute (in this case C) is always at the bottom and is called the, meet of those attributes (nodes) immediately above it. In other words, the OR operation yields the join of two attributes, while the AND operation yields their meet. Thus, the OR operator is upward or inductive (yielding the more inclusive join of the operands), while the AND operation is downward or deductive (yielding the more exclusive meet of the operands). The nodal attributes of such a lattice are analogous to filters; but since a principle called CF duality states that attributes and sets are to some extent interchangeable because every attribute characterizes a set and every set is characterized by an attribute, these attributes are logically equivalent to the sets they characterize.

In an example optical context, the downward AND operator corresponds to stacking colored filters, while the upward OR operator corresponds to mixing colored paints or filters. In color optics, stacking and unstacking colored lenses is called a subtractive process, while mixing or unmixing paints is called an additive process. Unfortunately, while combining or "adding" filters is subtractive with respect to the sets they characterize, it is additive with respect to the filters themselves, and adding sets is subtractive with respect to the filters. So it is better to refer to operations among attributes (filters, lenses, etc.) as "filtrative" or "infonegative, and to those among sets (paints, lights, etc.) as "constructive" or "infopositive". CF duality can now be rephrased as follows: every infonegative entity (attribute) descriptively characterizes an associated infopositive entity (set/object), and every infopositive entity instantiates or is descriptively characterized by an associated infonegative entity.

The search engine 125 includes iconization (iconic representation) of an algebra or calculus of relations defined on Boolean lattices. This representation begins with a set of primitive icons extracted from base tables and defines new icons (derived tables, virtual databases) by means of simple user-executed operations. The icons can be effortlessly translated into lists of data corresponding to the icons, and it is these lists that comprise the real substance of any search procedure.

When search chains are branched into to chains A and B, the filters subsequently applied to each chain can be the same or different, and merging can signify any of two or more Boolean relationships (relational operations) defined on a relational database. Specifically, when chains merge, sets of filters can be added or intersected. Since filters are constraints, adding them amounts to intersecting their images, while adding their images amounts to intersecting the filters (infopositive-infonegative distinction). Equivalently, one may consider positive and negative filters effecting deduction and induction respectively; the filters are descriptive, while the images are substantive. The extent to which the images of filters can intersect depends on the commonality (predicative non-exclusivity) of domains. Icon algebras (of iconic operators) are "object-oriented" on the GUI level; they are Ul extensions of the innate object-orientation of relational databases themselves, wherein the objects are records, attributes, tables, virtual databases and so on, and the operations are those of any relational algebra.

The looping and merging of search chains is to some extent algebraic. First, since actual topology is being changed, such transformations do not directly form a topological homeomorphisin group; the algebra remains Boolean, and the "homeomorphism" is defined on the operator graph of the Boolean algebra (of which the <u>initial</u> search tree is generally only a subspace). Icons representing sets of nested predicates are "Boolean objects"; when decision chains converge or diverge, objects merge or split, and these objects represent (combinatorially) unique search paths. Thus, operations among paths can be reduced to operations among objects; e.g., regress-diverge is just an object-splitting operation. Continuous looping applies "inverse deductive filters" to achieve induction by descriptive intersection of filter constraints, permitting the retrograde convergence of paths to identical ancestral objects (inductive merging of objects), while inductive looping is just direct regression to an ancestral object preparatory to splitting it and thus effecting divergence of paths (deductive splitting of objects). Deductive convergence of paths is "natural" if iconic image sets intersect and "forced" if not; if natural, then there has been non-exclusivity of subobjects, and paths are not unique (even though identical filters can apply to divergent paths without impairing uniqueness). So all deductive merging is forced, and this entails a decision regarding which filters are to be conserved and which discarded. Any such operation will effectively "rewrite the paths", and doing this optimally is NP-complete.

More specifically, icons are subject to CF duality. The merge control thus has a “switch” toggling between "Qualities / Objects". When the switch is in the "qualities" position, merging icons performs a qualified deductive conjunction of filters and yields a set intersect; when it is in the "objects" position, merging the icons performs a disjunction of filters and an inductive union of sets, yielding a more general attribute (the genera qualities created by the object-merge operation will be produced by sets of filters applied disjunctively). The search engine 125 is therefore capable of inductive and deductive information processing. A quality-merge in which filters do not cross the line between composite icons equates to an object merge; the set thus selected is characterized by a more general quality which amounts to the descriptive (filtrative) union. There is also a modified quality-merge in which filters in either icon applicable to both iconized sets are applied to both, thus crossing the line between icons. In this case, a true merging of paths occurs, as opposed to path icons. The search engine 125 allows users to choose which filters are to cross the inter-icon line and which are not, resulting in complex Boolean expressions and the sets they characterize (determining consistency of complex expressions can amount to LSAT; sets of inconsistent expressions will simply yield a null return.

Icons may reside in the first menu box to appear, being transferred from menu to menu as the path is generated and filters arc accumulated. When a direct regress occurs, the path is regarded as "complete" and is stored in a holding module. Prior to the merging operation, the quality/object switch is set; and icon subfilters or subsets individually displayed. A "lattice navigator" will keep track of position and equivalence, folding the search graph in case a node of the original tree is inductively encountered in the course of an object-merge; otherwise, the icon remains in "internodal space" (which is to be regarded as a virtual space realized only in the event that the search tree is nondisjunctive in its nodes and therefore incomplete with respect to the semantic net generated by the tree).

Figure 27 is a flow chart illustrating an alternative operation 600 of the query generator 150 of Figure 6. In the illustrated operation, the query generator 150 is adapted to receive multiple selections of items within a same menu function and within a same merge function. To provide this functionality of the query generatory150, the request analyzer 130 (see Figure 5) may be adapted to receive a collection of user choices.

The operation 600 begins in block 601. In block 603, the request analyzer 130 receives constraints collected from the constraint collator 136, and the updated request 115, which may be an initial request or a subsequent request, is provided to the query generator 150. In block 605, the query generator 150 determines if the constraints (the request 115) are in the same merge group. If the query generator 150 determines that the request 115 is in the same merge group, the process moves to block 607 and the query generator 150 generates the query with a Boolean AND. If the request is not in the same merge group, the query generator 150 generates the query with a Boolean OR, block 609.

In block 611, the items selected within the same unit are Or'ed and the default truncator may be used depending on the size of the returned items. In block 613, the generated query is executed. In block 615, the number of records to be displayed is checked. If the number is within a specified limit, the process moves to block 617 and the search results are returned for display. The operation 600 then ends, block 625. In block 6125, if the number of records to be displayed is too large, the process moves to block 621, and a truncation routine is executed.

The truncation routine may be any of the previously-described truncation routines. Figure 28 illustrates an alternate truncation routine 630. The routine 630 begins in block 631 with the truncator 152 receiving the request 115. In block 633, the truncation is set to the size of the field being viewed on the GUI, and sets the False Flag. The query is then run against the database using the selected truncator, block 635. In block 635, the truncator 152 determines if the number of records that would be retrieved from the database can be displayed on the existing GUI. If the records can be displayed, the process moves to block 639, and the truncator 152 determines if the Flag is set False. If the Flag is set False, the process moves to block 653 and the records are returned (displayed on the GUI). The process then ends, block 655. In block 637, if the number of records exceeds the display size of the GUI, the status of the Flag is checked as False. If false, the truncator is set to 1, and the flag is set to true, block 647, and the process returns to block 635. If in block 637. If the flag is not set false, the process moves to block 651, and saved records are retrieved. The retrieved records are then displayed, block 653.

In block 639, if the Flag is not set to false, the retrieved records are saved, and the truncator 152 is incremented. The process then returns to block 635.

Figures 29 - 38 illustrate graphical user interfaces and search on the fly results using the search engine 125 with a merge function. In Figure 29, a search of a patent database has been executed to search for patents by primary examiner. The Primary Examiner results table lists the arabic numerals 0 - 7 and the letters A-Z, indicating that the database contains names of primary examiners beginning with these numerals/letters. To quickly narrow the search, the user selects the letter O, and results are returned listing last and first names all primary examiners whose last name begins with O. As can be seen by the returned results, the database lists several primary examiner instances of O'Dea. This could indicate an error in the database. The search engine 125 allows these errors to be detected and corrected. The correction may be made by selecting the incorrect instances, right-clicking the correct instance, and then choosing a 'correct all other's based on this instance" function.

Figure 30 shows how multiple-select capabilities of the search engine 125 may be used to enhance a search. In the illustrated example, the user searches for 3 M Company. Different versions of the company name are then displayed with the returned results. In this way, the user may select the different versions of the company that the user wants to use for the search. The pop-up pane shows a current status control for the GUI.

Figure 31 shows the results of subsequent menus showing the aggregation, or merge, of two previous constraints, "3m" and 3-M." Figure 32 shows a merge execution. The user first selects the '3-M" and the "3M" company names using the check boxes in the previous menu. The user then selects the merge option, placing the menu on hold, and going to the "M", "MI", "MIN" and "MINNESOTA M" menus. The merge option is then selected on the menu and the merged menu is displayed showing the merge of searches between "3M" and "Minnesota Mining and Manufacturing Co." Figures 32 - 36 show other search engine 125 features including data mining and database correction.

Figures 37 - 39 show the results of a full text search of a patent database using the keyword "encryption" and searching on all fields. The initial search results are truncated to display by first letter/numeral of the patent title. From this intermediate search result menu, the user selects all patents whose title begins with the letter "E", and a subsequent search result menu is displayed listing partial titles of all such patents. From the next intermediate list, the user selects the patent whose title begins "Electronic copy protection mechanis." The search engine 125 then returns this specific patent, the first page of which is shown in Figure 39. The displayed patent includes the keyword "encryption" highlighted wherever it occurs. The display also indicates the number of instances of the keyword in the patent.

Figures 40-49 illustrates additional search results.

In specific embodiments, the search engine 125 is implemented as a program executed on a general purpose computer, such as a personal computer. The search engine may also be implemented as a routine attached to a database structure. In addition, the search engine may be implemented on any processor capable of executing the routines of the program. In alternative embodiments, the search engine 125 may be implemented as a single special purpose integrated circuit (e.g., ASIC) having a main or central processor section for overall, system level control, and separate circuits dedicated to performing various different specific functions, computations and other processes under control of the central processor section. Those of ordinary skill in the art will appreciate that the search engine 125 may also be implemented using a plurality of separated dedicated or programmable integrated circuits, or other electronic circuits or devices (e.g., hardwired electronic or logic circuits such as discrete elements circuits, or programmable logic devices, such as PLDs, PLAs, or PALs). In general, any device or assembly of devices on which a finite state machine capable of implementing flowcharts similar to the flowcharts of Figures 16 - 20 and 27 and 28 can be used to implement the search engine 125.

The terms and descriptions used herein are set forth by way of illustration only and are not meant as limitations. Those skilled in the art will recognize that many variations are possible within the spirit and scope of the invention as defined in the following claims, and there equivalents, in which all terms are to be understood in their broadest possible sense unless otherwise indicated.

In the claims:

1. A method for searching databases, comprising:

determining a database schema for a database;

providing a list of database fields, wherein the list includes a descriptor indicating a data category;

receiving a search selection for a database field on the provided list of database fields;

determining a quantity of entries in the selected database field;

if the quantity exceed a specified amount;

truncating data, and

displaying the truncated data; and

if the quantity does not exceed the specified amount, displaying contents of the database field.

2. The method of claim 1, further comprising providing a key word search.

3. A method for searching a database, comprising:

generating a list of data fields;

receiving a first data field selection from the list of data fields;

determining a first quantity indicative of a number of entries of the selected data field;

if the first quantity exceeds a specified limit, reducing a size of data to be displayed from the selected data field; and

displaying data from the selected data field.

4. The method of claim 3, wherein the specified limit is fixed.

5. The method of claim 3, wherein the specified limit is variable.

6. The method of claim 3, wherein the data are displayed on a terminal, and wherein the specified limit is determined dynamically, based on a characteristic of the terminal.

7. The method of claim 3, wherein the specified limit is a user-determined limit.

8. The method of claim 3, wherein the method for reducing the size of the data to be displayed from the selected data field comprises:

performing a truncation that reduces the size of the data to be displayed from the selected data field;

comparing the reduced size to the specified limit; and

if the reduced size exceeds the specified limit, repeating the truncation and comparing steps until the size of the data to be displayed from the selected data field is less than or equal to the specified limit.

9. The method of claim 8, wherein a parameter is related to the size of the data to be displayed from the selected data field, and wherein the truncation comprises decrementing the parameter.

10. The method of claim 9, wherein the parameter is decremented by a value of one.

11. The method of claim 8, wherein a parameter is related to the size of the data to be displayed from the selected data field, and wherein the truncation comprises dividing the parameter by a value.

12. The method of claim 11, wherein the value is two.

13. The method of claim 8, wherein a parameter is related to the size of the data to be displayed from the selected data field, and wherein the truncation comprises multiplying the parameter by a value.

14. The method of claim 3, further comprising:

receiving a first constraint, wherein the first constraint is related to a data element in a data field; and

receiving one or more subsequent constraints, wherein search results are generated based on a combination of the first and the one or more subsequent constraints.

ABSTRACT

A Sort-on-the-Fly/Search-on-the-Fly search engine provides an intuitive means for searching databases, allowing a user to access data in the database without having to know anything about the database structure. A user selects a desired search term, and the search engine searches the database for all instances of the desired term, even if a specific file or table does not contain the instance. The database need not have a specific file (in a flat database) or a table (in a relational database) of names. The user may specify other criteria, or constraints to narrow the search results, or for other reasons. The search engine then conducts a further search using this criteria and produces a second search result. Further narrowing or broadening of the search are permitted, with the search-on-the-fly search engine returning results based on any new constraints. If the returned data would be too large to be conveniently displayed at a terminal, the search engine executes a truncation routine so that the returned data is easily displayed.

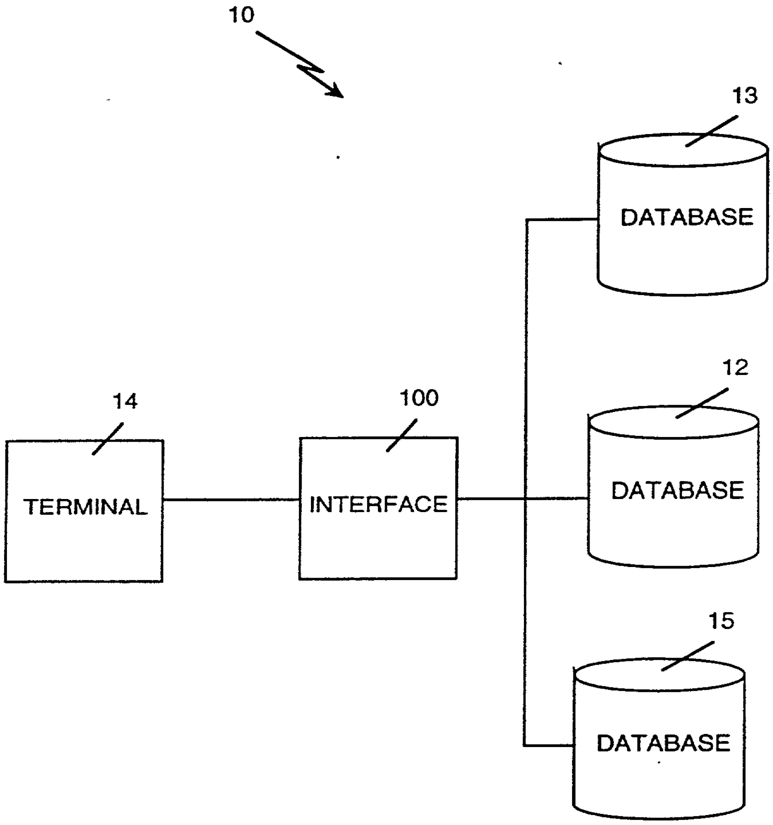

10
13
DATABASE
12
14
100
TERMINAL
INTERFACE
DATABASE
15
DATABASE

Fig. 1

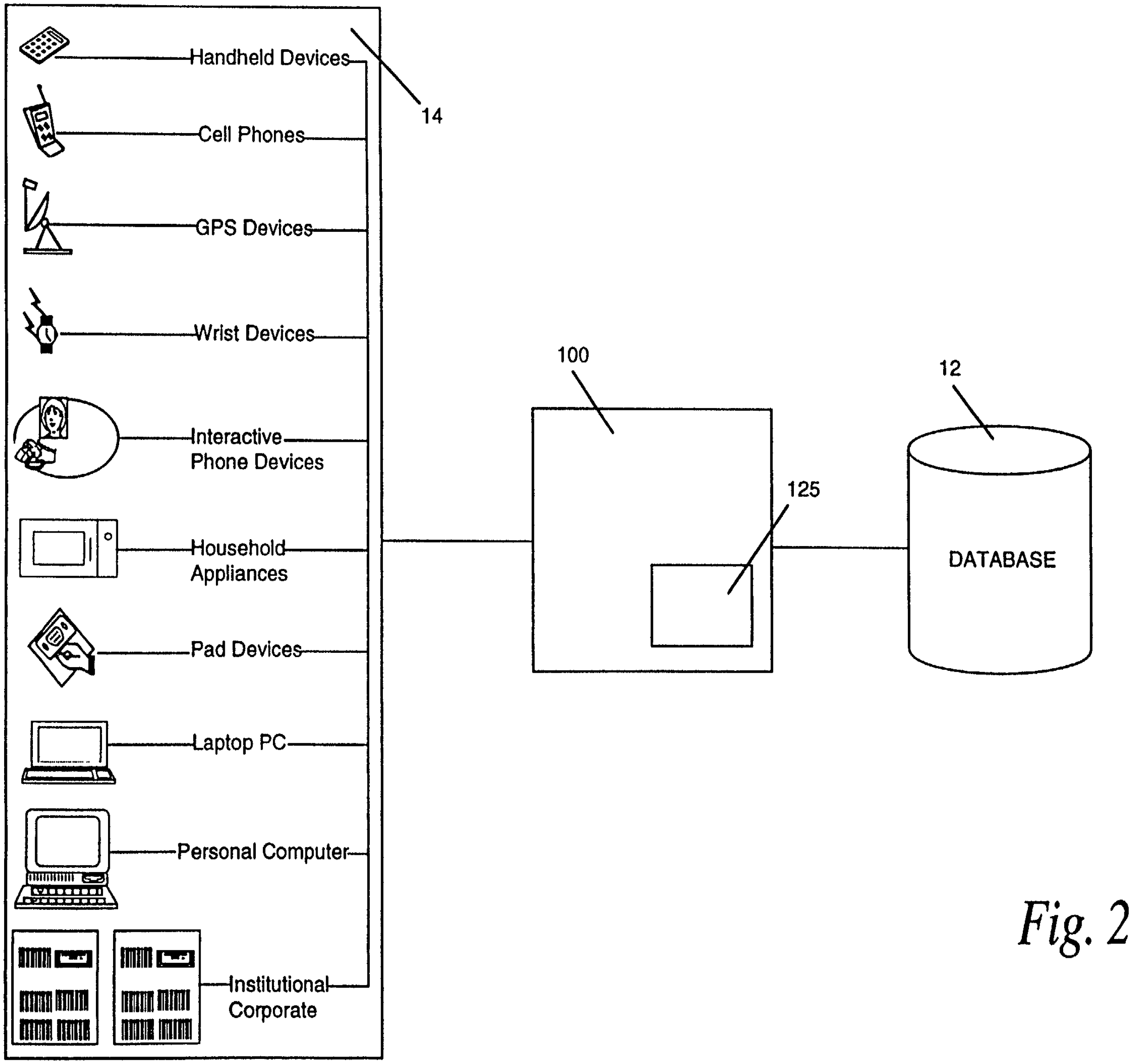

Handheld Devices
Cell Phones
GPS Devices
Wrist Devices
Interactive Phone Devices
Household Appliances
Pad Devices
Laptop PC
Personal Computer
Institutional Corporate
14
100
125
12
DATABASE

Fig. 2

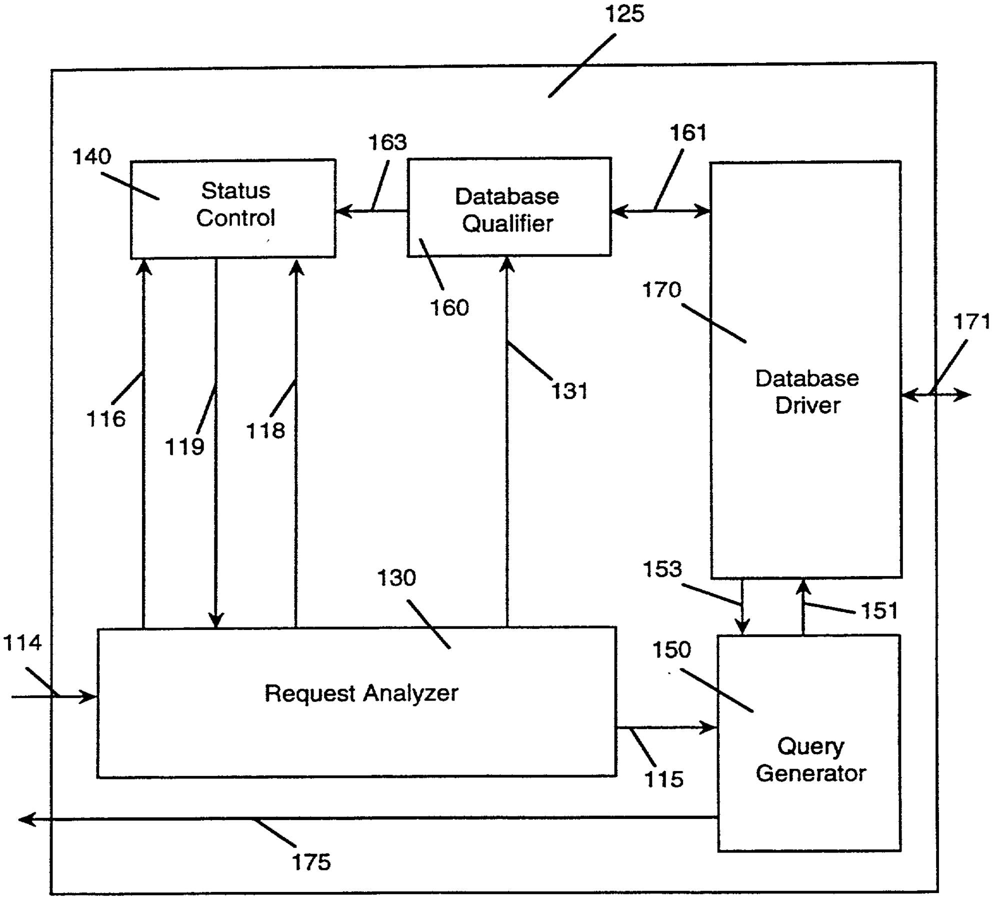
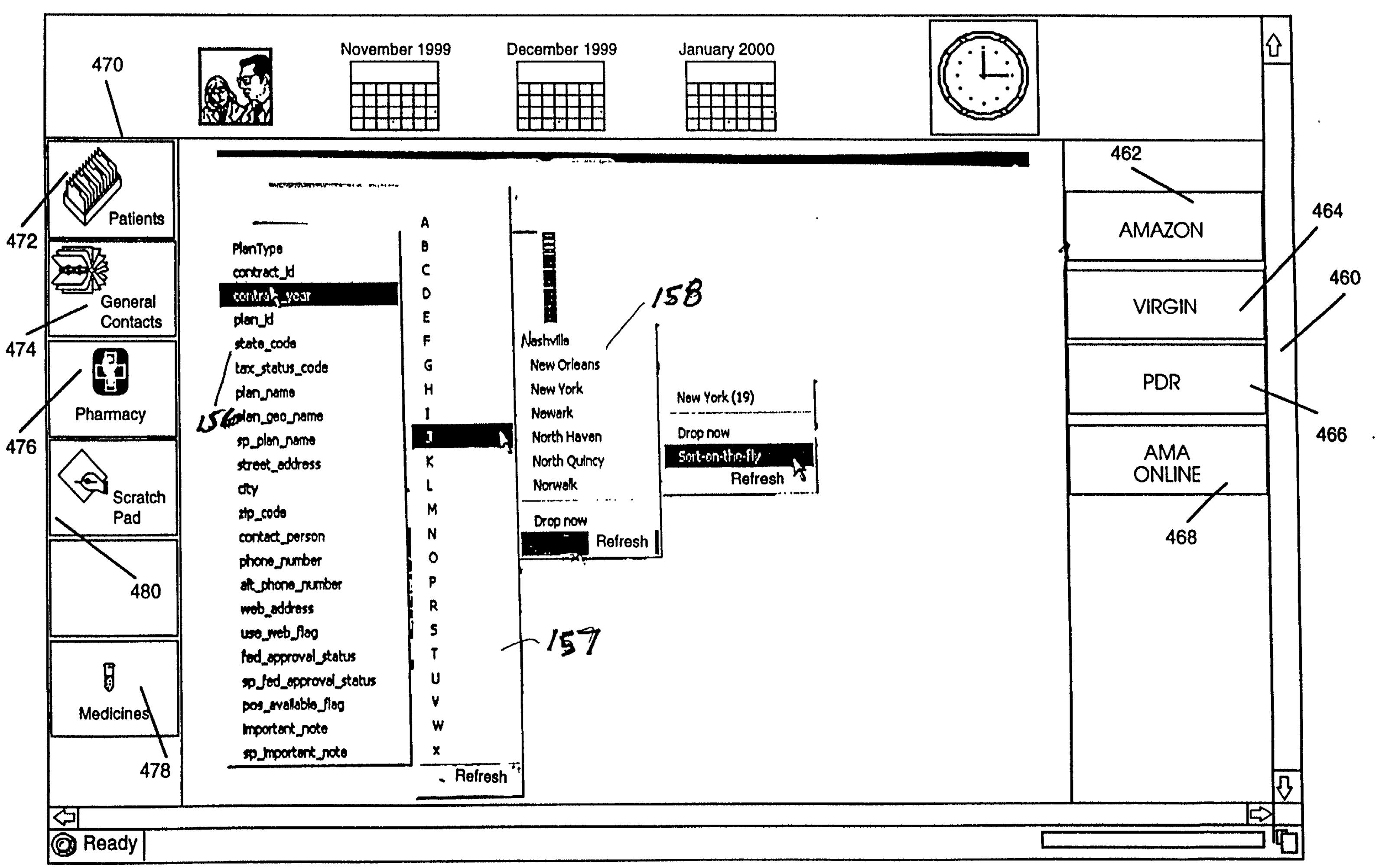

125
140
Status Control
163
Database Qualifier
161
160
170
Database Driver
171
131
116
119
118
130
153
151
114
150
Request Analyzer
Query Generator
115
175

Fig. 3

Fig. 4


450
470
472
474
476
480
478
462
464
460
466
468
156
157
158
November 1999
December 1999
January 2000
Patients
General Contacts
Pharmacy
Scratch Pad
Medicines
AMAZON
VIRGIN
PDR
AMA ONLINE
PlanType
contract_id
contract_year
plan_id
state_code
tax_status_code
plan_name
plan_geo_name
sp_plan_name
street_address
city
zip_code
contact_person
phone_number
alt_phone_number
web_address
use_web_flag
fed_approval_status
sp_fed_approval_status
pos_available_flag
important_note
sp_important_note
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
R
S
T
U
V
W
X
Refresh
Nashville
New Orleans
New York
Newark
North Haven
North Quincy
Norwalk
Drop now
Refresh
New York (19)
Drop now
Sort-on-the-fly
Refresh
Ready

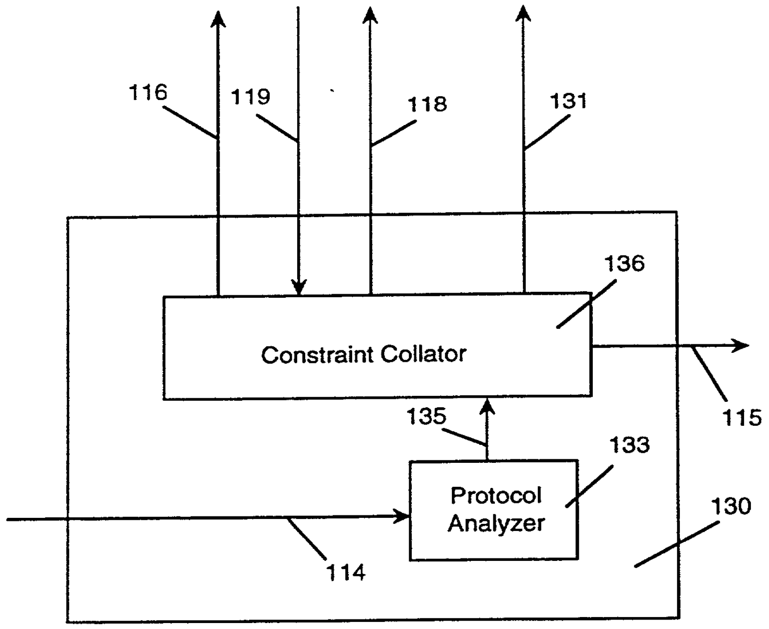

116
119
118
131
136
Constraint Collator
115
135
133
Protocol Analyzer
130
114

Fig. 5

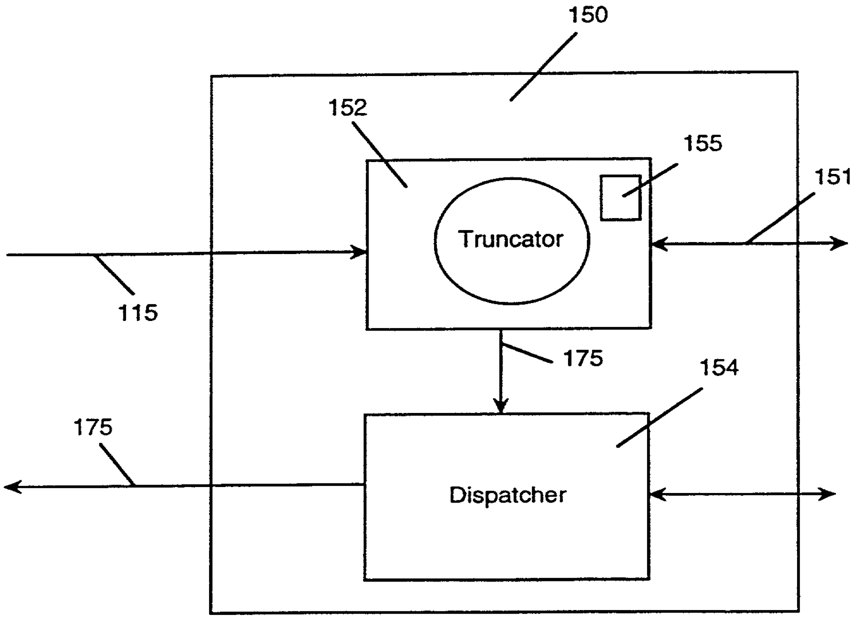


Fig. 6

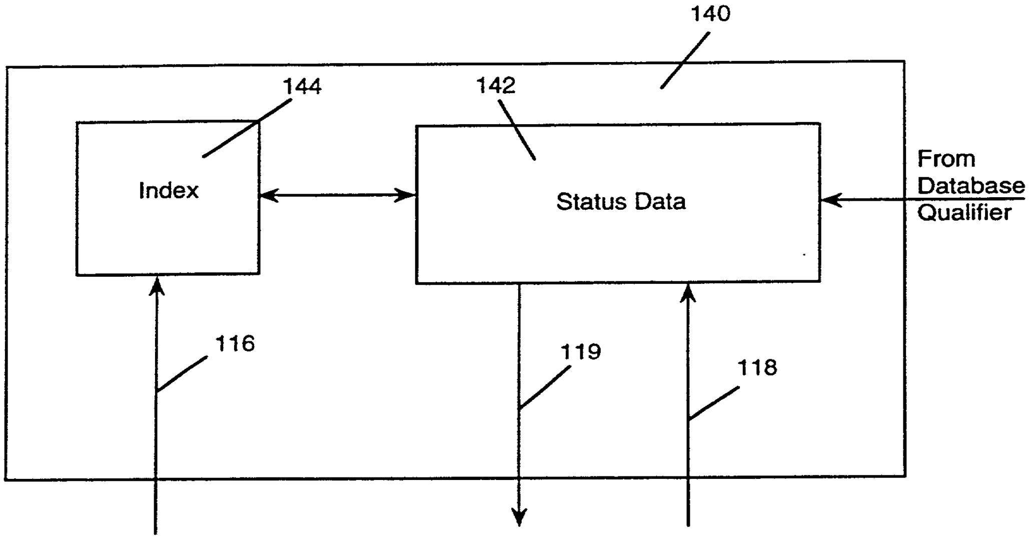

140
144
142
Index
Status Data
From Database Qualifier
116
119
118

Fig. 7

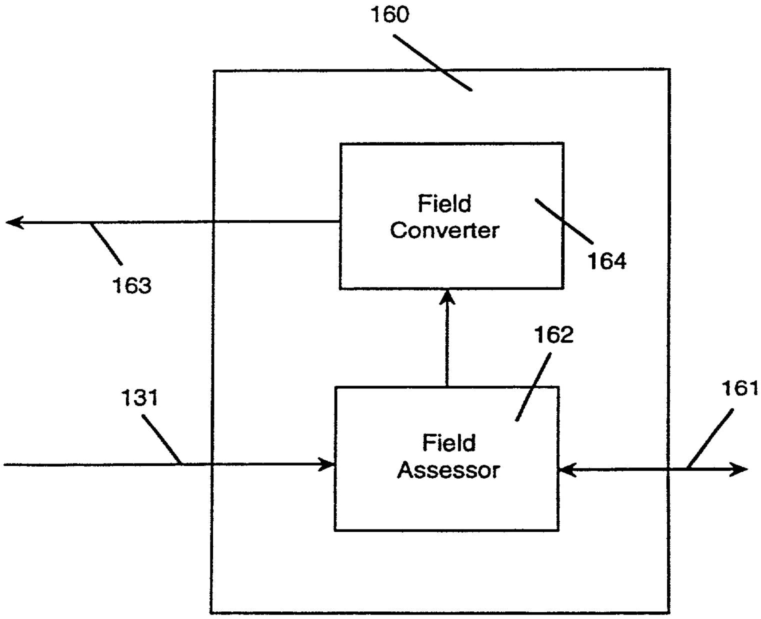


Fig. 8

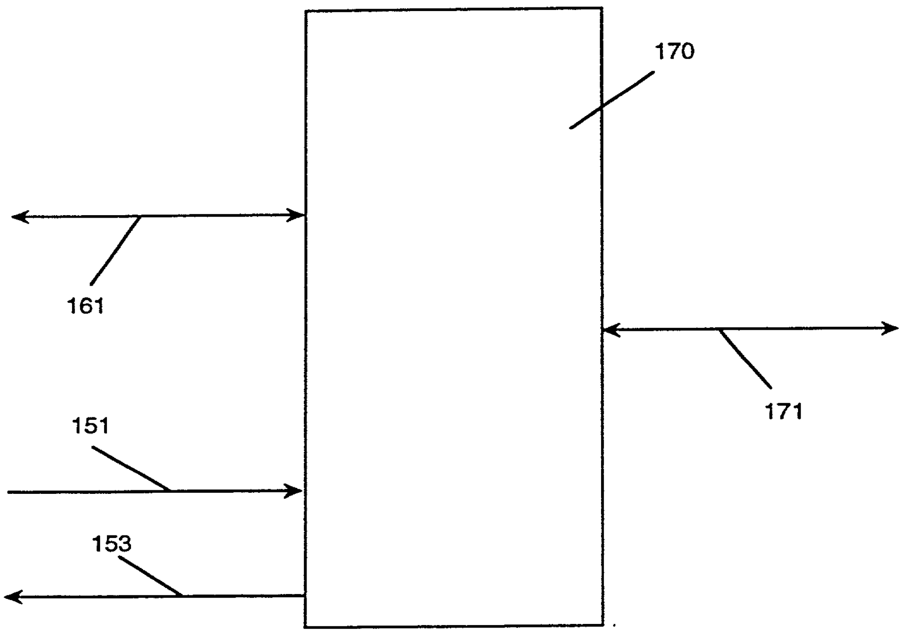
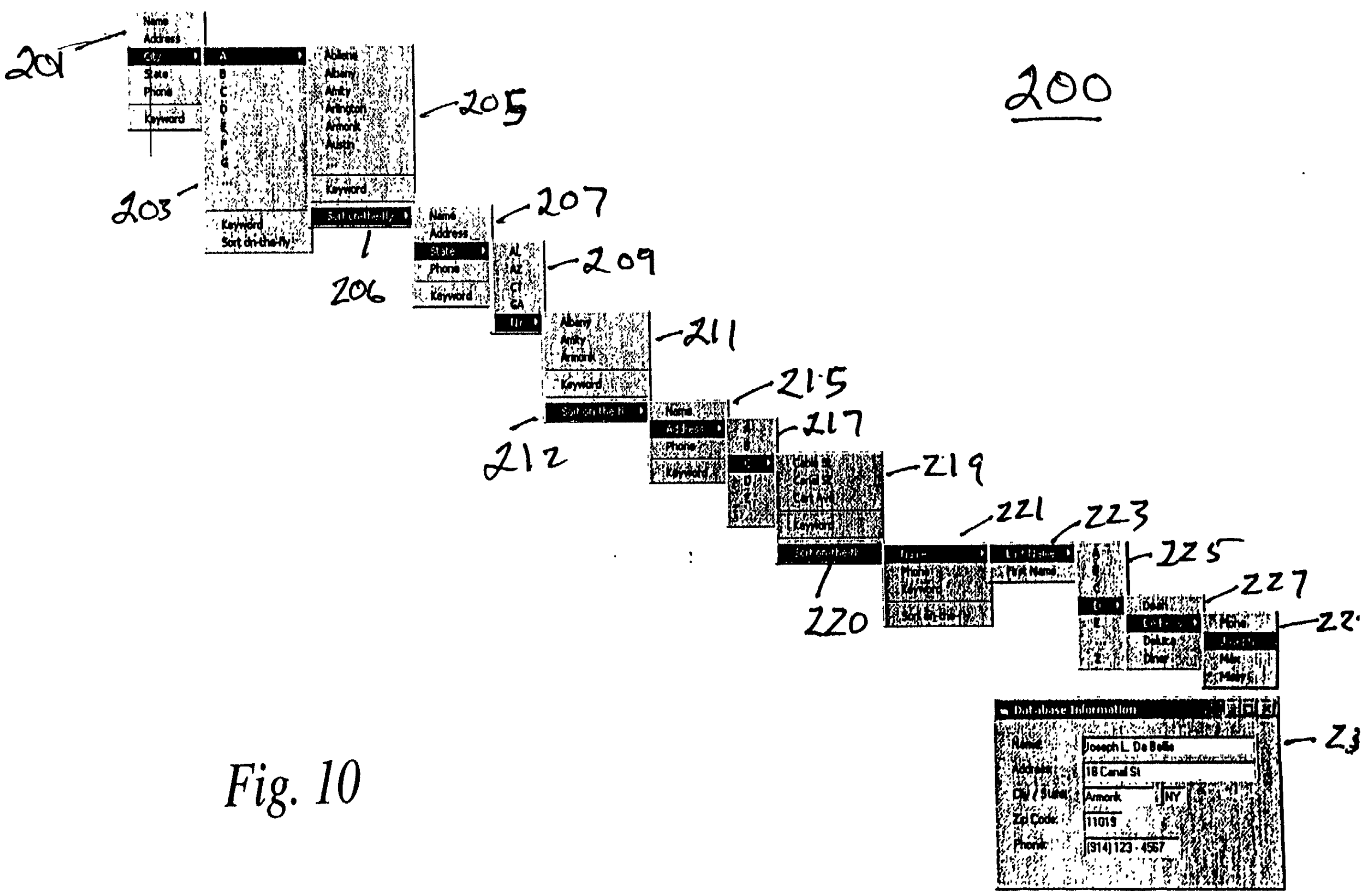


Fig. 9



Database Information

Name: Joseph L. De Bellis

Address: 18 Canal St

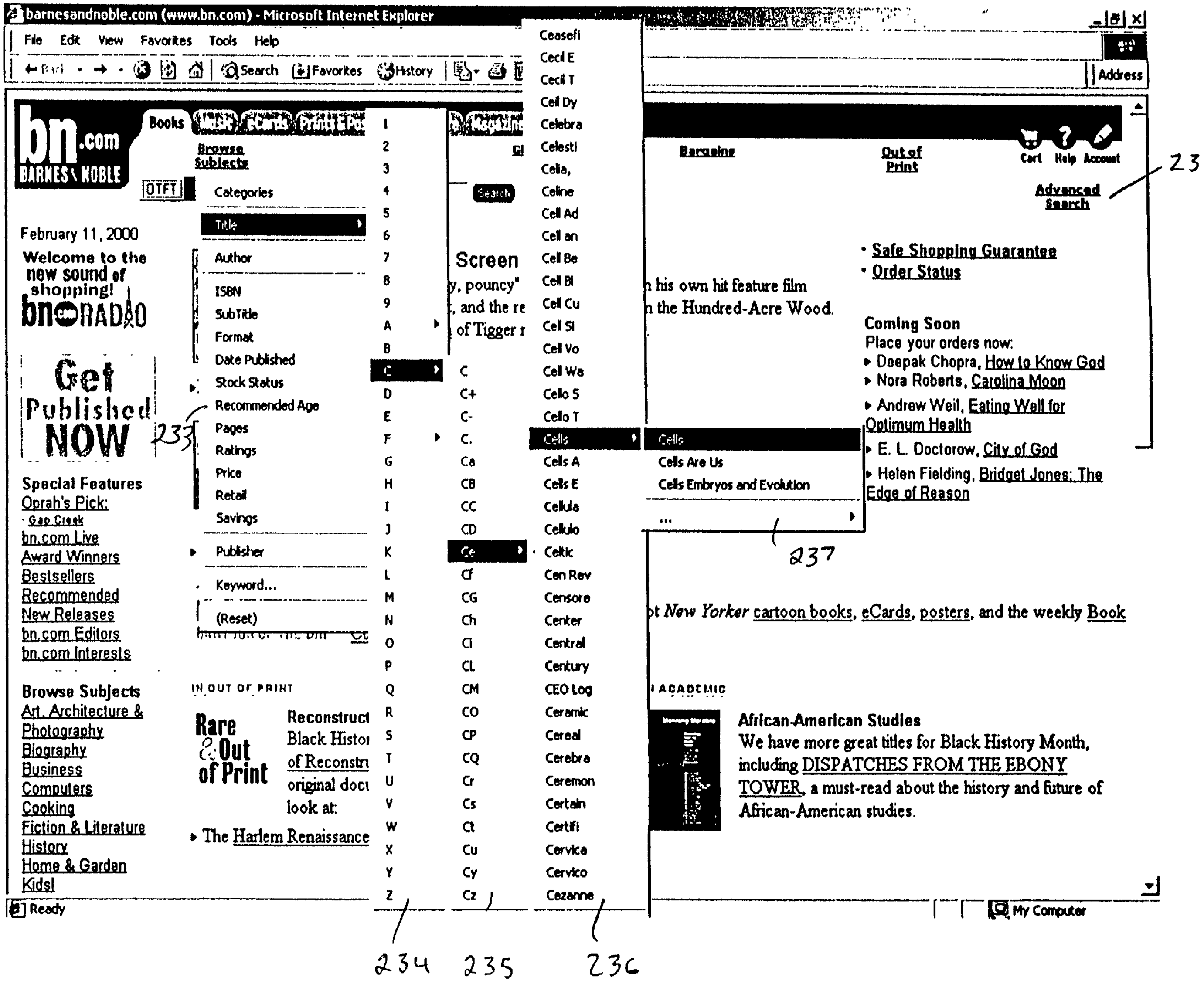
City / State: Armonk NY

Zip Code: 11019

Phone: (914) 123 - 4567

Fig. 10

Fig. 11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(Reset)
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Ceasefi Cecil E Cecil T Cell Dy Celebra Celesti Celia, Celine Cell Ad Cell an Cell Be Cell Bi Cell Cu Cell Si Cell Vo Cell Wa Cello S Cello T Cells Cells A Cells E Cellula Cellulo Celtic Cen Rev Censore Center Central Century CEO Log Ceramic Cereal Cerebra Ceremon Certain Certifi Cervica Cervico Cezanne
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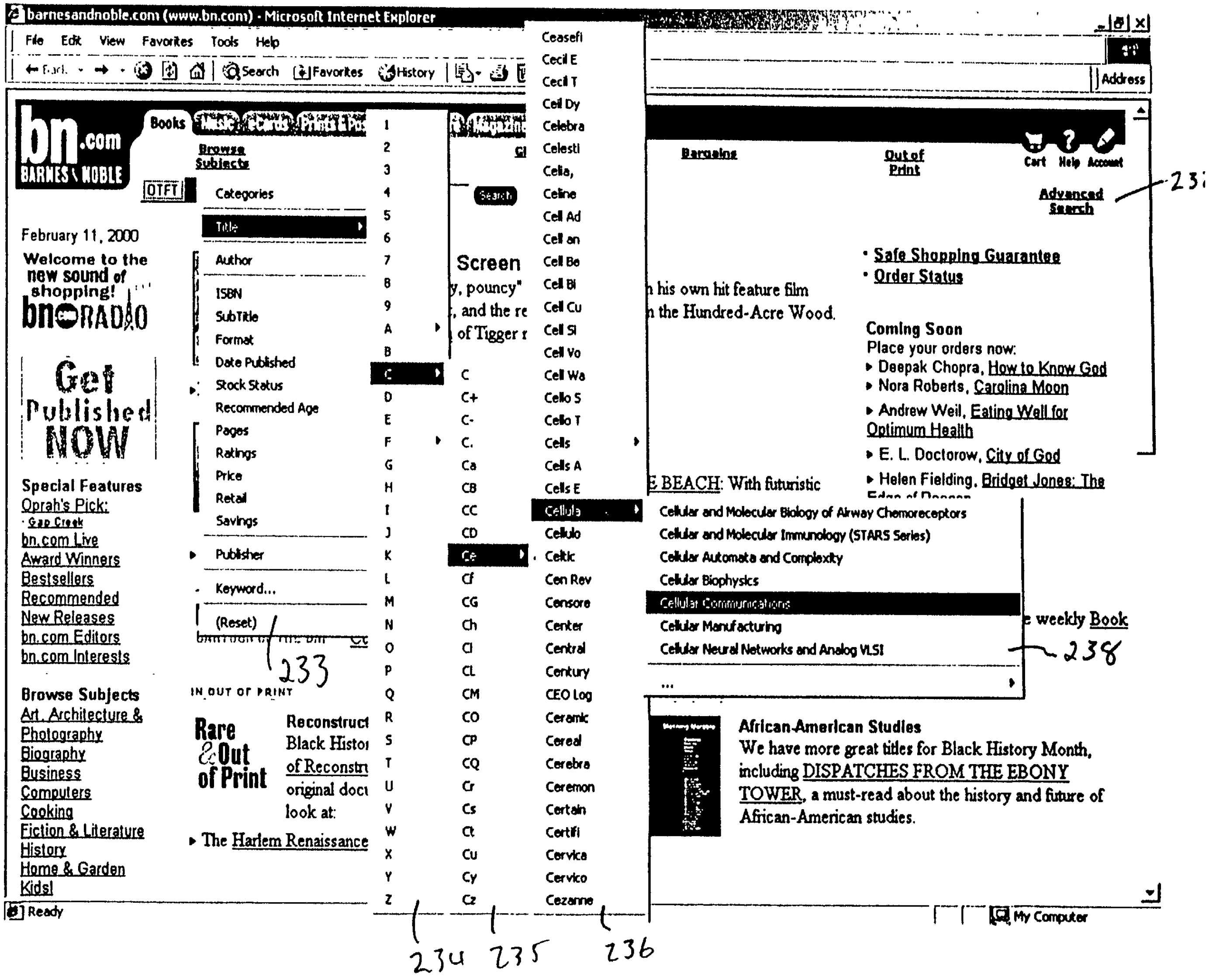
Fig. 12



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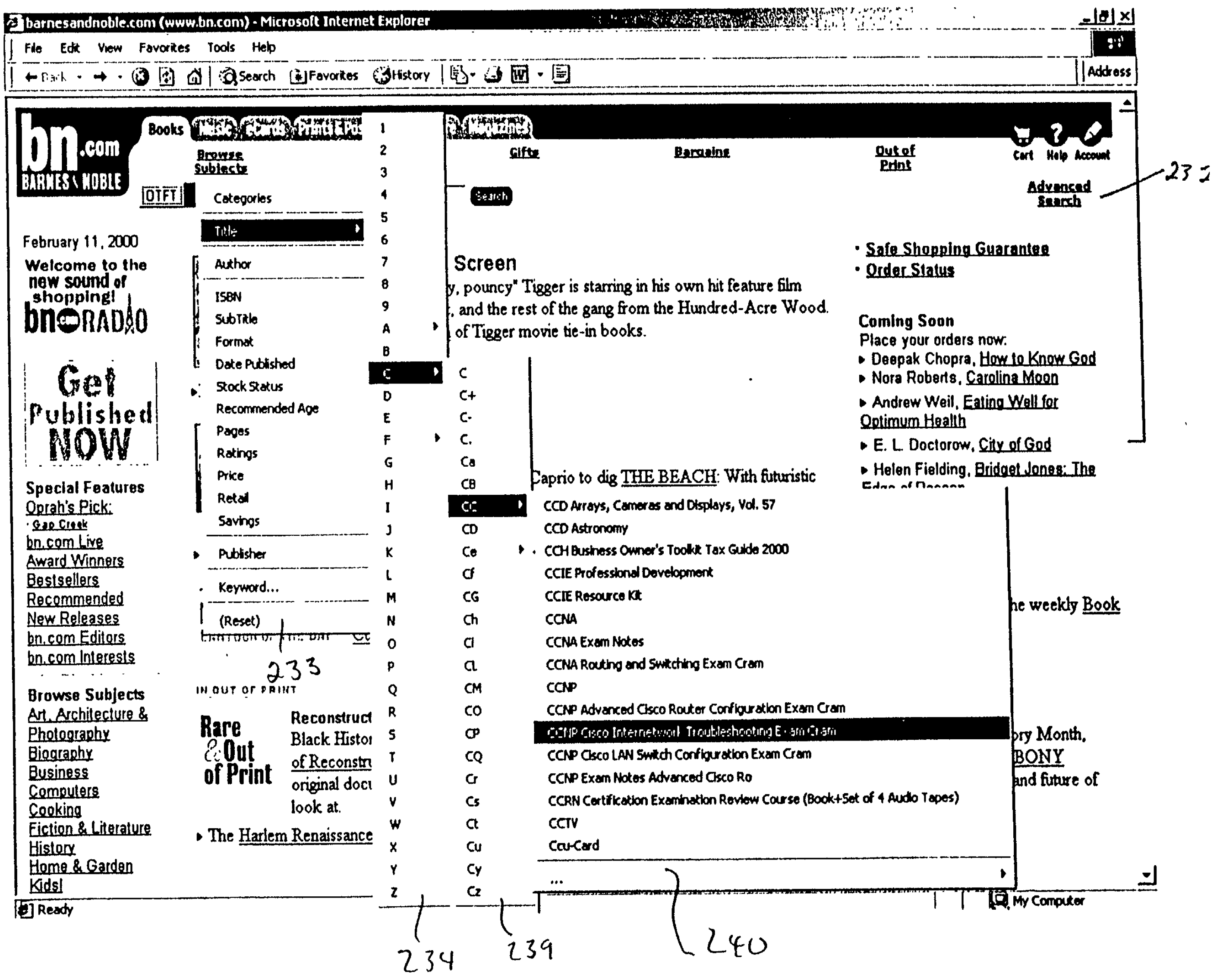

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Fig. 14

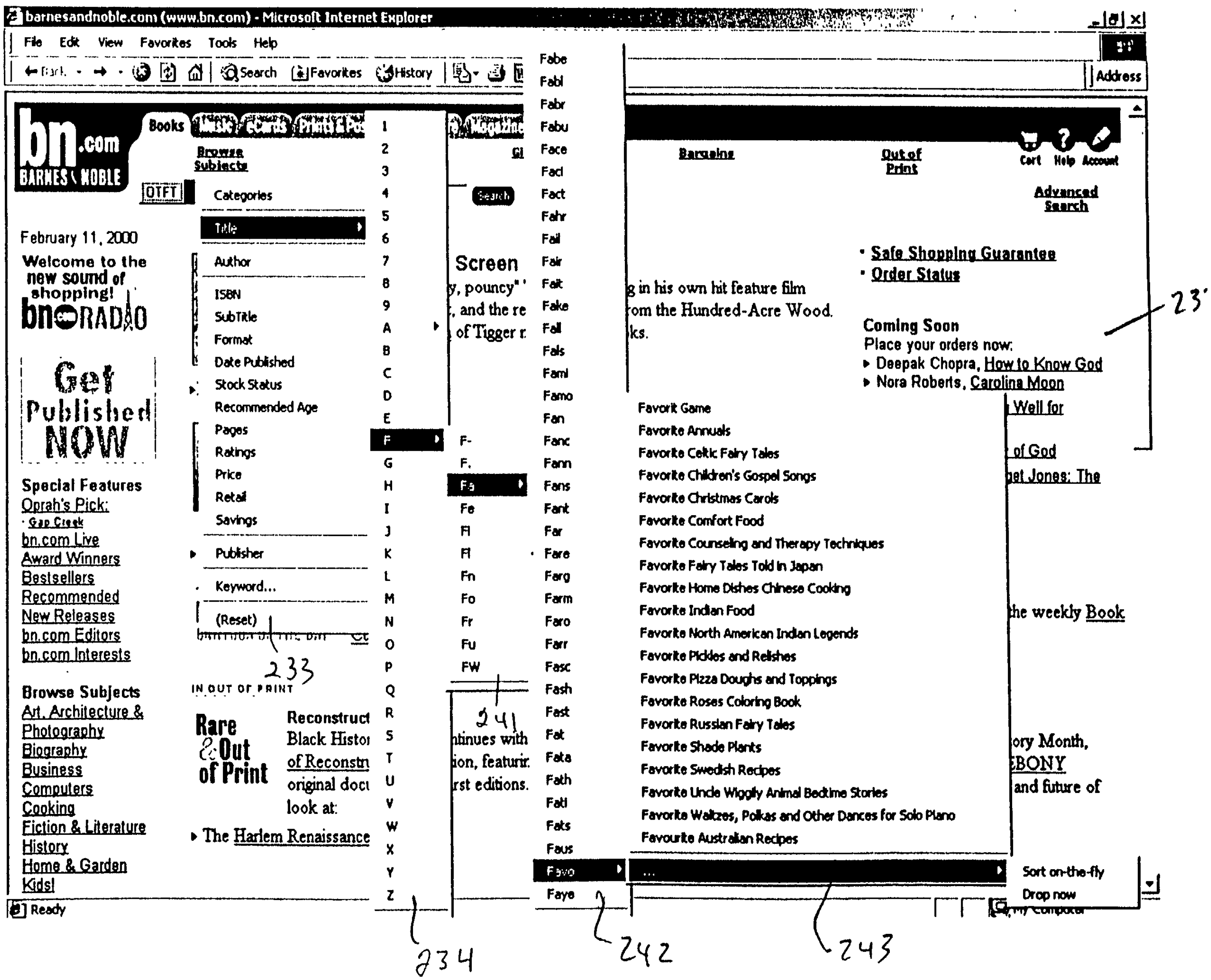

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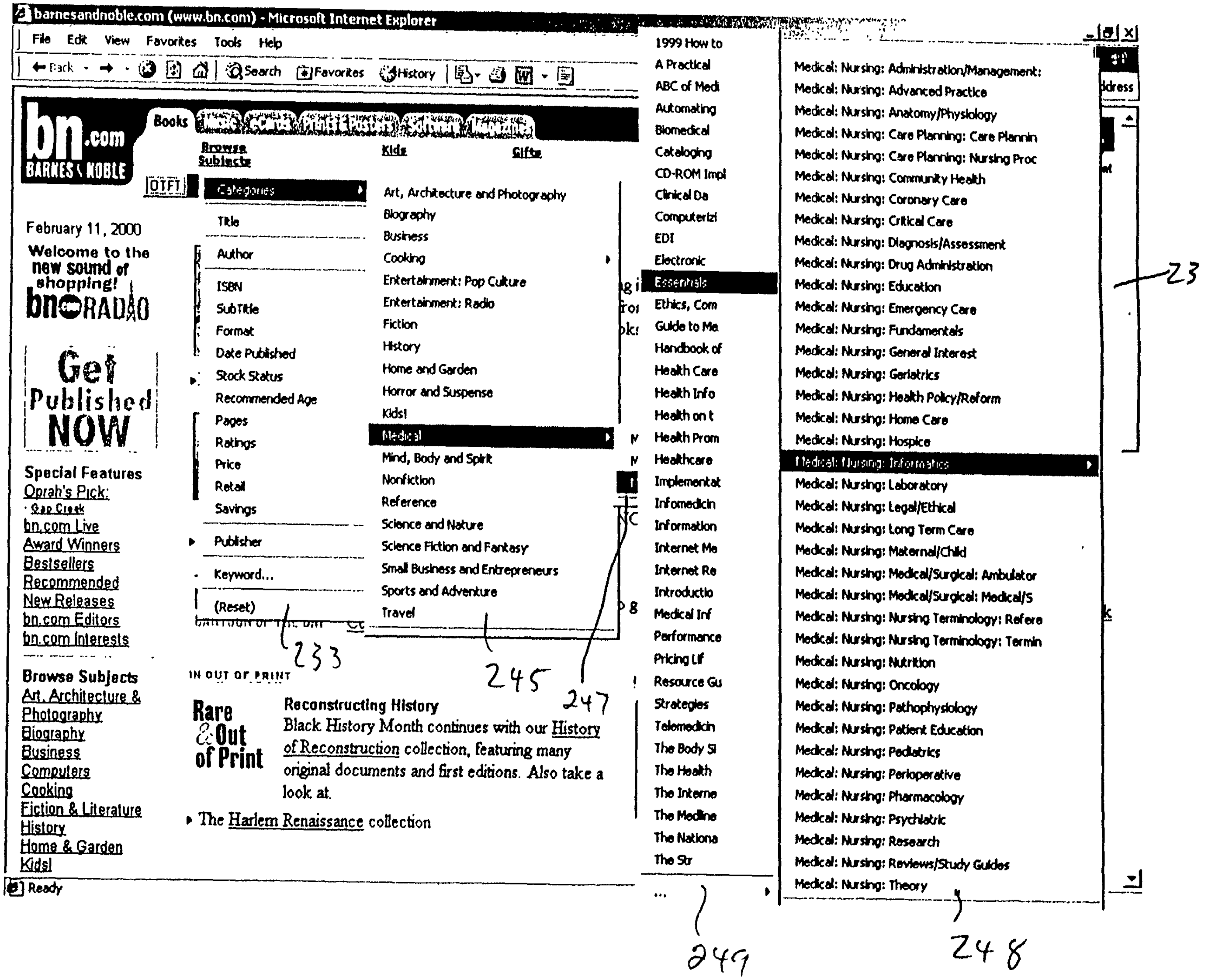
Fig. 15a



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Medical: Nursing: Community Health
Medical: Nursing: Coronary Care
Medical: Nursing: Critical Care
Medical: Nursing: Diagnosis/Assessment
Medical: Nursing: Drug Administration
Medical: Nursing: Education
Medical: Nursing: Emergency Care
Medical: Nursing: Fundamentals
Medical: Nursing: General Interest
Medical: Nursing: Geriatrics
Medical: Nursing: Health Policy/Reform
Medical: Nursing: Home Care
Medical: Nursing: Hospice
Medical: Nursing: Informatics
Medical: Nursing: Laboratory
Medical: Nursing: Legal/Ethical
Medical: Nursing: Long Term Care
Medical: Nursing: Maternal/Child
Medical: Nursing: Medical/Surgical: Ambulator
Medical: Nursing: Medical/Surgical: Medical/S
Medical: Nursing: Nursing Terminology: Refere
Medical: Nursing: Nursing Terminology: Termin
Medical: Nursing: Nutrition
Medical: Nursing: Oncology
Medical: Nursing: Pathophysiology
Medical: Nursing: Patient Education
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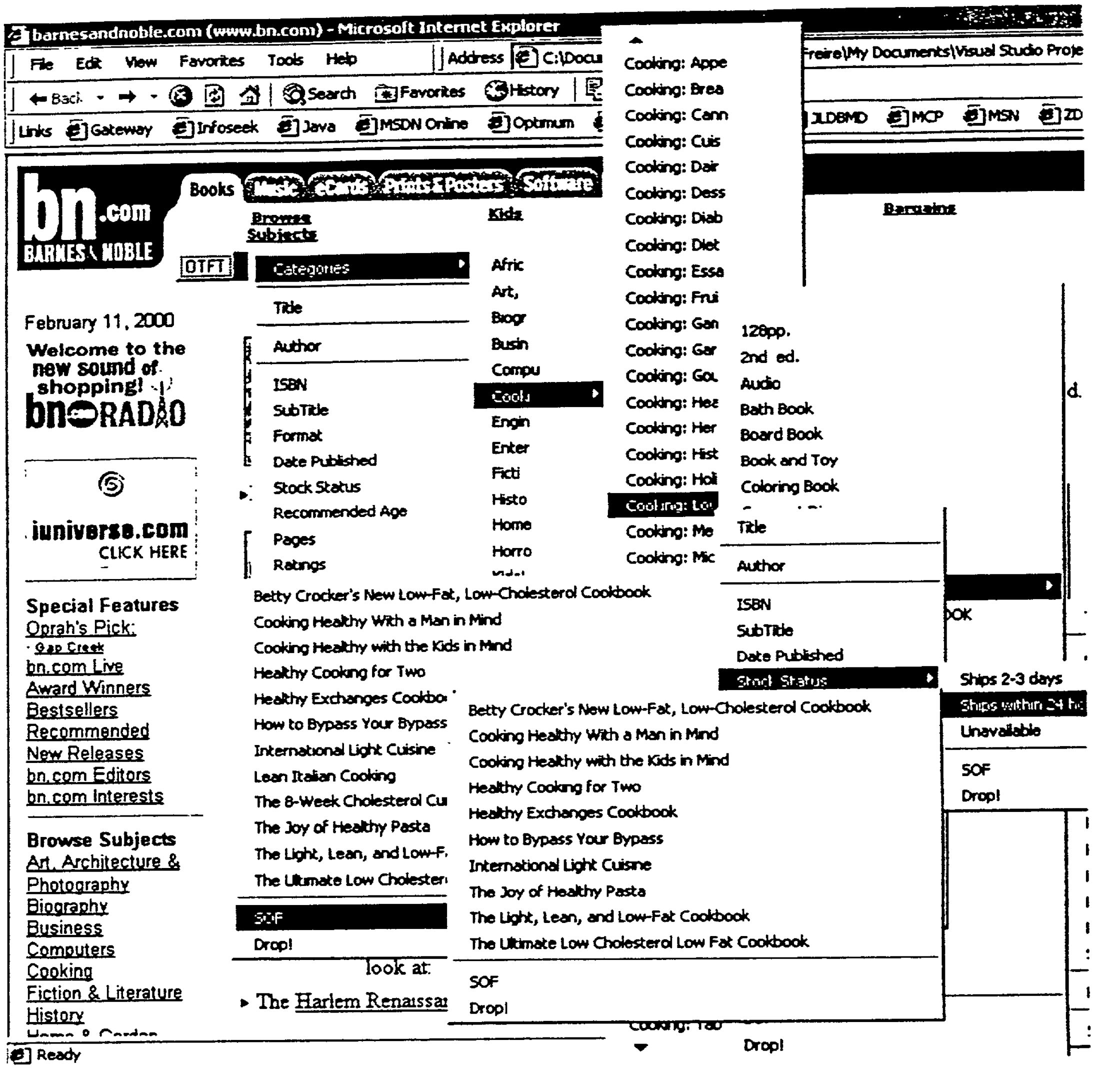
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Cooking: Essa
Cooking: Frui
Cooking: Gan
Cooking: Gar
Cooking: Gou
Cooking: Hea
Cooking: Her
Cooking: Hist
Cooking: Holi
Cooking: Lo
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2nd ed.
Audio
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Title
Author
ISBN
SubTitle
Date Published
Stock Status
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Cooking Healthy With a Man in Mind
Cooking Healthy with the Kids in Mind
Healthy Cooking for Two
Healthy Exchanges Cookbo
How to Bypass Your Bypass
International Light Cuisine
Lean Italian Cooking
The 8-Week Cholesterol Cu
The Joy of Healthy Pasta
The Light, Lean, and Low-F
The Ultimate Low Cholester
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How to Bypass Your Bypass
International Light Cuisine
The Joy of Healthy Pasta
The Light, Lean, and Low-Fat Cookbook
The Ultimate Low Cholesterol Low Fat Cookbook
SOF
Drop!
Cooking: Tab
Drop!
OK
Ready

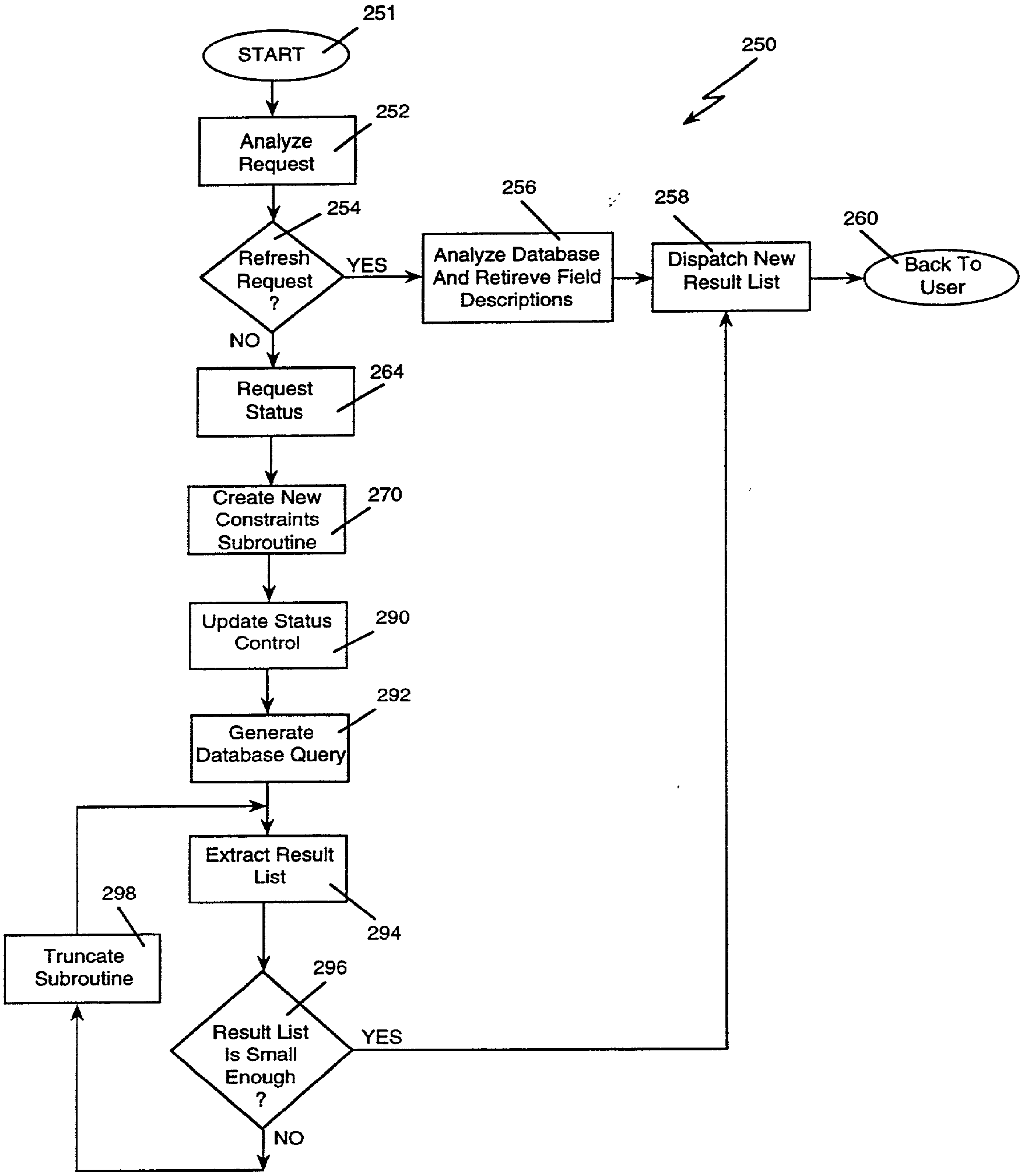

251
START
250
252
Analyze Request
254
Refresh Request ?
YES
NO
256
Analyze Database And Retireve Field Descriptions
258
Dispatch New Result List
260
Back To User
264
Request Status
270
Create New Constraints Subroutine
290
Update Status Control
292
Generate Database Query
Extract Result List
294
298
Truncate Subroutine
296
Result List Is Small Enough ?
YES
NO

Fig. 16

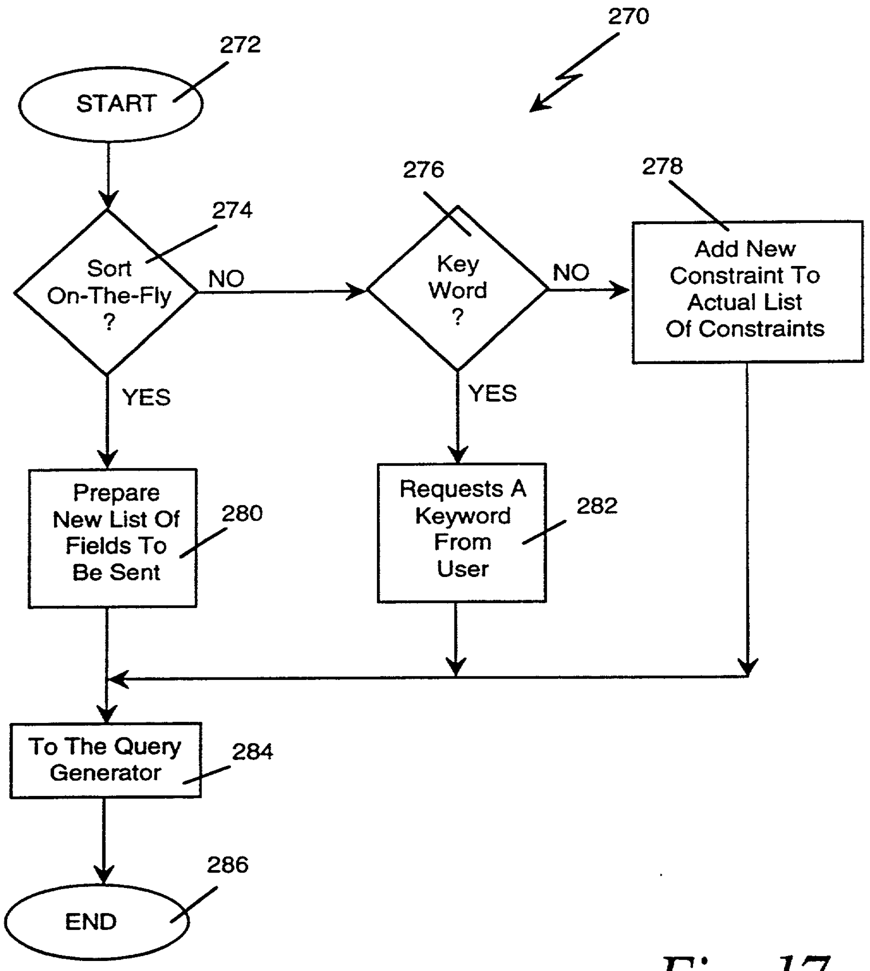

270
272
START
274
Sort On-The-Fly ?
NO
276
Key Word ?
NO
278
Add New Constraint To Actual List Of Constraints
YES
YES
Prepare New List Of Fields To Be Sent
280
Requests A Keyword From User
282
To The Query Generator
284
286
END

Fig. 17

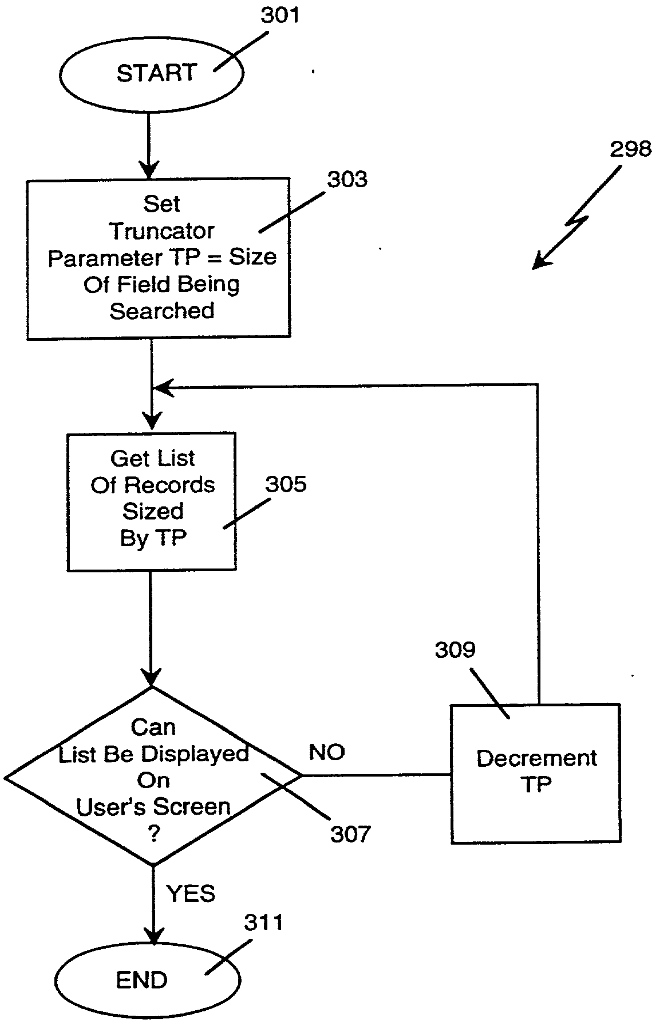

301
START
298
303
Set Truncator Parameter TP = Size Of Field Being Searched
Get List Of Records Sized By TP
305
309
Can List Be Displayed On User's Screen ?
NO
Decrement TP
307
YES
311
END

Fig. 18

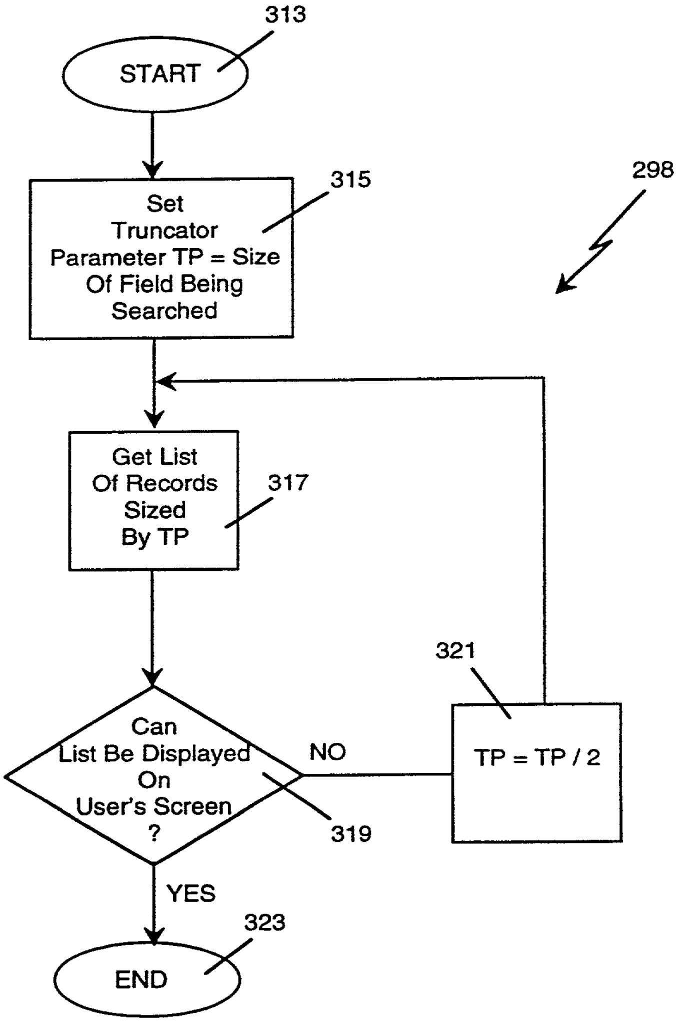

313
START
Set Truncator Parameter TP = Size Of Field Being Searched
315
298
Get List Of Records Sized By TP
317
321
Can List Be Displayed On User's Screen ?
NO
TP = TP / 2
319
YES
323
END

Fig. 19

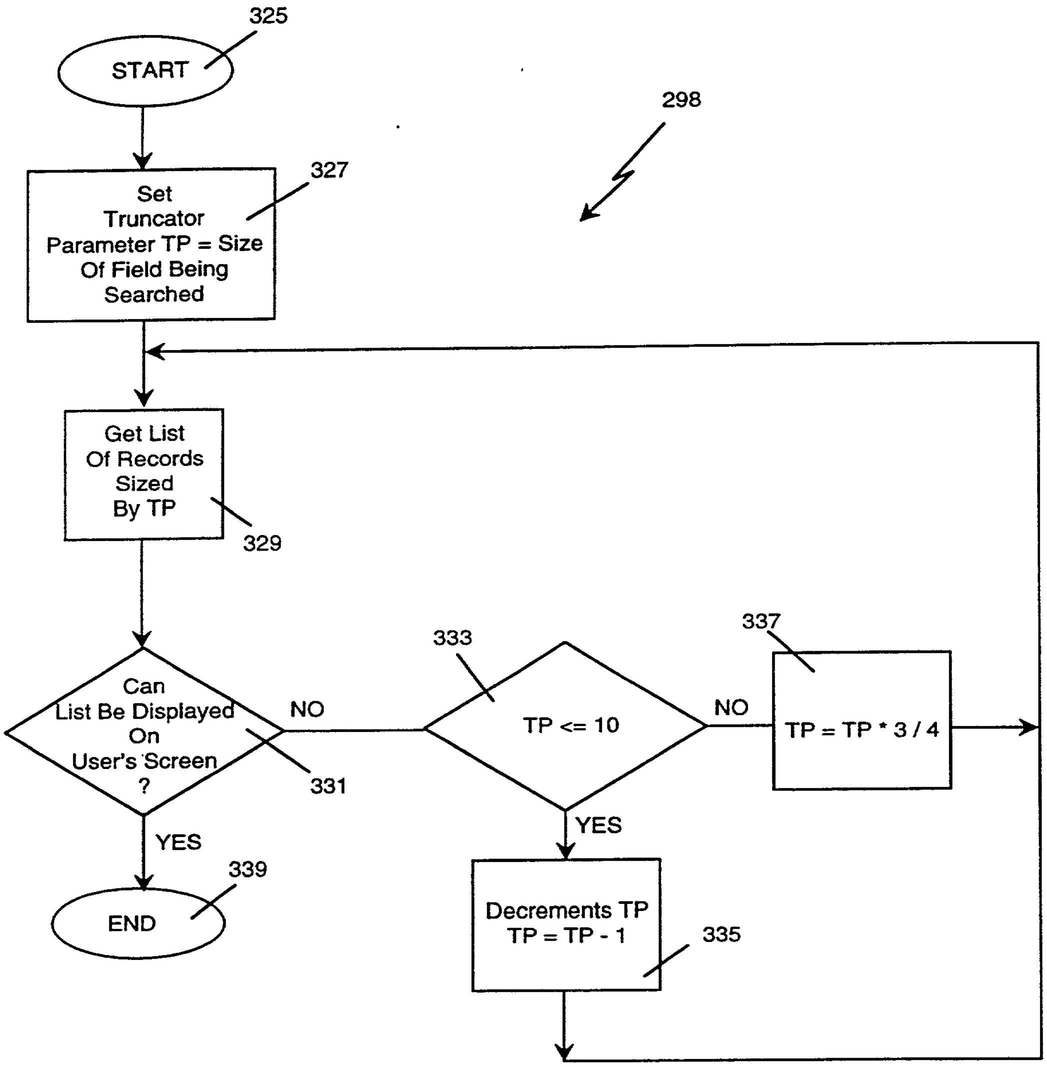

325
START
298
327
Set Truncator Parameter TP = Size Of Field Being Searched
Get List Of Records Sized By TP
329
333
337
Can List Be Displayed On User's Screen ?
NO
TP <= 10
NO
TP = TP * 3 / 4
331
YES
YES
339
END
Decrements TP TP = TP - 1
335

Fig. 20

Fig. 21

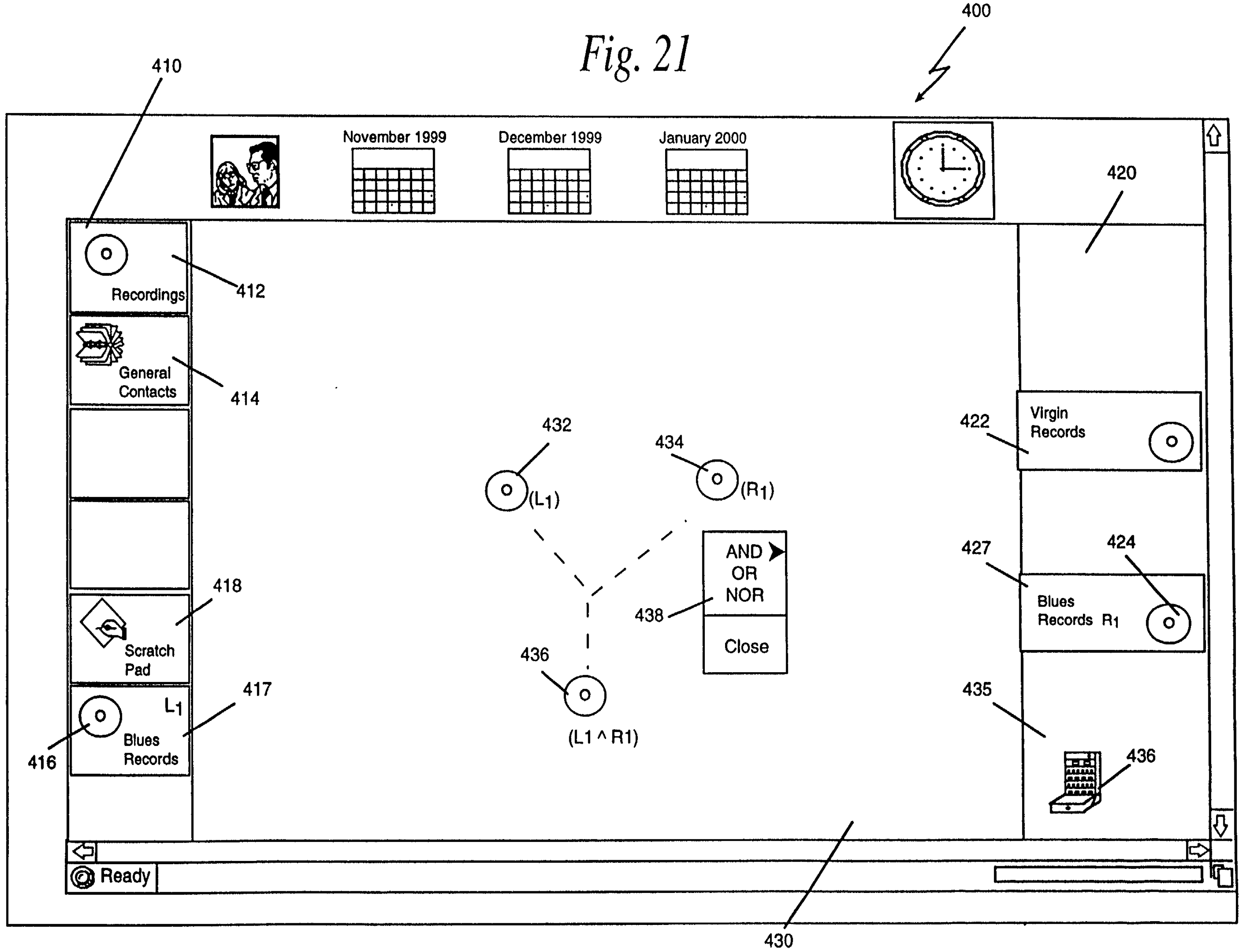

400
410
November 1999
December 1999
January 2000
420
Recordings
412
General
Contacts
414
432
(L1)
434
(R1)
422
Virgin
Records
AND
OR
NOR
Close
438
427
424
Blues
Records R1
418
Scratch
Pad
436
417
L1
Blues
Records
416
(L1 ^ R1)
435
436
Ready
430

Fig. 22

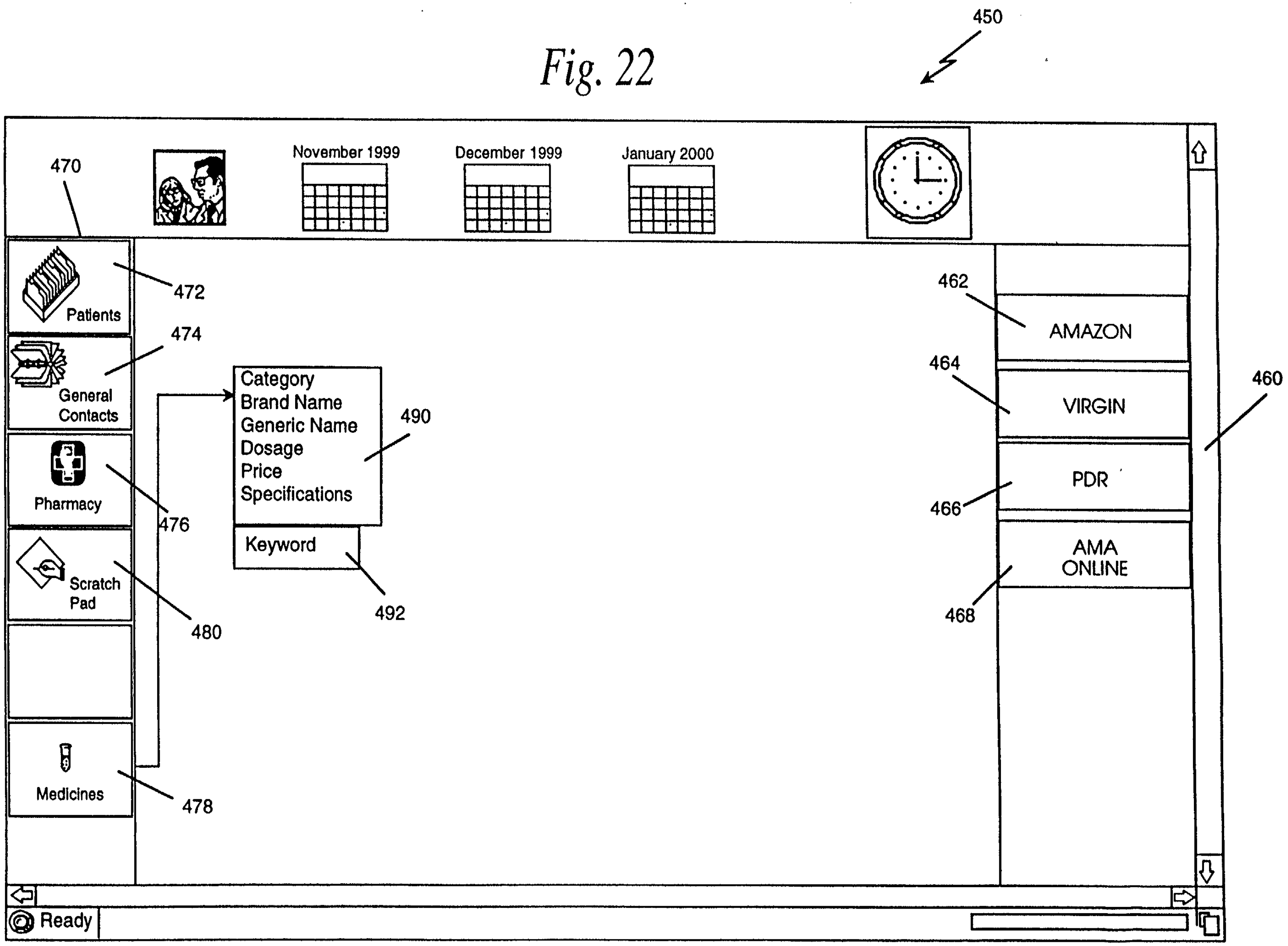
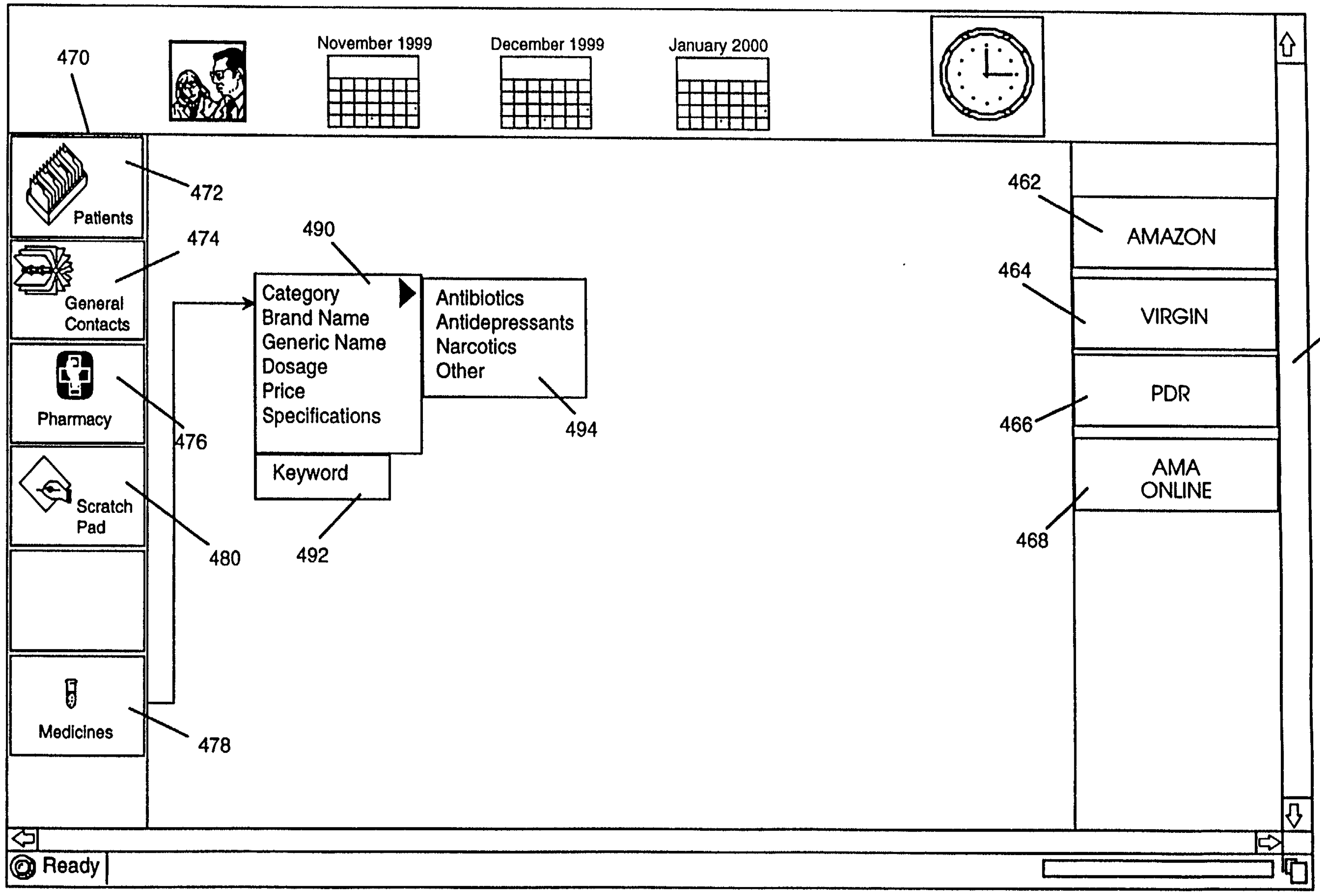

450
470
November 1999
December 1999
January 2000
Patients
472
General Contacts
474
Pharmacy
476
Scratch Pad
480
Medicines
478
Category
Brand Name
Generic Name
Dosage
Price
Specifications
490
Keyword
492
462
AMAZON
464
VIRGIN
466
PDR
468
AMA ONLINE
460
Ready

Fig. 23


450
470
November 1999
December 1999
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Patients
472
General Contacts
474
Pharmacy
476
Scratch Pad
480
Medicines
478
490
Category
Brand Name
Generic Name
Dosage
Price
Specifications
Keyword
492
Antibiotics
Antidepressants
Narcotics
Other
494
462
AMAZON
464
VIRGIN
466
PDR
468
AMA ONLINE
460
Ready

Fig. 24

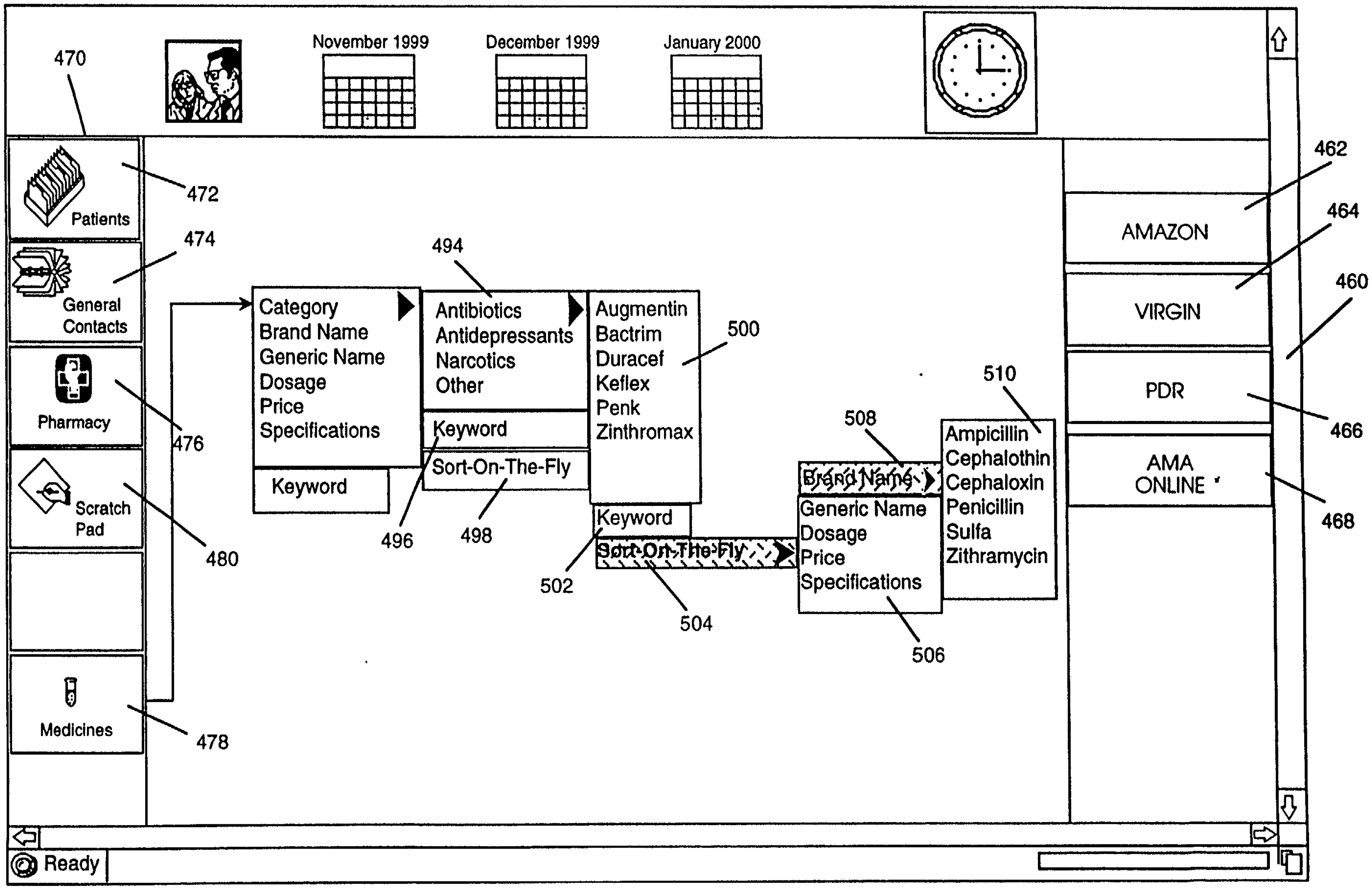

450
470
November 1999
December 1999
January 2000
Patients
472
General Contacts
474
Pharmacy
476
Scratch Pad
480
Medicines
478
Category
Brand Name
Generic Name
Dosage
Price
Specifications
Keyword
494
Antibiotics
Antidepressants
Narcotics
Other
Keyword
Sort-On-The-Fly
496
498
Augmentin
Bactrim
Duracef
Keflex
Penk
Zinthromax
500
Keyword
Sort-On-The-Fly
502
504
508
Brand Name
Generic Name
Dosage
Price
Specifications
506
510
Ampicillin
Cephalothin
Cephaloxin
Penicillin
Sulfa
Zithramycin
AMAZON
462
VIRGIN
464
460
PDR
466
AMA ONLINE
468
Ready

Fig. 25

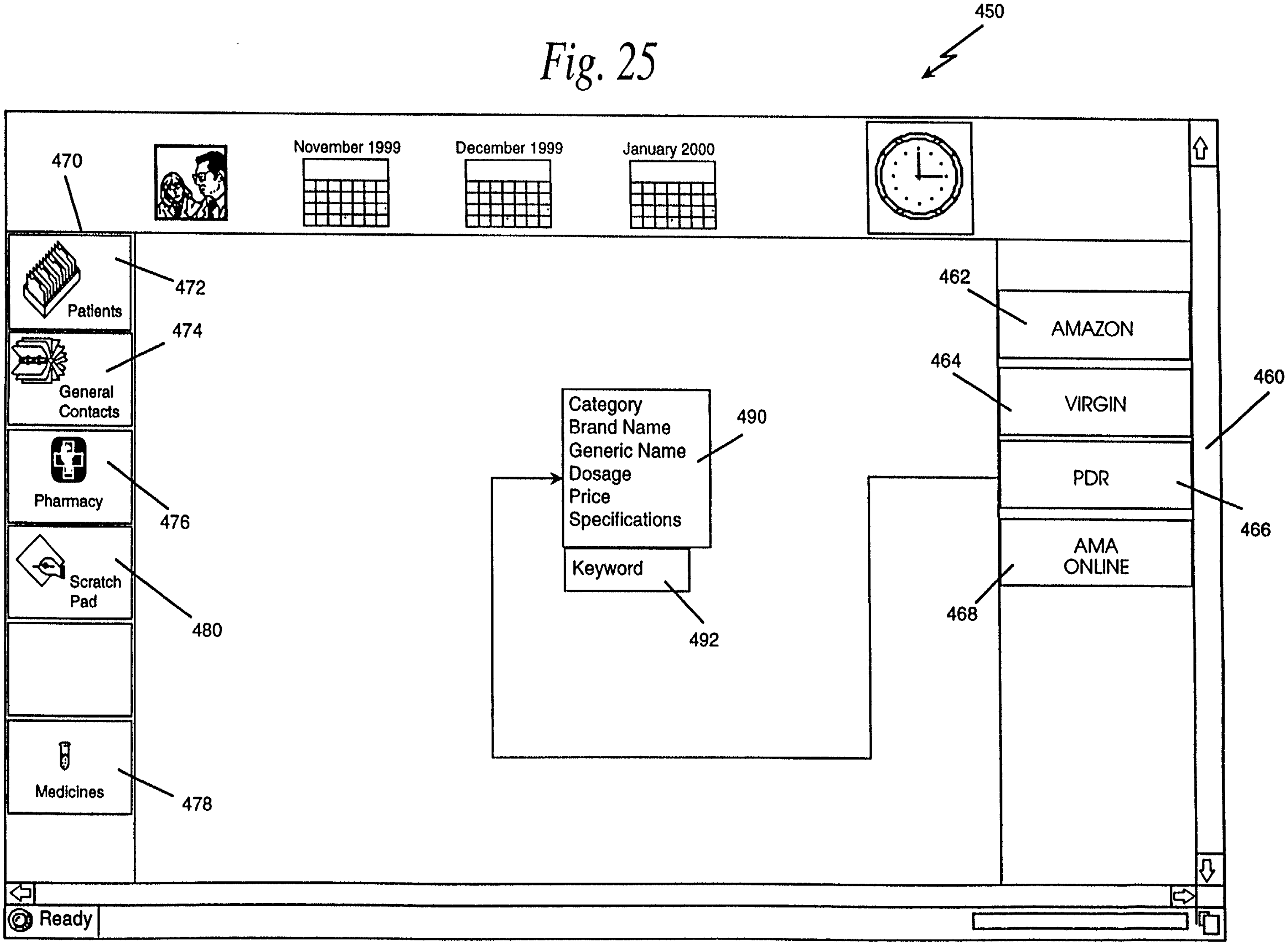
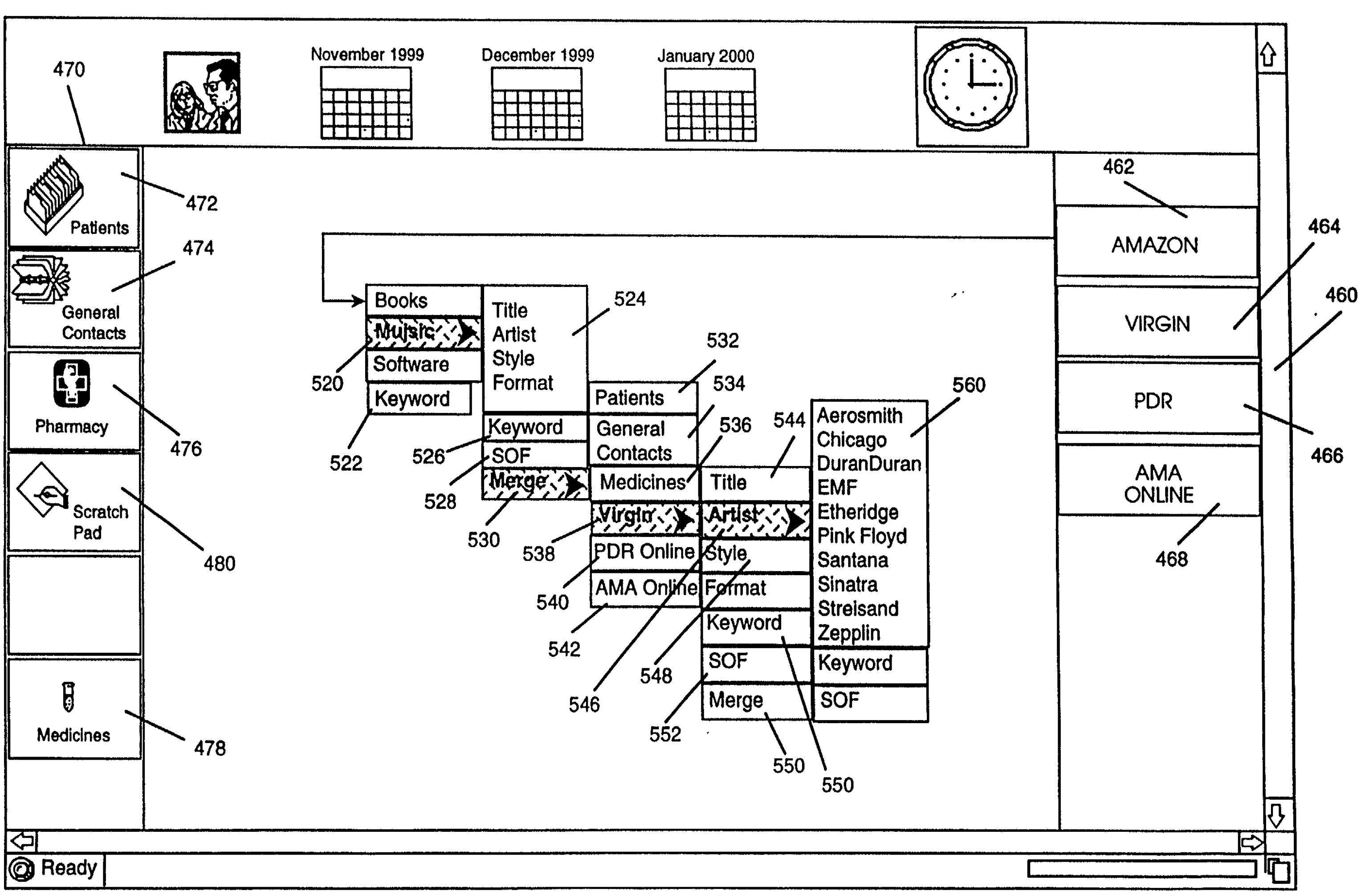

450
470
November 1999
December 1999
January 2000
Patients
472
General Contacts
474
Pharmacy
476
Scratch Pad
480
Medicines
478
Category
Brand Name
Generic Name
Dosage
Price
Specifications
490
Keyword
492
462
AMAZON
464
VIRGIN
PDR
466
AMA ONLINE
468
460
Ready

Fig. 26



450
470
November 1999
December 1999
January 2000
Patients
472
General Contacts
474
Pharmacy
476
Scratch Pad
480
Medicines
478
Books
Music
Software
Keyword
520
522
Title
Artist
Style
Format
524
Keyword
SOF
Merge
526
528
530
Patients
General Contacts
Medicines
Virgin
PDR Online
AMA Online
532
534
536
538
540
542
Title
Artist
Style
Format
Keyword
SOF
Merge
544
546
548
552
550
550
Aerosmith
Chicago
DuranDuran
EMF
Etheridge
Pink Floyd
Santana
Sinatra
Streisand
Zepplin
Keyword
SOF
560
462
AMAZON
VIRGIN
PDR
AMA ONLINE
464
460
466
468
Ready

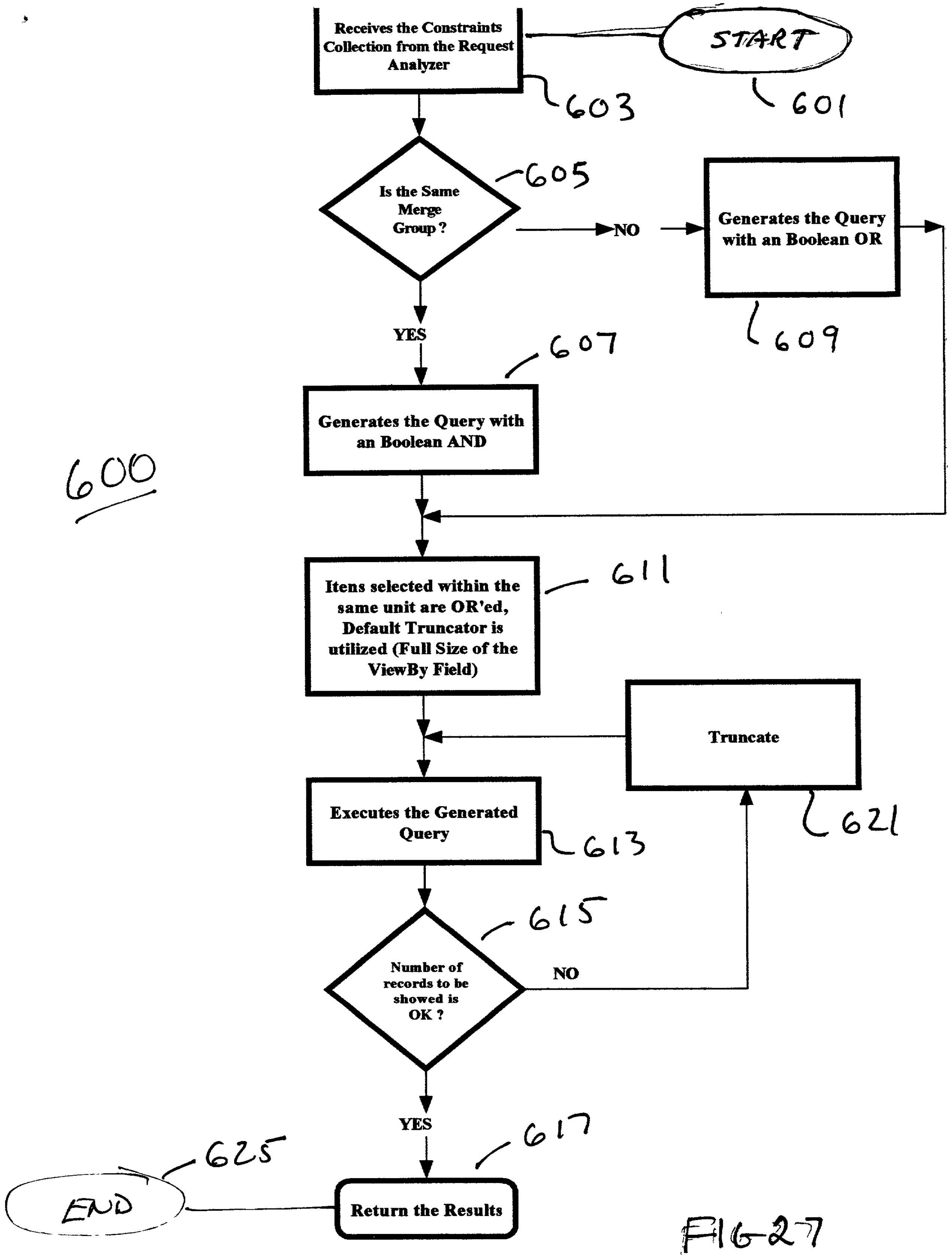
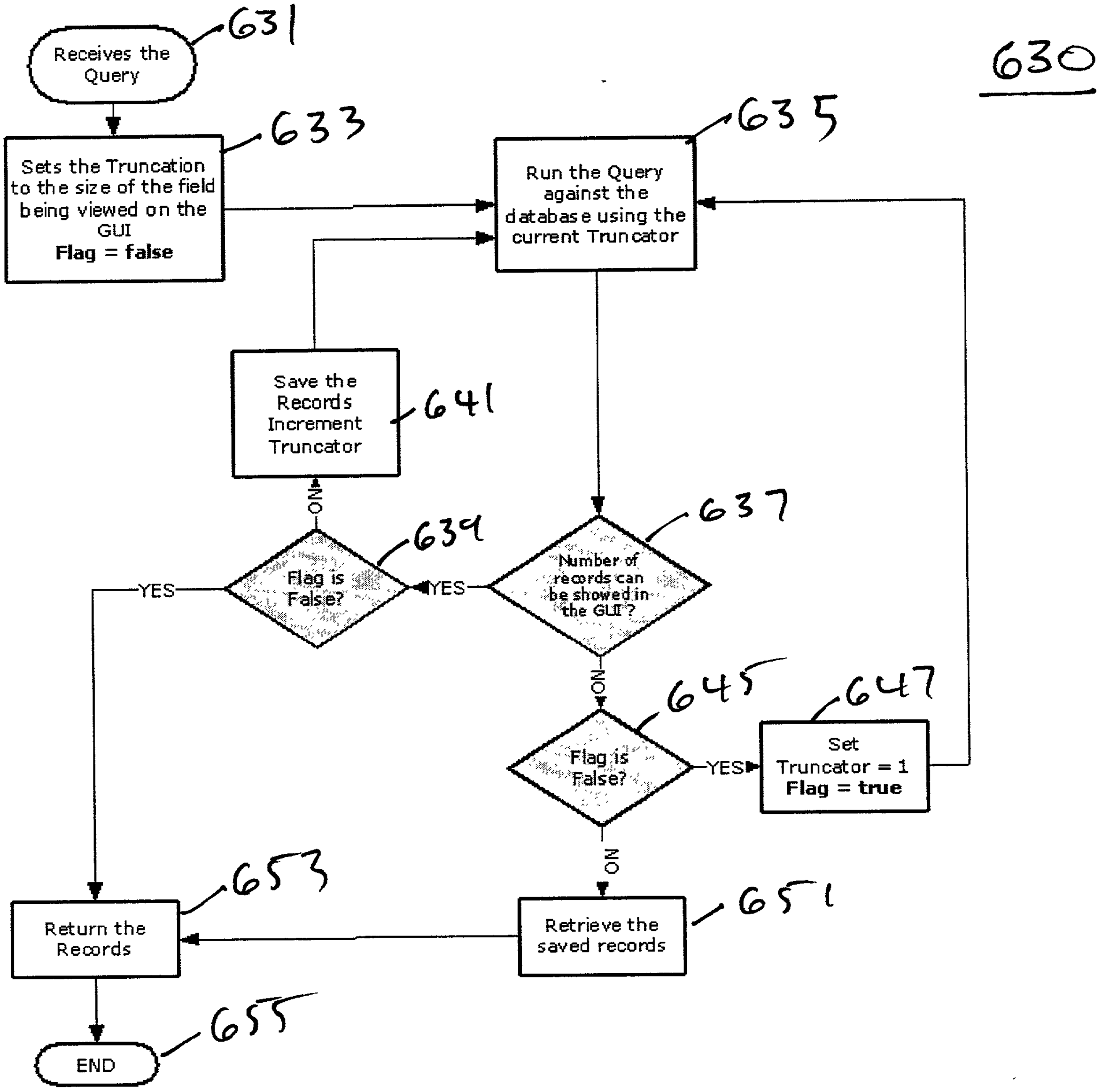
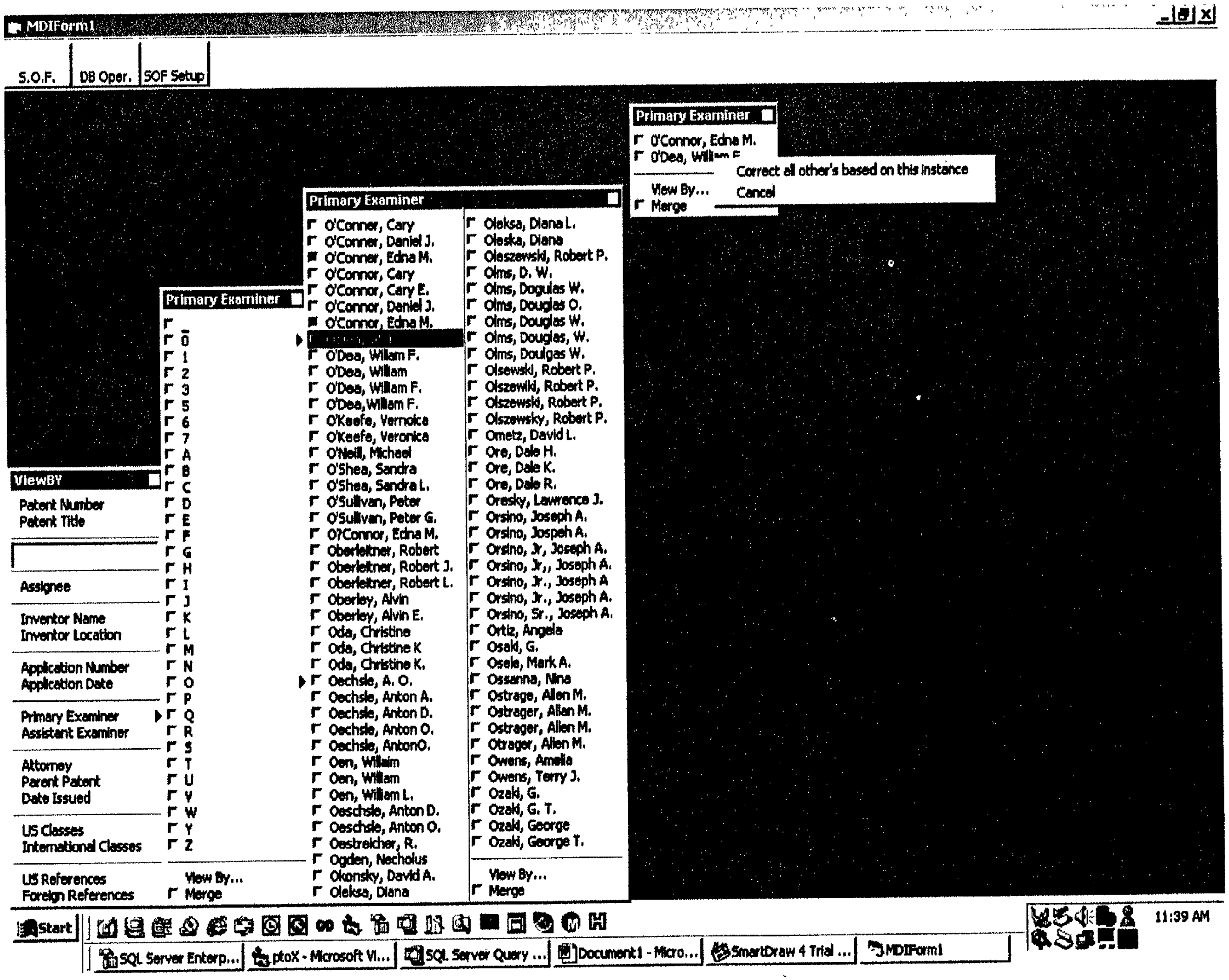

START
601
Receives the Constraints Collection from the Request Analyzer
603
Is the Same Merge Group ?
605
NO
Generates the Query with an Boolean OR
609
YES
607
Generates the Query with an Boolean AND
600
611
Itens selected within the same unit are OR'ed, Default Truncator is utilized (Full Size of the ViewBy Field)
Truncate
621
Executes the Generated Query
613
615
Number of records to be showed is OK ?
NO
YES
617
625
END
Return the Results

FIG 27



631
Receives the Query
630
633
Sets the Truncation to the size of the field being viewed on the GUI
Flag = false
635
Run the Query against the database using the current Truncator
Save the Records Increment Truncator
641
NO
639
Flag is False?
YES
YES
637
Number of records can be showed in the GUI ?
NO
645
647
Flag is False?
YES
Set Truncator = 1
Flag = true
NO
653
Return the Records
651
Retrieve the saved records
655
END

FIG. 28



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S.O.F. | DB Oper. | SOF Setup

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- Application Date
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- Assistant Examiner
- Attorney
- Parent Patent
- Date Issued
- US Classes
- International Classes
- US References
- Foreign References

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- ☐ 7
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- ☐ D
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- ☐ F
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- ☐ H
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- ☐ J
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- ☐ L
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- ☐ O
- ☐ P
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- ☐ R
- ☐ S
- ☐ T
- ☐ U
- ☐ V
- ☐ W
- ☐ Y
- ☐ Z

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- ☐ Ore, Dale K.
- ☐ Ore, Dale R.
- ☐ Oresky, Lawrence J.
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- ☐ Orsino, Jr., Joseph A
- ☐ Orsino, Jr., Joseph A.
- ☐ Orsino, Sr., Joseph A.
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- ☐ O'Connor, Edna M.
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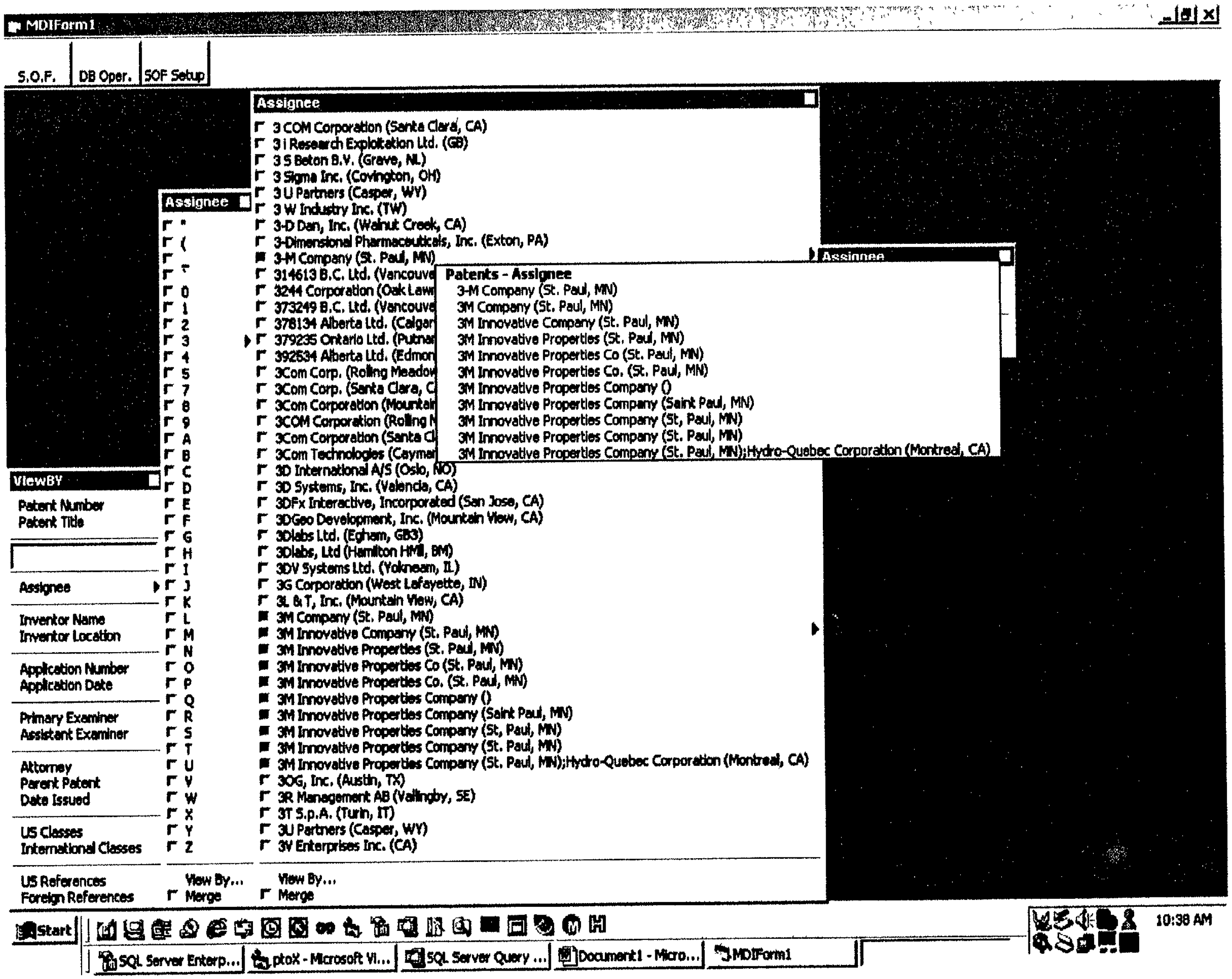
FIG-29



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□ 3244 Corporation (Oak Law
□ 373249 B.C. Ltd. (Vancouve
□ 378134 Alberta Ltd. (Calgar
□ 379235 Ontario Ltd. (Putnar
□ 392534 Alberta Ltd. (Edmon
□ 3Com Corp. (Rolling Meadov
□ 3Com Corp. (Santa Clara, C
□ 3Com Corporation (Mountai
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□ 3Com Corporation (Santa Cl
□ 3Com Technologies (Caymar
□ 3D International A/S (Oslo, NO)
□ 3D Systems, Inc. (Valencia, CA)
□ 3DFx Interactive, Incorporated (San Jose, CA)
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□ 3Dlabs, Ltd (Hamilton HMll, BM)
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□ 3G Corporation (West Lafayette, IN)
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■ 3M Innovative Properties Co (St. Paul, MN)
■ 3M Innovative Properties Co. (St. Paul, MN)
■ 3M Innovative Properties Company ()
■ 3M Innovative Properties Company (Saint Paul, MN)
■ 3M Innovative Properties Company (St, Paul, MN)
■ 3M Innovative Properties Company (St. Paul, MN)
■ 3M Innovative Properties Company (St. Paul, MN);Hydro-Quebec Corporation (Montreal, CA)
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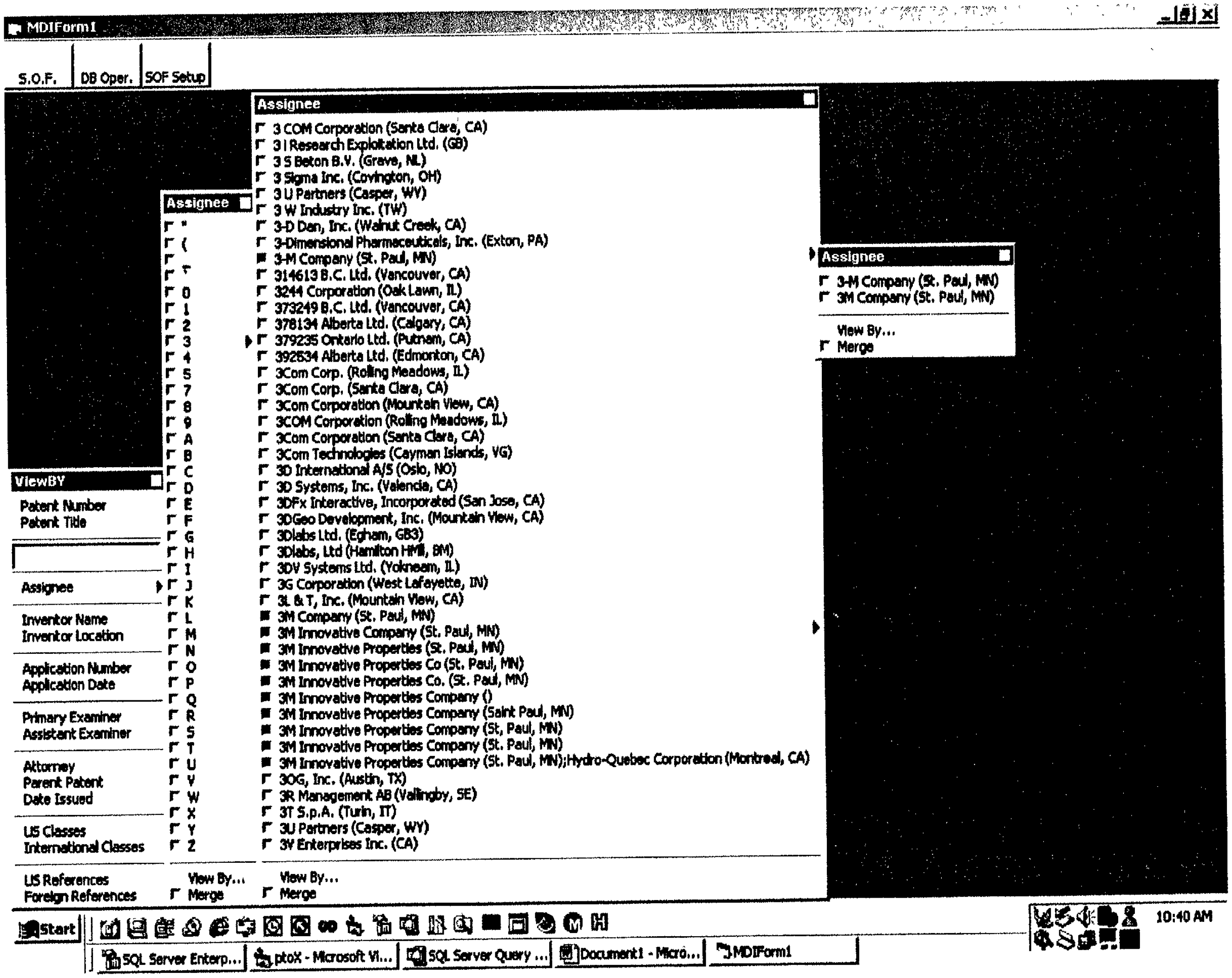
3M Innovative Properties (St. Paul, MN)
3M Innovative Properties Co (St. Paul, MN)
3M Innovative Properties Co. (St. Paul, MN)
3M Innovative Properties Company ()
3M Innovative Properties Company (Saint Paul, MN)
3M Innovative Properties Company (St, Paul, MN)
3M Innovative Properties Company (St. Paul, MN)
3M Innovative Properties Company (St. Paul, MN);Hydro-Quebec Corporation (Montreal, CA)

FIG. 30



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Patent Title

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Inventor Name
Inventor Location

Application Number
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Primary Examiner
Assistant Examiner

Attorney
Parent Patent
Date Issued

US Classes
International Classes

US References
Foreign References

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☐ 3Dlabs, Ltd (Hamilton HMII, BM)
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■ 3M Innovative Properties Co. (St. Paul, MN)
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■ 3M Innovative Properties Company (Saint Paul, MN)
■ 3M Innovative Properties Company (St, Paul, MN)
■ 3M Innovative Properties Company (St. Paul, MN)
■ 3M Innovative Properties Company (St. Paul, MN);Hydro-Quebec Corporation (Montreal, CA)
☐ 3OG, Inc. (Austin, TX)
☐ 3R Management AB (Vallingby, SE)
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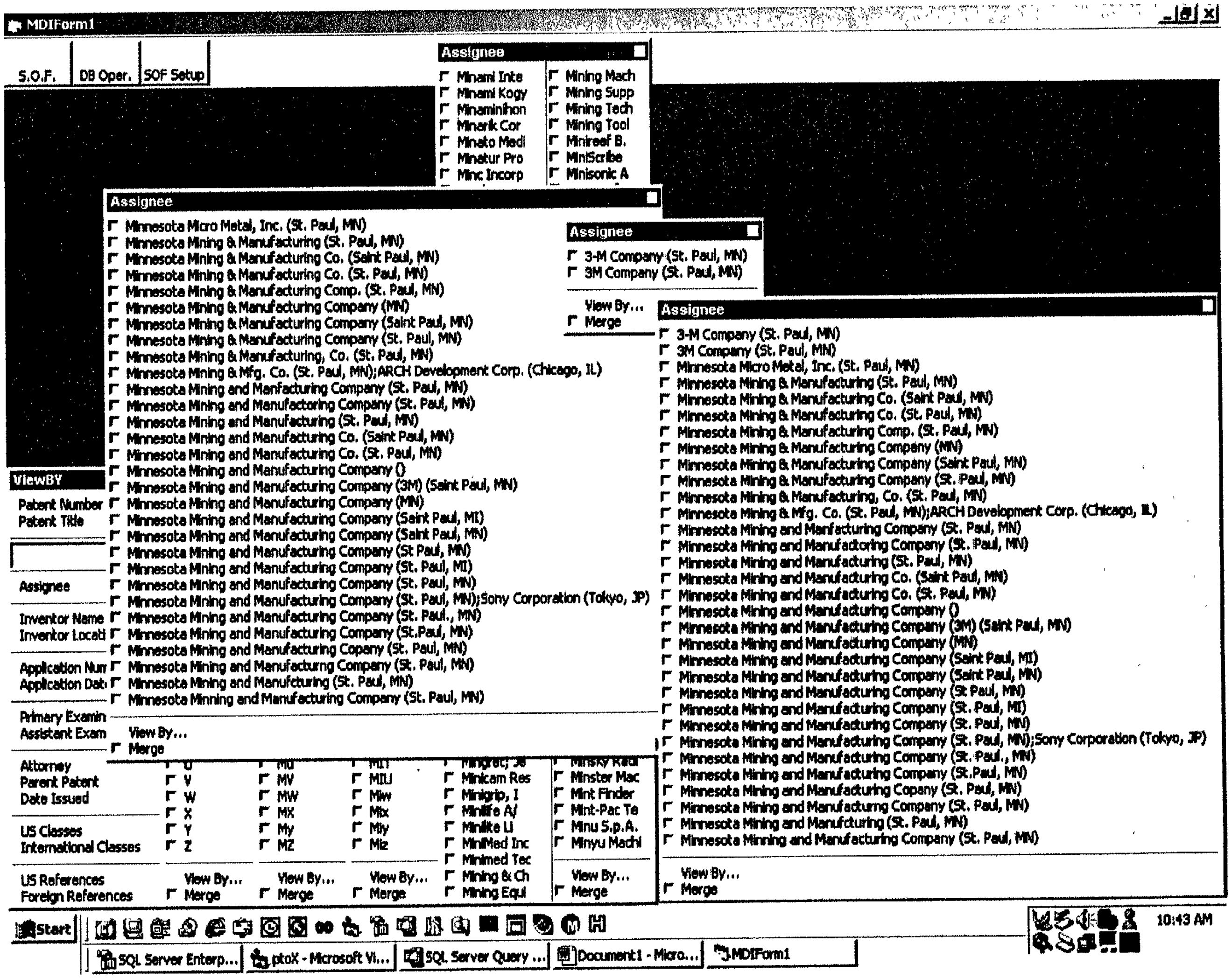
FIG. 31



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☐ Minami Kogy
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☐ Minnesota Mining & Manufacturing Comp. (St. Paul, MN)
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☐ Minnesota Mining and Manufacturing Company (3M) (Saint Paul, MN)
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☐ MW
☐ MX
☐ My
☐ MZ

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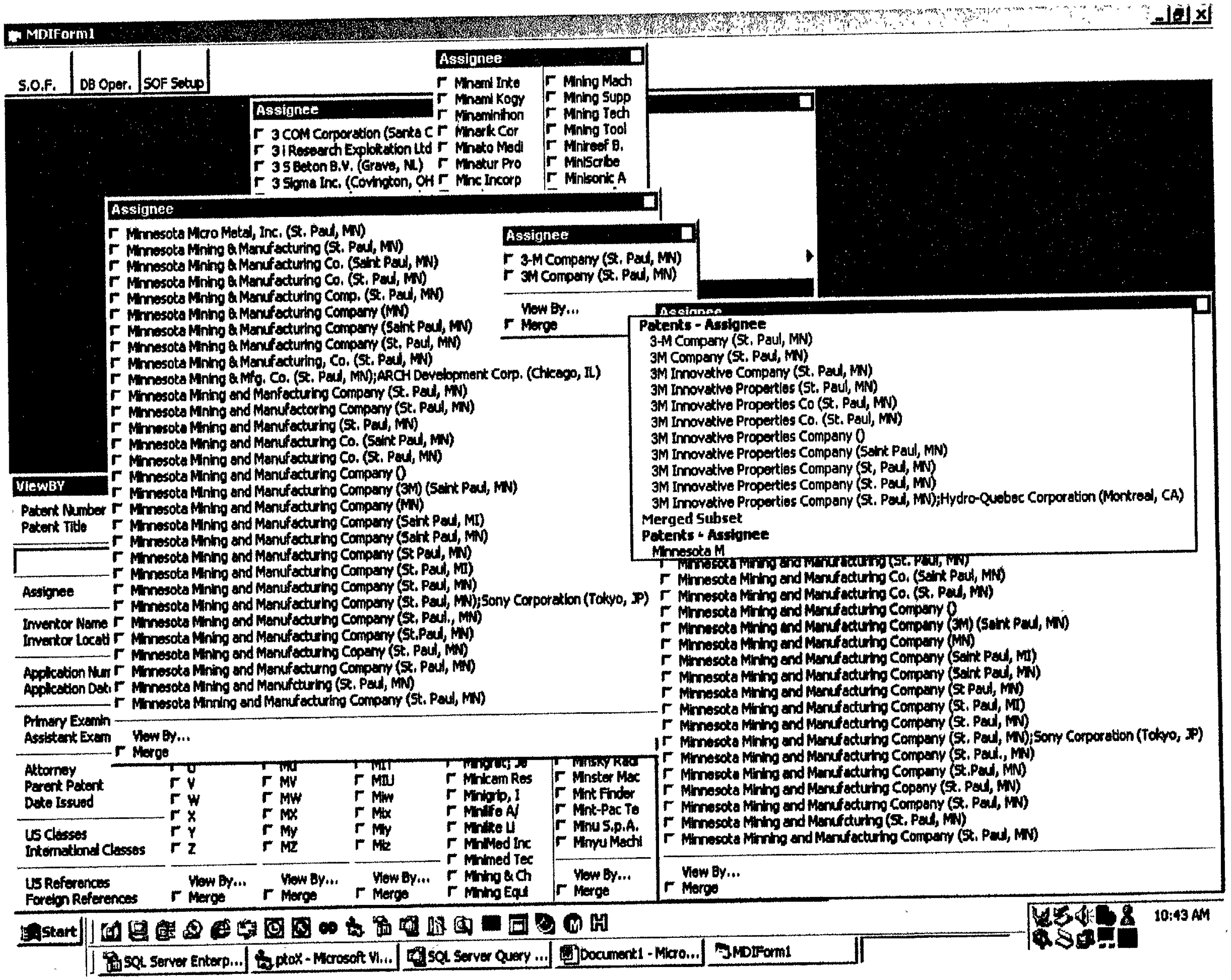
FIG. 32



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Assignee

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☐ 3 S Beton B.V. (Grave, NL)
☐ 3 Sigma Inc. (Covington, OH

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☐ Minaminihon
☐ Minarik Cor
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☐ Minatur Pro
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☐ Minnesota Mining & Manufacturing Comp. (St. Paul, MN)
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☐ Minnesota Mining & Manufacturing, Co. (St. Paul, MN)
☐ Minnesota Mining & Mfg. Co. (St. Paul, MN);ARCH Development Corp. (Chicago, IL)
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☐ Minnesota Mining and Manufacturing (St. Paul, MN)
☐ Minnesota Mining and Manufacturing Co. (Saint Paul, MN)
☐ Minnesota Mining and Manufacturing Co. (St. Paul, MN)
☐ Minnesota Mining and Manufacturing Company ()
☐ Minnesota Mining and Manufacturing Company (3M) (Saint Paul, MN)
☐ Minnesota Mining and Manufacturing Company (MN)
☐ Minnesota Mining and Manufacturing Company (Saint Paul, MI)
☐ Minnesota Mining and Manufacturing Company (Saint Paul, MN)
☐ Minnesota Mining and Manufacturing Company (St Paul, MN)
☐ Minnesota Mining and Manufacturing Company (St. Paul, MI)
☐ Minnesota Mining and Manufacturing Company (St. Paul, MN)
☐ Minnesota Mining and Manufacturing Company (St. Paul, MN);Sony Corporation (Tokyo, JP)
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☐ Minnesota Mining and Manufacturing Company (St.Paul, MN)
☐ Minnesota Mining and Manufacturing Copany (St. Paul, MN)
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☐ Minnesota Mining and Manufcturing (St. Paul, MN)
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☐ Minnesota Mining and Manufacturing Company ()
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Patent Number
Patent Title

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Inventor Name
Inventor Locati

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Primary Examin
Assistant Exam

Attorney
Parent Patent
Date Issued

US Classes
International Classes

US References
Foreign References

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☐ MiniMed Inc
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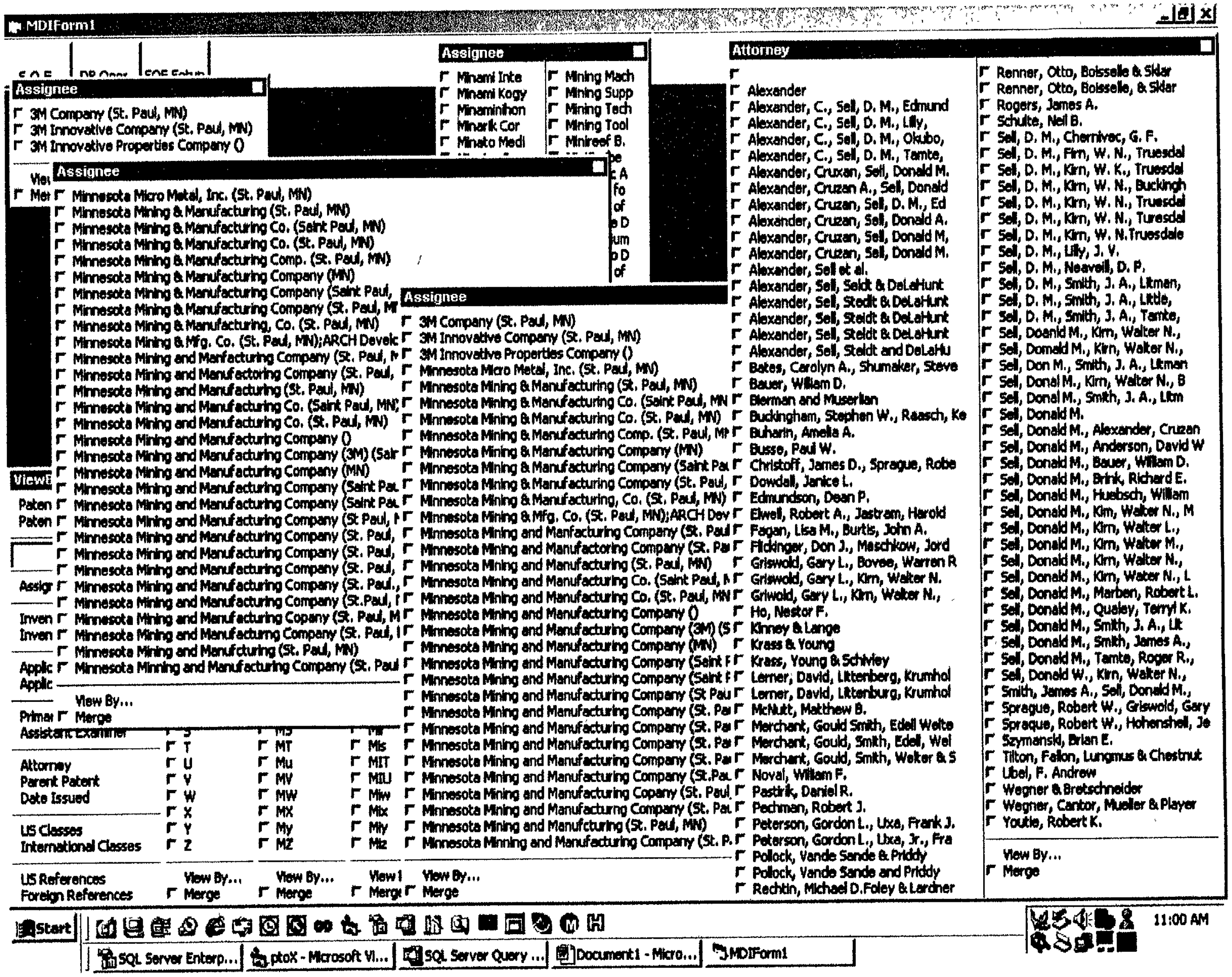
FIG. 33



Assignee

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- □ 3M Innovative Properties Company ()

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- □ Minnesota Mining & Manufacturing Company (MN)
- □ Minnesota Mining & Manufacturing Company (Saint Paul,
- □ Minnesota Mining & Manufacturing Company (St. Paul, M
- □ Minnesota Mining & Manufacturing, Co. (St. Paul, MN)
- □ Minnesota Mining & Mfg. Co. (St. Paul, MN);ARCH Develc
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- □ Minnesota Mining and Manufacturing Co. (St. Paul, MN)
- □ Minnesota Mining and Manufacturing Company ()
- □ Minnesota Mining and Manufacturing Company (3M) (Sair
- □ Minnesota Mining and Manufacturing Company (MN)
- □ Minnesota Mining and Manufacturing Company (Saint Pau
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- □ Minnesota Mining and Manufacturing Company (St. Paul.,
- □ Minnesota Mining and Manufacturing Company (St.Paul, I
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- □ Minnesota Mining and Manufacturng Company (St. Paul, I
- □ Minnesota Mining and Manufcturing (St. Paul, MN)
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Assignee

□ Minami Inte	□ Mining Mach
□ Minami Kogy	□ Mining Supp
□ Minaminihon	□ Mining Tech
□ Minarik Cor	□ Mining Tool
□ Minato Medi	□ Minireef B.

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□ U	□ Mu	□ MIT
□ V	□ MV	□ MIU
□ W	□ MW	□ Miw
□ X	□ MX	□ Mix
□ Y	□ My	□ Miy
□ Z	□ MZ	□ Miz
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Assignee

- □ 3M Company (St. Paul, MN)
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- □ Minnesota Mining & Manufacturing, Co. (St. Paul, MN)
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- □ Minnesota Mining and Manufacturing Company ()
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- □ Sell, Donald M., Qualey, Terryl K.
- □ Sell, Donald M., Smith, J. A., Lit
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- □ Sell, Donald M., Tamte, Roger R.,
- □ Sell, Donald W., Kirn, Walter N.,
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- □ Sprague, Robert W., Hohenshell, Je
- □ Szymanski, Brian E.
- □ Tilton, Fallon, Lungmus & Chestnut
- □ Ubel, F. Andrew
- □ Wegner & Bretschneider
- □ Wegner, Cantor, Mueller & Player
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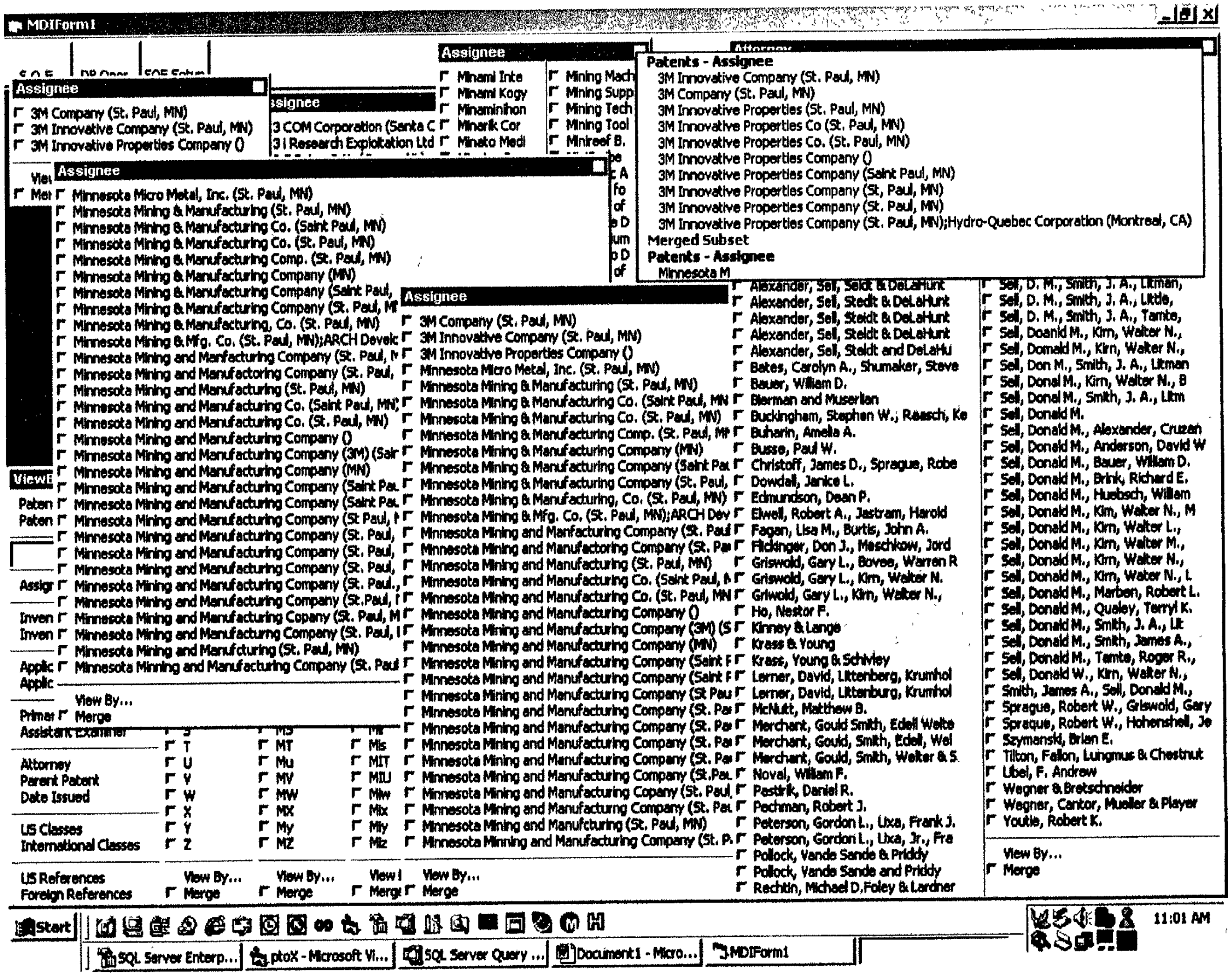

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Assignee

- ☐ 3M Company (St. Paul, MN)
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- ☐ 3M Innovative Properties Company ()

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3 COM Corporation (Santa C
3 I Research Exploitation Ltd

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- ☐ Minami Kogy
- ☐ Minaminihon
- ☐ Minerik Cor
- ☐ Minato Medi
- ☐ Mining Mach
- ☐ Mining Supp
- ☐ Mining Tech
- ☐ Mining Tool
- ☐ Minireef B.

Patents - Assignee

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3M Innovative Properties Company ()
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Merged Subset

Patents - Assignee

Minnesota M

Assignee

- ☐ Minnesota Micro Metal, Inc. (St. Paul, MN)
- ☐ Minnesota Mining & Manufacturing (St. Paul, MN)
- ☐ Minnesota Mining & Manufacturing Co. (Saint Paul, MN)
- ☐ Minnesota Mining & Manufacturing Co. (St. Paul, MN)
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- ☐ Minnesota Mining & Manufacturing Company (MN)
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- ☐ Minnesota Mining and Manufactoring Company (St. Paul,
- ☐ Minnesota Mining and Manufacturing (St. Paul, MN)
- ☐ Minnesota Mining and Manufacturing Co. (Saint Paul, MN;
- ☐ Minnesota Mining and Manufacturing Co. (St. Paul, MN)
- ☐ Minnesota Mining and Manufacturing Company ()
- ☐ Minnesota Mining and Manufacturing Company (3M) (Sair
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- ☐ Minnesota Mining & Mfg. Co. (St. Paul, MN);ARCH Dev
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- ☐ Minnesota Mining and Manufacturing (St. Paul, MN)
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- ☐ Minnesota Mining and Manufacturing Company ()
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- ☐ Rechtin, Michael D.Foley & Lardner
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- ☐ Szymanski, Brian E.
- ☐ Tilton, Fallon, Lungmus & Chestnut
- ☐ Libel, F. Andrew
- ☐ Wegner & Bretschneider
- ☐ Wegner, Cantor, Mueller & Player
- ☐ Youtie, Robert K.

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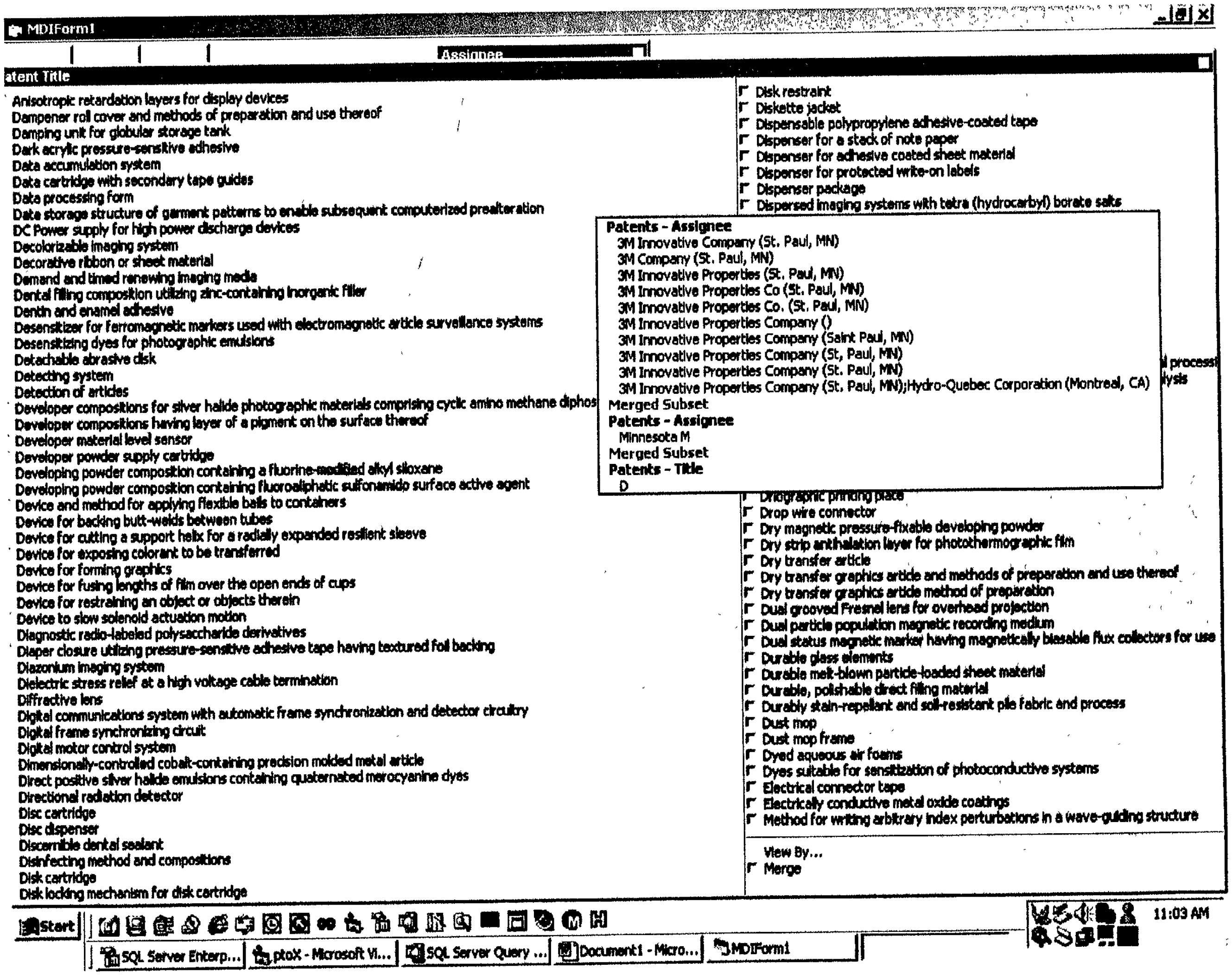
FIG. 35



Anisotropic retardation layers for display devices
Dampener roll cover and methods of preparation and use thereof
Damping unit for globular storage tank
Dark acrylic pressure-sensitive adhesive
Data accumulation system
Data cartridge with secondary tape guides
Data processing form
Data storage structure of garment patterns to enable subsequent computerized prealteration
DC Power supply for high power discharge devices
Decolorizable imaging system
Decorative ribbon or sheet material
Demand and timed renewing imaging media
Dental filling composition utilizing zinc-containing inorganic filler
Dentin and enamel adhesive
Desensitizer for ferromagnetic markers used with electromagnetic article surveillance systems
Desensitizing dyes for photographic emulsions
Detachable abrasive disk
Detecting system
Detection of articles
Developer compositions for silver halide photographic materials comprising cyclic amino methane diphos
Developer compositions having layer of a pigment on the surface thereof
Developer material level sensor
Developer powder supply cartridge
Developing powder composition containing a fluorine-modified alkyl siloxane
Developing powder composition containing fluoroaliphatic sulfonamido surface active agent
Device and method for applying flexible balls to containers
Device for backing butt-welds between tubes
Device for cutting a support helix for a radially expanded resilient sleeve
Device for exposing colorant to be transferred
Device for forming graphics
Device for fusing lengths of film over the open ends of cups
Device for restraining an object or objects therein
Device to slow solenoid actuation motion
Diagnostic radio-labeled polysaccharide derivatives
Diaper closure utilizing pressure-sensitive adhesive tape having textured foil backing
Diazonium imaging system
Dielectric stress relief at a high voltage cable termination
Diffractive lens
Digital communications system with automatic frame synchronization and detector circuitry
Digital frame synchronizing circuit
Digital motor control system
Dimensionally-controlled cobalt-containing precision molded metal article
Direct positive silver halide emulsions containing quaternated merocyanine dyes
Directional radiation detector
Disc cartridge
Disc dispenser
Discernible dental sealant
Disinfecting method and compositions
Disk cartridge
Disk locking mechanism for disk cartridge

- ☐ Disk restraint
- ☐ Diskette jacket
- ☐ Dispensable polypropylene adhesive-coated tape
- ☐ Dispenser for a stack of note paper
- ☐ Dispenser for adhesive coated sheet material
- ☐ Dispenser for protected write-on labels
- ☐ Dispenser package
- ☐ Dispersed imaging systems with tetra (hydrocarbyl) borate salts

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3M Innovative Properties Company (St. Paul, MN);Hydro-Quebec Corporation (Montreal, CA)
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- ☐ Drographic printing plate
- ☐ Drop wire connector
- ☐ Dry magnetic pressure-fixable developing powder
- ☐ Dry strip antihalation layer for photothermographic film
- ☐ Dry transfer article
- ☐ Dry transfer graphics article and methods of preparation and use thereof
- ☐ Dry transfer graphics article method of preparation
- ☐ Dual grooved Fresnel lens for overhead projection
- ☐ Dual particle population magnetic recording medium
- ☐ Dual status magnetic marker having magnetically biasable flux collectors for use
- ☐ Durable glass elements
- ☐ Durable melt-blown particle-loaded sheet material
- ☐ Durable, polishable direct filling material
- ☐ Durably stain-repellant and soil-resistant pile fabric and process
- ☐ Dust mop
- ☐ Dust mop frame
- ☐ Dyed aqueous air foams
- ☐ Dyes suitable for sensitization of photoconductive systems
- ☐ Electrical connector tape
- ☐ Electrically conductive metal oxide coatings
- ☐ Method for writing arbitrary index perturbations in a wave-guiding structure

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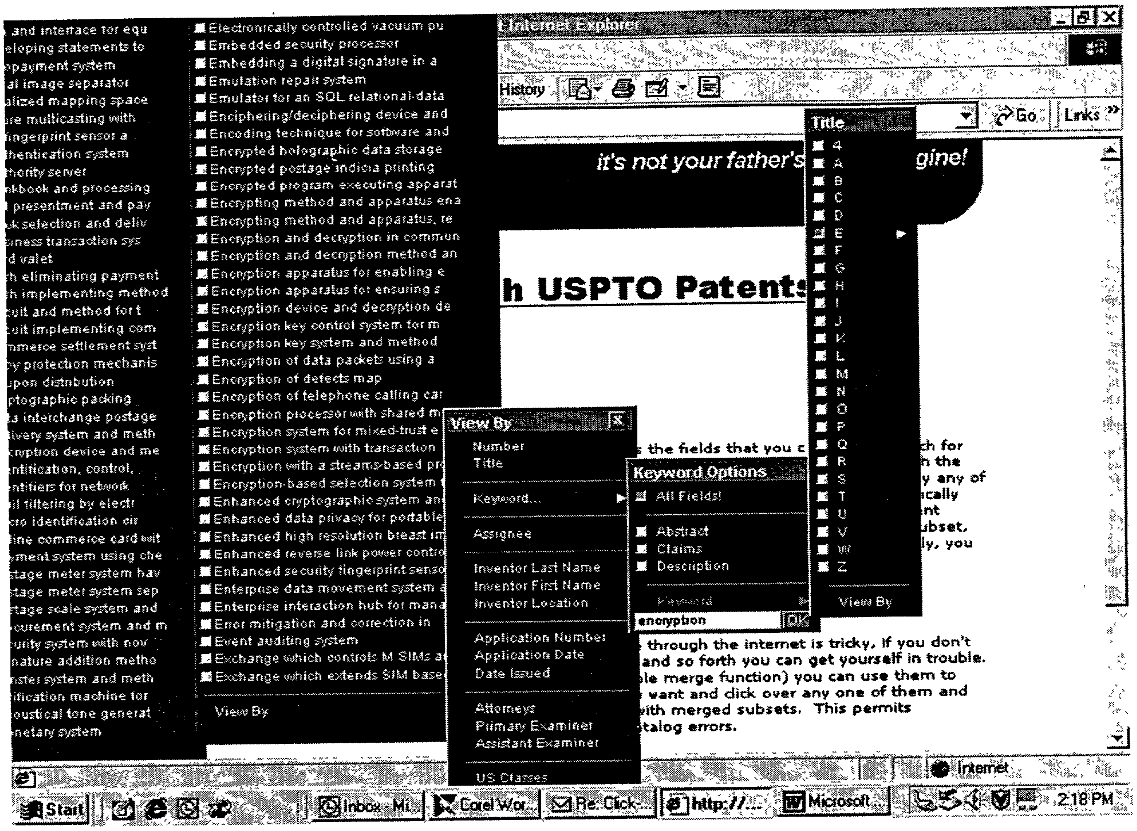
FIG. 36



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■ Encoding technique for software and
■ Encrypted holographic data storage
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■ Encryption key control system for m
■ Encryption key system and method
■ Encryption of data packets using a
■ Encryption of defects map
■ Encryption of telephone calling car
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■ Encryption system for mixed-trust e
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■ Encryption with a streams-based pr
■ Encryption-based selection system
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■ Enhanced reverse link power contro
■ Enhanced security fingerprint senso
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■ Enterprise interaction hub for mana
■ Error mitigation and correction in
■ Event auditing system
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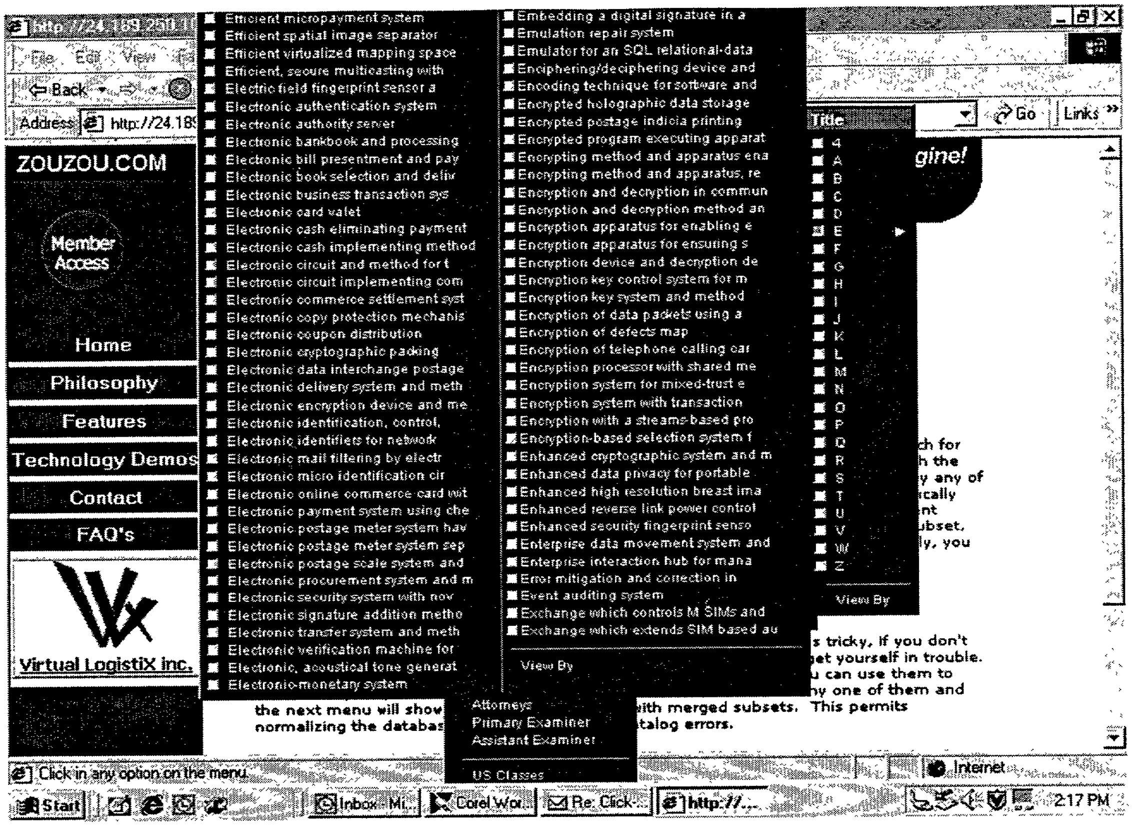
FIG 37



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Efficient virtualized mapping space
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Emulator for an SQL relational-data
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Encryption key system and method
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FIG. 38

Patent: 5935246

Electronic copy protection mechanism using challenge and response to prevent unauthorized execution of software

Date Filed:	Date Issued:	Application Number:	Go to USPTO.GOV
4/11/1997	8/10/1999	838620	US PTO

Abstract:

A copy protection mechanism for protecting software against copying, consists of a challenge mechanism embedded in each protected item of software. The challenge mechanism has no access to the customer's private keying material. In operation, the challenge mechanism sends a random challenge to the customer's signature server. The signature server signs the challenge, using the customer's private keying material and then returns the signed challenge to the challenge mechanism. The challenge mechanism then verifies the signed challenge, using the customer's public keying material, and prohibits the customer from using some or all of the protected item of software unless the verification is successful. The mechanism permits every customer to receive an identical copy of the copy protected program with the embedded challenge mechanism.

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Assignee:

International Computers Limited (London, GB)

US Classes:	International Classes:
713/200	
713/201	

US References:	Foreign References:
4558176	
4926480	
4947430	
5109413	
5146575	
5224163	
5315657	
5371794	
5436972	
5568552	
5724425	

Primary Examiner:	Assistant Examiner:
Kizou, Hassan	Mai, Rijue

Attorney:

Lee, Mann, Smith, McWilliams, Sweeney & Ohlson

Claims:

FIG. 39

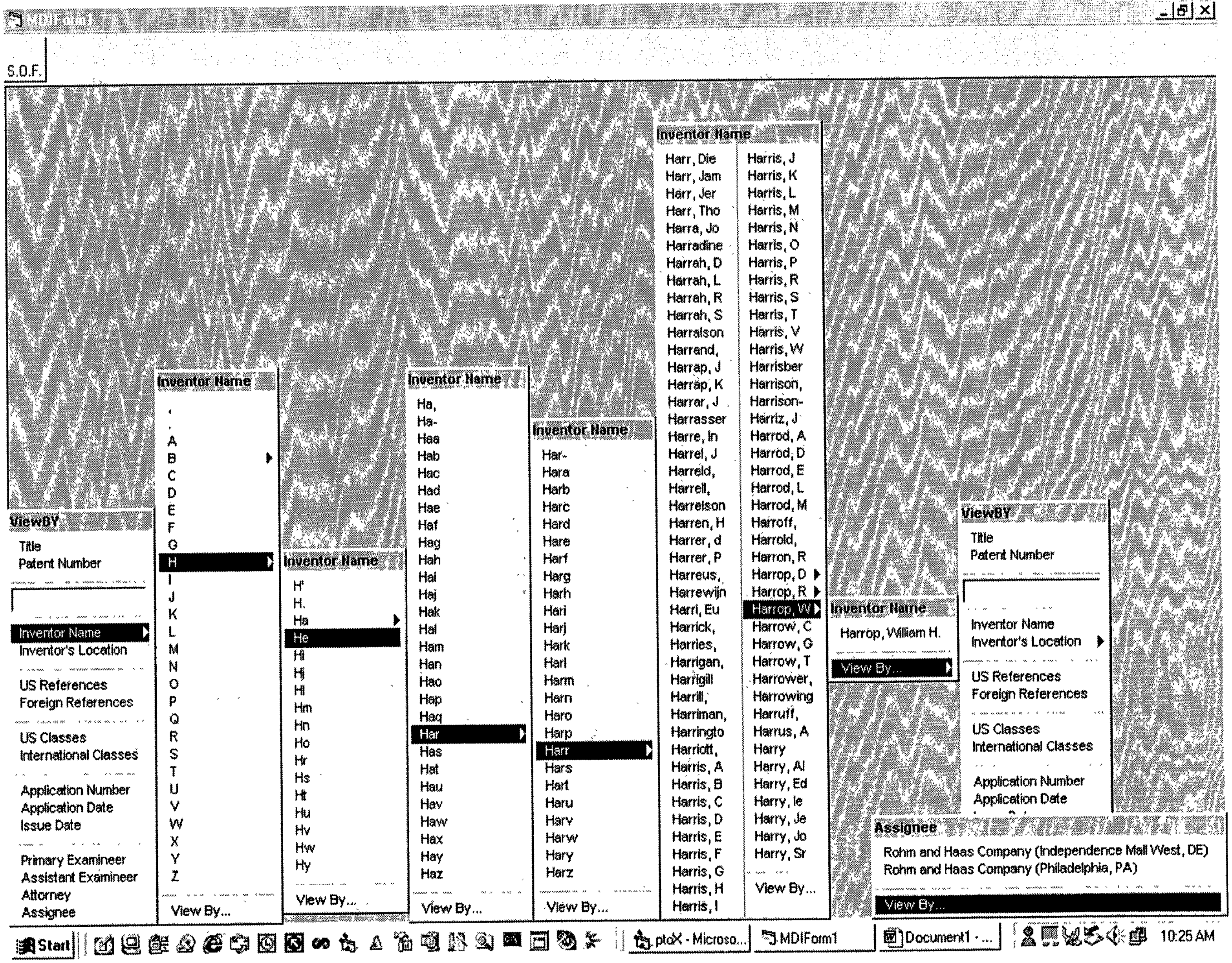
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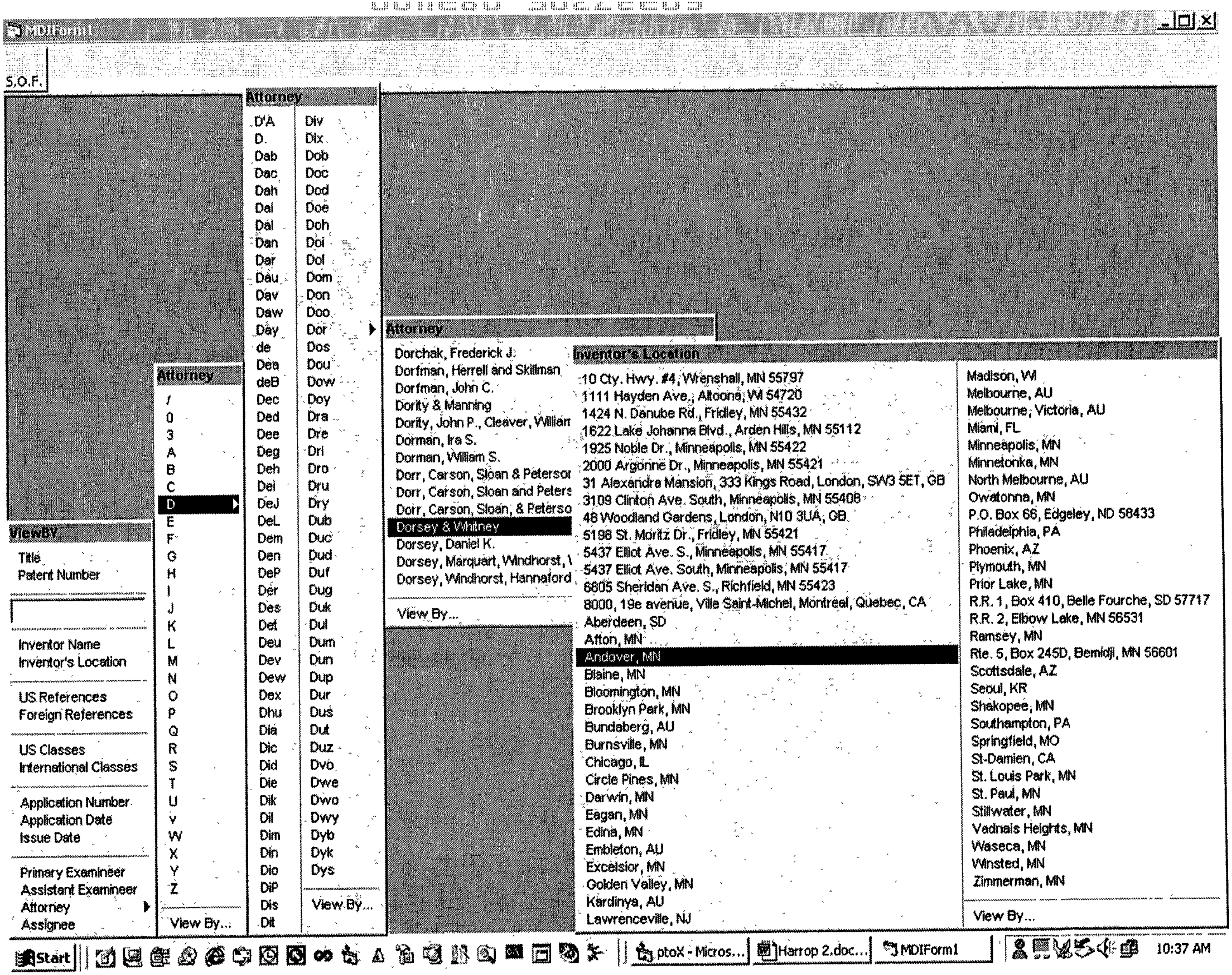
FIG. 40



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48 Woodland Gardens, London, N10 3UA, GB
5198 St. Moritz Dr., Fridley, MN 55421
5437 Elliot Ave. S., Minneapolis, MN 55417
5437 Elliot Ave. South, Minneapolis, MN 55417
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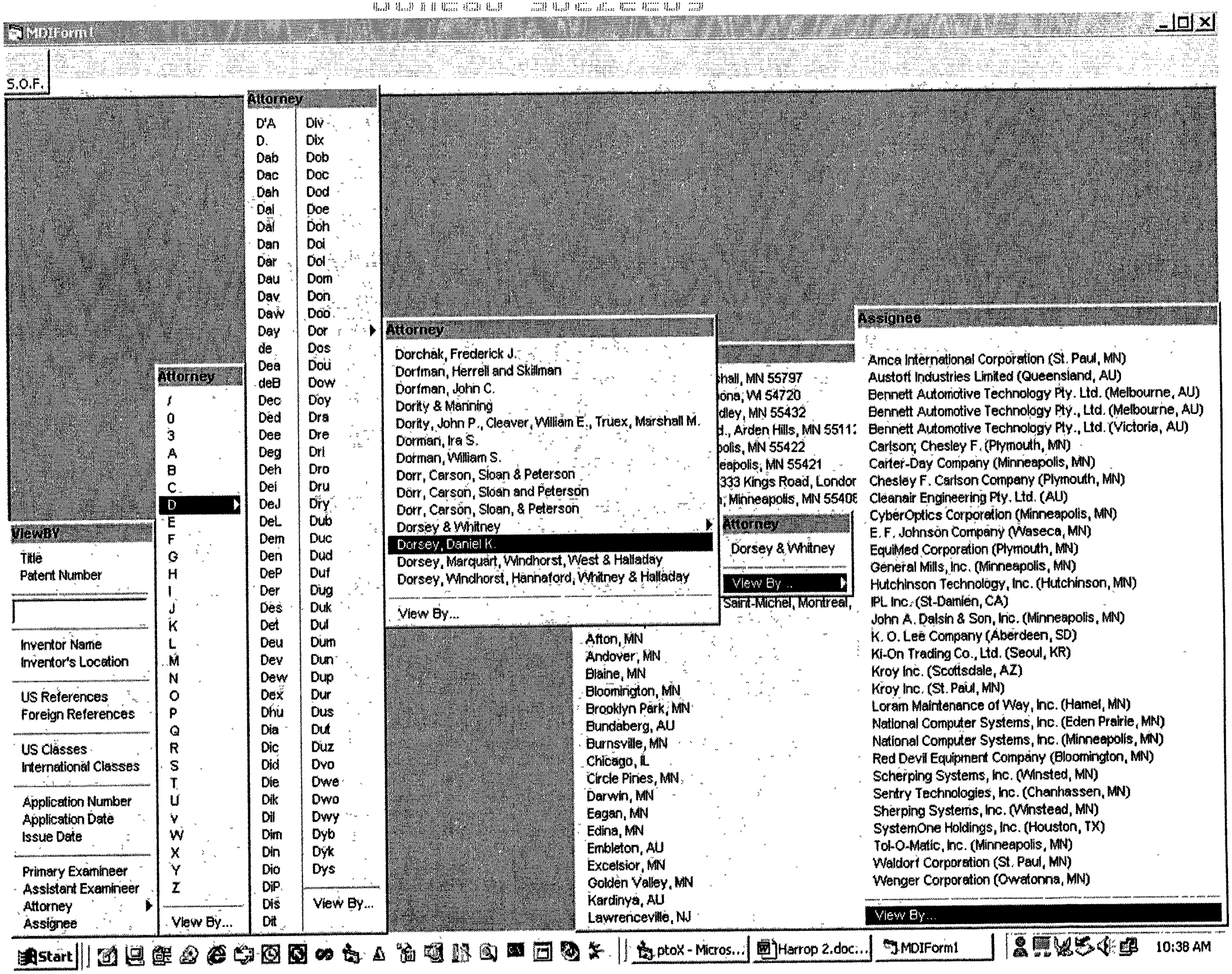
FIG 41



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Dority, John P., Cleaver, William E., Truex, Marshall M.
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E. F. Johnson Company (Waseca, MN)
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National Computer Systems, Inc. (Eden Prairie, MN)
National Computer Systems, Inc. (Minneapolis, MN)
Red Devil Equipment Company (Bloomington, MN)
Scherping Systems, Inc. (Winsted, MN)
Sentry Technologies, Inc. (Chanhassen, MN)
Sherping Systems, Inc. (Winstead, MN)
SystemOne Holdings, Inc. (Houston, TX)
Tol-O-Matic, Inc. (Minneapolis, MN)
Waldorf Corporation (St. Paul, MN)
Wenger Corporation (Owatonna, MN)

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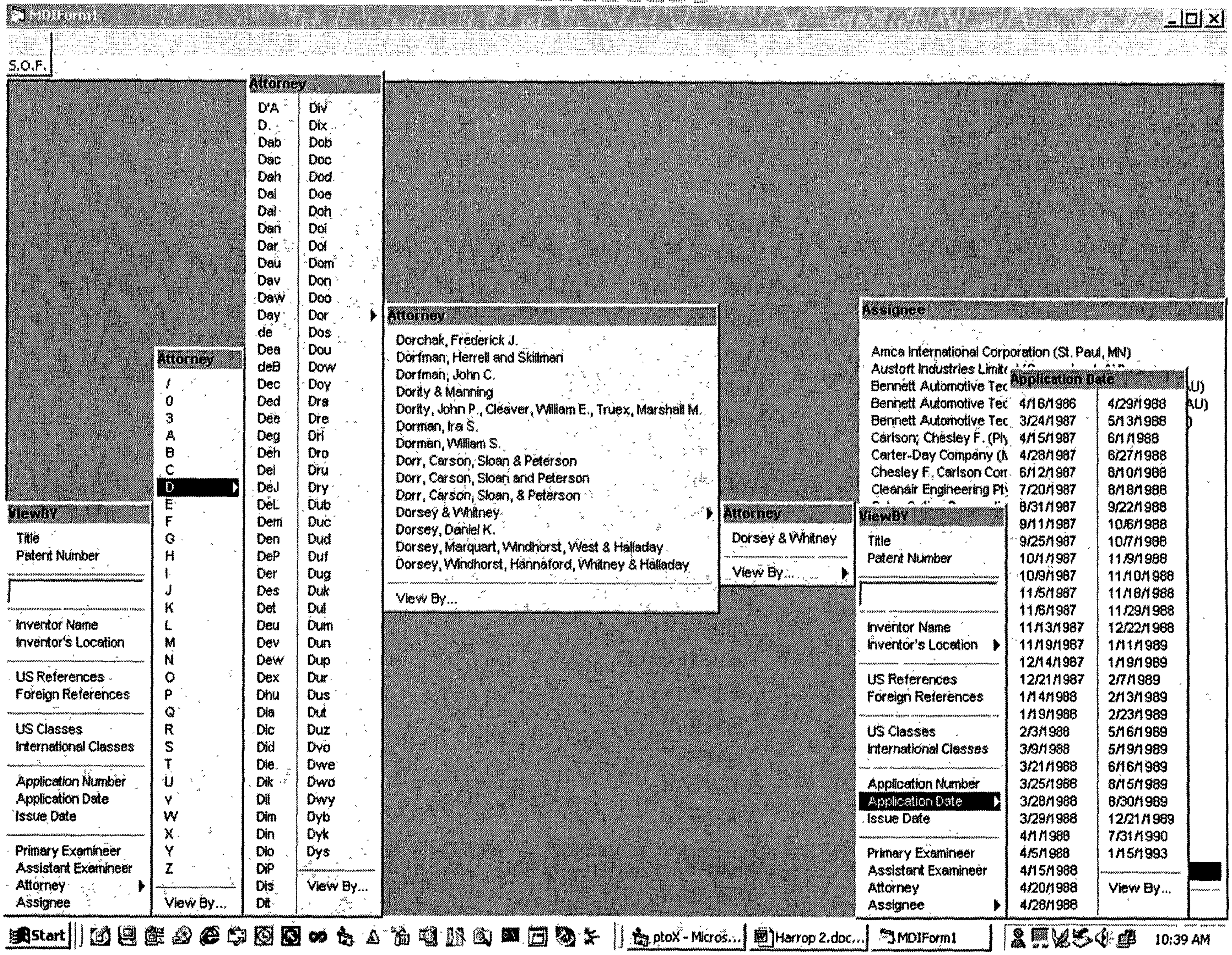
FIG 47



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Dorchak, Frederick J.
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Dorfman, John C.
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4/28/1987	6/27/1988
6/12/1987	8/10/1988
7/20/1987	8/18/1988
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3/9/1988	5/19/1989
3/21/1988	6/16/1989
3/25/1988	8/15/1989
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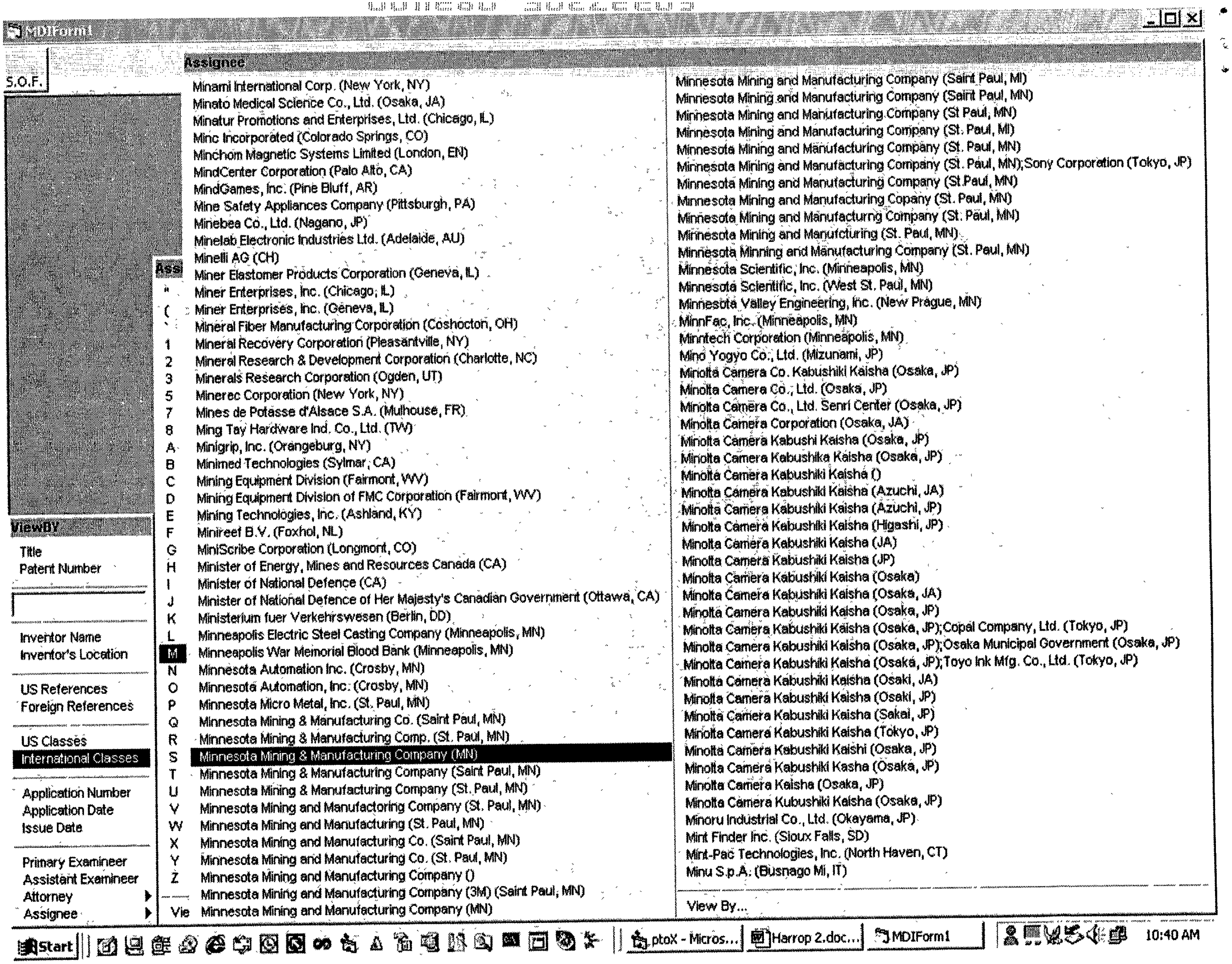
FIG 43



Title
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Inventor Name
Inventor's Location

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Primary Examineer
Assistant Examineer
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Assignee

Minami International Corp. (New York, NY)
Minato Medical Science Co., Ltd. (Osaka, JA)
Minatur Promotions and Enterprises, Ltd. (Chicago, IL)
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Minchom Magnetic Systems Limited (London, EN)
MindCenter Corporation (Palo Alto, CA)
MindGames, Inc. (Pine Bluff, AR)
Mine Safety Appliances Company (Pittsburgh, PA)
Minebea Co., Ltd. (Nagano, JP)
Minelab Electronic Industries Ltd. (Adelaide, AU)
Minelli AG (CH)
Miner Elastomer Products Corporation (Geneva, IL)
Miner Enterprises, Inc. (Chicago, IL)
Miner Enterprises, Inc. (Geneva, IL)
Mineral Fiber Manufacturing Corporation (Coshocton, OH)
Mineral Recovery Corporation (Pleasantville, NY)
Mineral Research & Development Corporation (Charlotte, NC)
Minerals Research Corporation (Ogden, UT)
Minerec Corporation (New York, NY)
Mines de Potasse d'Alsace S.A. (Mulhouse, FR)
Ming Tay Hardware Ind. Co., Ltd. (TW)
Minigrip, Inc. (Orangeburg, NY)
Minimed Technologies (Sylmar, CA)
Mining Equipment Division (Fairmont, WV)
Mining Equipment Division of FMC Corporation (Fairmont, WV)
Mining Technologies, Inc. (Ashland, KY)
Minireef B.V. (Foxhol, NL)
MiniScribe Corporation (Longmont, CO)
Minister of Energy, Mines and Resources Canada (CA)
Minister of National Defence (CA)
Minister of National Defence of Her Majesty's Canadian Government (Ottawa, CA)
Ministerium fuer Verkehrswesen (Berlin, DD)
Minneapolis Electric Steel Casting Company (Minneapolis, MN)
Minneapolis War Memorial Blood Bank (Minneapolis, MN)
Minnesota Automation Inc. (Crosby, MN)
Minnesota Automation, Inc. (Crosby, MN)
Minnesota Micro Metal, Inc. (St. Paul, MN)
Minnesota Mining & Manufacturing Co. (Saint Paul, MN)
Minnesota Mining & Manufacturing Comp. (St. Paul, MN)
Minnesota Mining & Manufacturing Company (MN)
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Minnesota Mining & Manufacturing Company (St. Paul, MN)
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Minnesota Minning and Manufacturing Company (St. Paul, MN)
Minnesota Scientific, Inc. (Minneapolis, MN)
Minnesota Scientific, Inc. (West St. Paul, MN)
Minnesota Valley Engineering, Inc. (New Prague, MN)
MinnFac, Inc. (Minneapolis, MN)
Minntech Corporation (Minneapolis, MN)
Mino Yogyo Co., Ltd. (Mizunami, JP)
Minolta Camera Co. Kabushiki Kaisha (Osaka, JP)
Minolta Camera Co., Ltd. (Osaka, JP)
Minolta Camera Co., Ltd. Senri Center (Osaka, JP)
Minolta Camera Corporation (Osaka, JA)
Minolta Camera Kabushi Kaisha (Osaka, JP)
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Minolta Camera Kabushiki Kaisha (Osaka, JP);Osaka Municipal Government (Osaka, JP)
Minolta Camera Kabushiki Kaisha (Osaka, JP);Toyo Ink Mfg. Co., Ltd. (Tokyo, JP)
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Minolta Camera Kubushiki Kaisha (Osaka, JP)
Minoru Industrial Co., Ltd. (Okayama, JP)
Mint Finder Inc. (Sioux Falls, SD)
Mint-Pac Technologies, Inc. (North Haven, CT)
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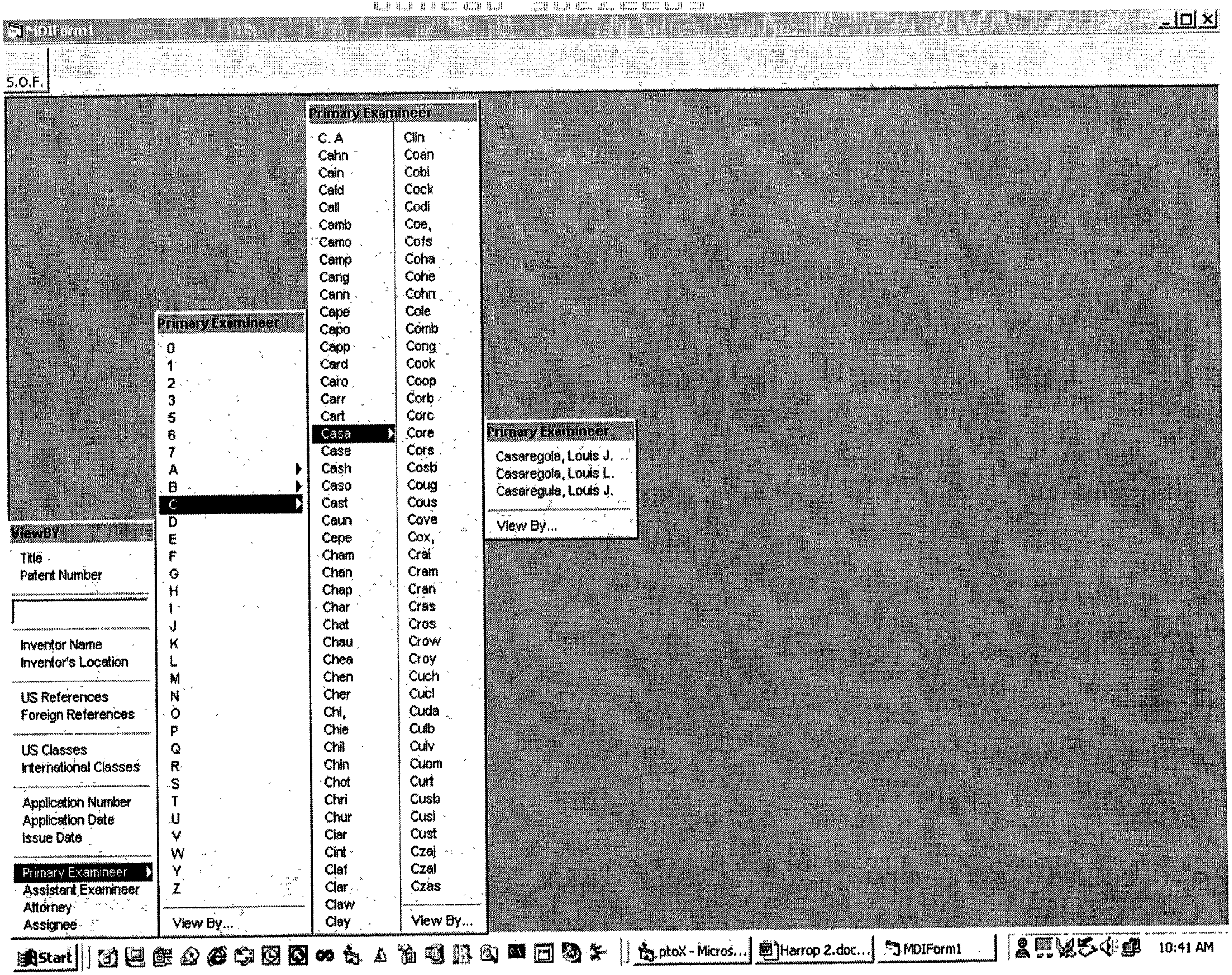
FIG. 44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Inventor Name
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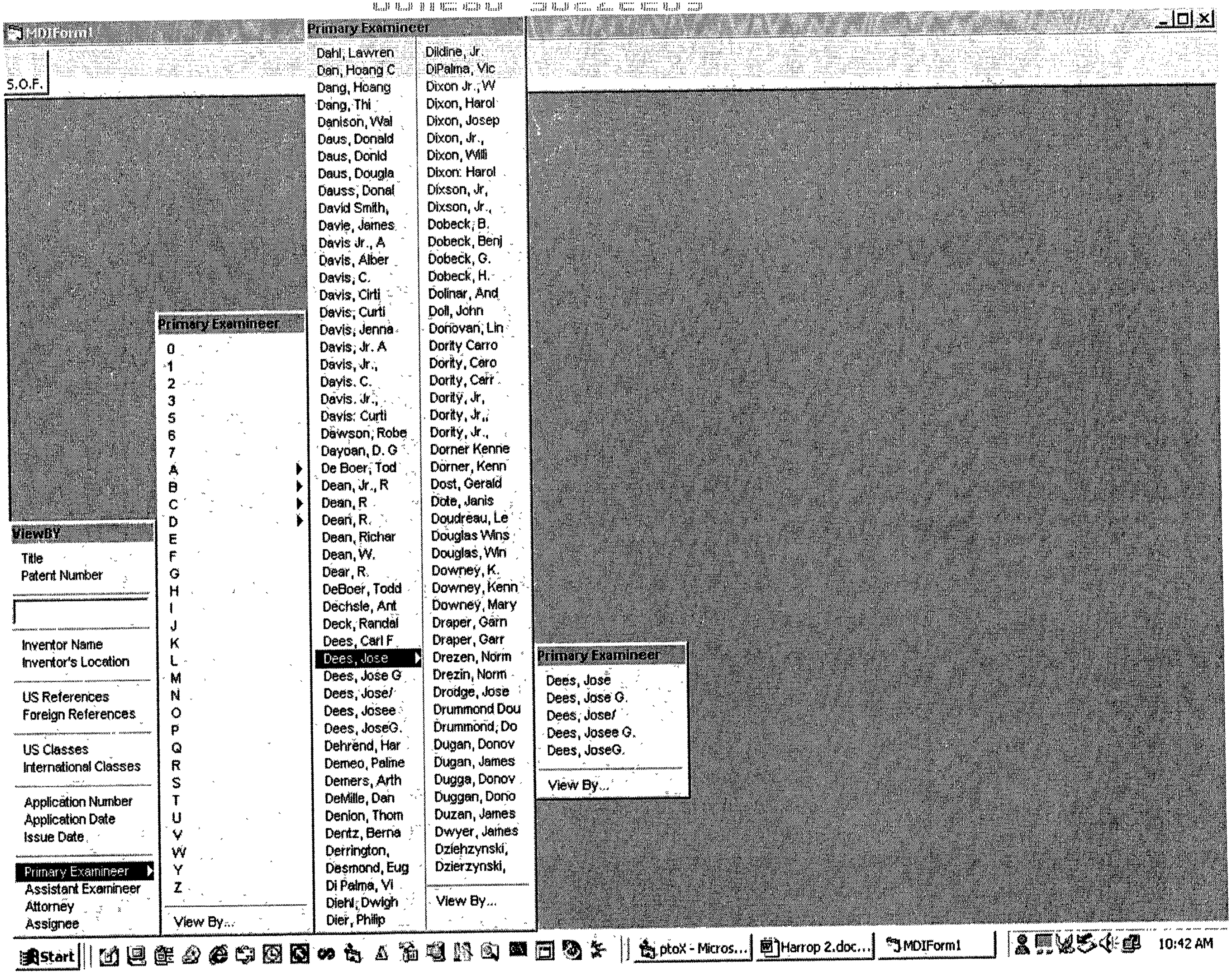
FIG. 45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Daus, Donald
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Daus, Dougla
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David Smith,
Davie, James
Davis Jr., A
Davis, Alber
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Davis, Cirti
Davis, Curti
Davis, Jenna
Davis, Jr. A
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Davis: Curti
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Dehrend, Har
Demeo, Palme
Demers, Arth
DeMille, Dan
Denion, Thom
Dentz, Berna
Derrington,
Desmond, Eug
Di Palma, Vi
Diehl, Dwigh
Dier, Philip
Dildine, Jr.
DiPalma, Vic
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Drezen, Norm
Drezin, Norm
Drodge, Jose
Drummond Dou
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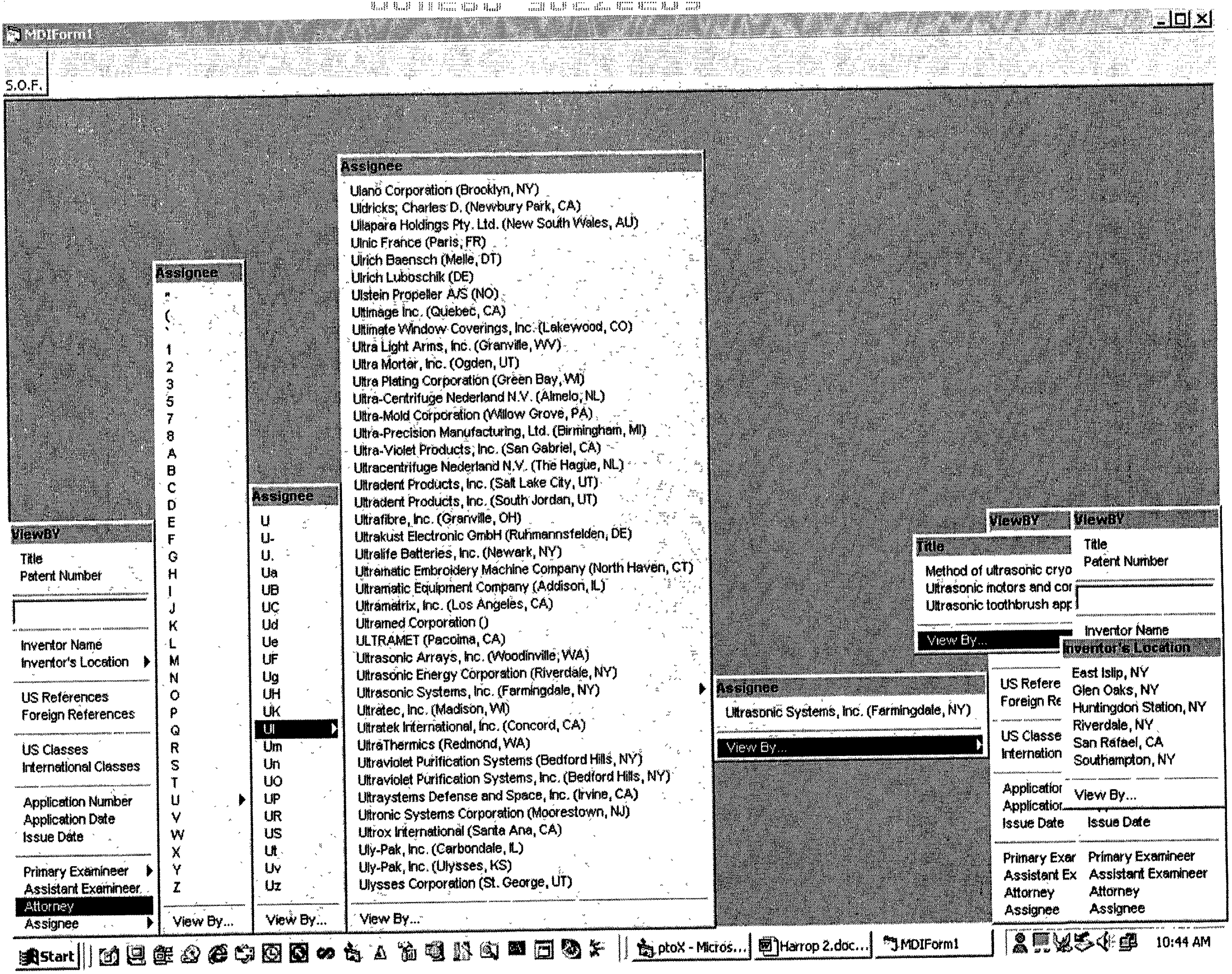
FIG. 46



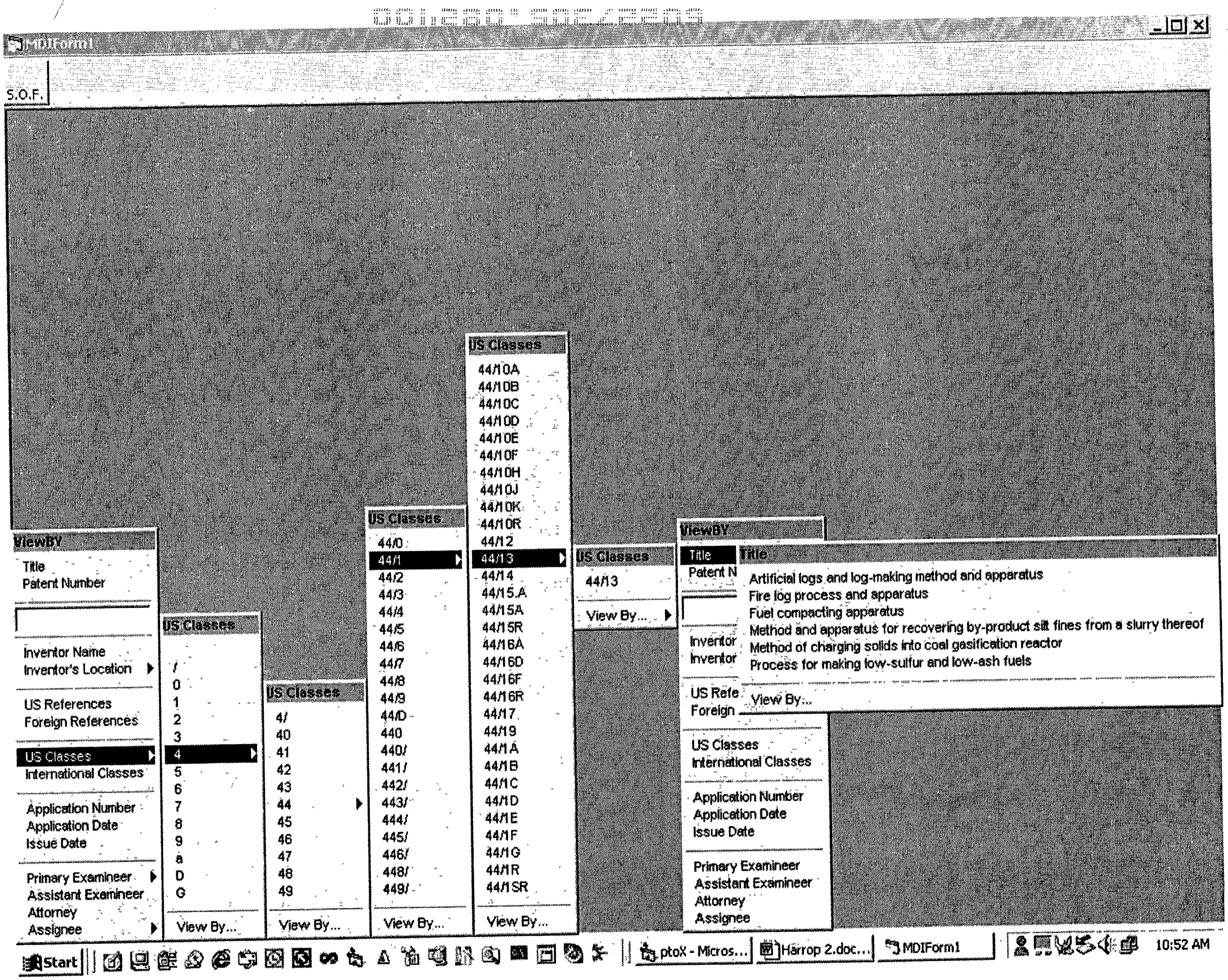
Ulano Corporation (Brooklyn, NY)
Uldricks; Charles D. (Newbury Park, CA)
Ullapara Holdings Pty. Ltd. (New South Wales, AU)
Ulnic France (Paris, FR)
Ulrich Baensch (Melle, DT)
Ulrich Luboschik (DE)
Ulstein Propeller A/S (NO)
Ultimage Inc. (Quebec, CA)
Ultimate Window Coverings, Inc. (Lakewood, CO)
Ultra Light Arms, Inc. (Granville, WV)
Ultra Mortar, Inc. (Ogden, UT)
Ultra Plating Corporation (Green Bay, WI)
Ultra-Centrifuge Nederland N.V. (Almelo, NL)
Ultra-Mold Corporation (Willow Grove, PA)
Ultra-Precision Manufacturing, Ltd. (Birmingham, MI)
Ultra-Violet Products, Inc. (San Gabriel, CA)
Ultracentrifuge Nederland N.V. (The Hague, NL)
Ultradent Products, Inc. (Salt Lake City, UT)
Ultradent Products, Inc. (South Jordan, UT)
Ultrafibre, Inc. (Granville, OH)
Ultrakust Electronic GmbH (Ruhmannsfelden, DE)
Ultralife Batteries, Inc. (Newark, NY)
Ultramatic Embroidery Machine Company (North Haven, CT)
Ultramatic Equipment Company (Addison, IL)
Ultramatrix, Inc. (Los Angeles, CA)
Ultramed Corporation ()
ULTRAMET (Pacoima, CA)
Ultrasonic Arrays, Inc. (Woodinville, WA)
Ultrasonic Energy Corporation (Riverdale, NY)
Ultrasonic Systems, Inc. (Farmingdale, NY)
Ultratec, Inc. (Madison, WI)
Ultratek International, Inc. (Concord, CA)
UltraThermics (Redmond, WA)
Ultraviolet Purification Systems (Bedford Hills, NY)
Ultraviolet Purification Systems, Inc. (Bedford Hills, NY)
Ultraystems Defense and Space, Inc. (Irvine, CA)
Ultronic Systems Corporation (Moorestown, NJ)
Ultrox International (Santa Ana, CA)
Uly-Pak, Inc. (Carbondale, IL)
Uly-Pak, Inc. (Ulysses, KS)
Ulysses Corporation (St. George, UT)

Ultrasonic Systems, Inc. (Farmingdale, NY)

Method of ultrasonic cryo
Ultrasonic motors and cor
Ultrasonic toothbrush app

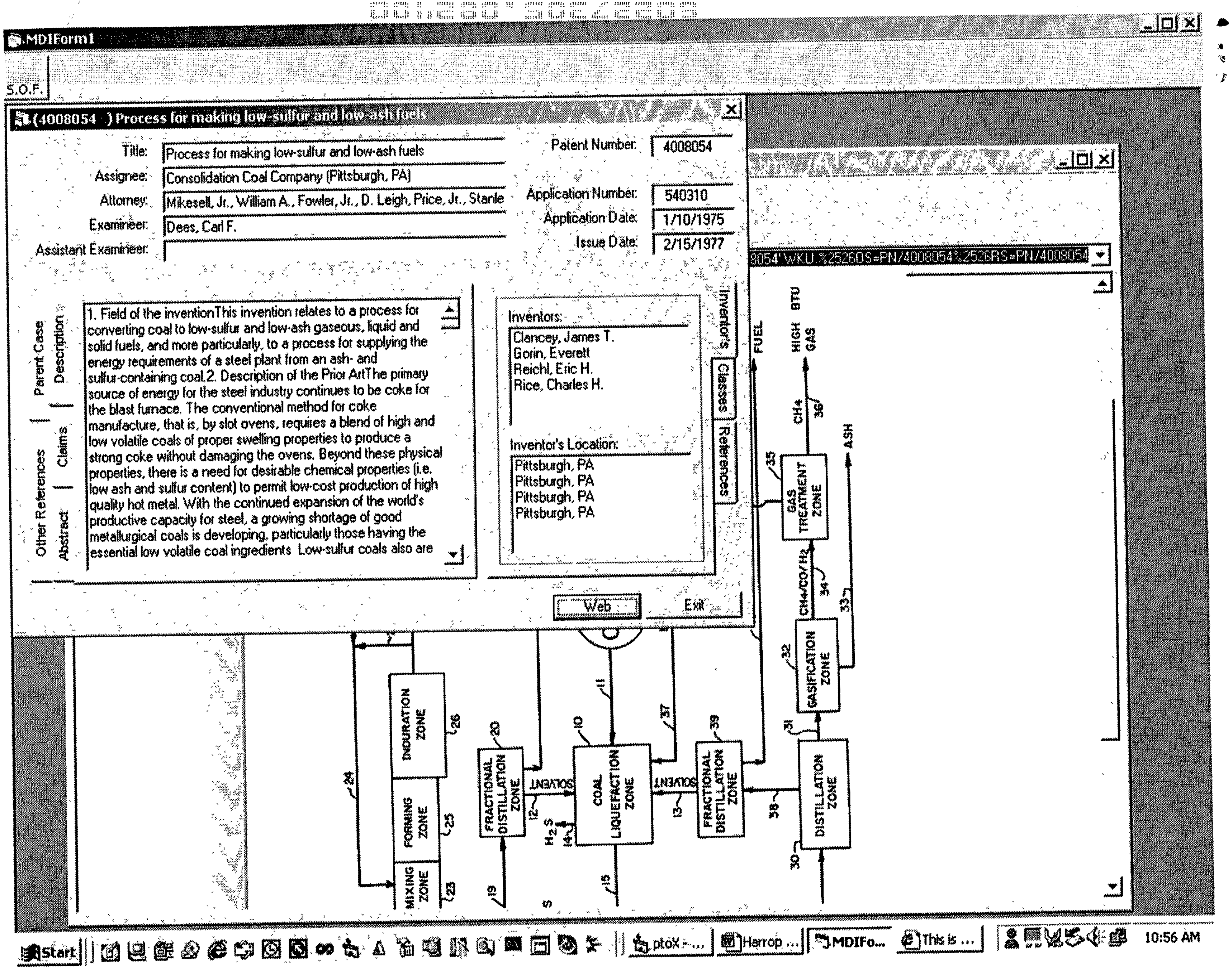
East Islip, NY
Glen Oaks, NY
Huntingdon Station, NY
Riverdale, NY
San Rafael, CA
Southampton, NY

FIG. 47



Artificial logs and log-making method and apparatus
Fire log process and apparatus
Fuel compacting apparatus
Method and apparatus for recovering by-product silt fines from a slurry thereof
Method of charging solids into coal gasification reactor
Process for making low-sulfur and low-ash fuels

FIG. 48



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S.O.F.

(4008054) Process for making low-sulfur and low-ash fuels

Title:	Process for making low-sulfur and low-ash fuels
Assignee:	Consolidation Coal Company (Pittsburgh, PA)
Attorney:	Mikesell, Jr., William A., Fowler, Jr., D. Leigh, Price, Jr., Stanle
Examineer:	Dees, Carl F.
Assistant Examineer:	

Patent Number:	4008054
Application Number:	540310
Application Date:	1/10/1975
Issue Date:	2/15/1977

1. Field of the inventionThis invention relates to a process for converting coal to low-sulfur and low-ash gaseous, liquid and solid fuels, and more particularly, to a process for supplying the energy requirements of a steel plant from an ash- and sulfur-containing coal.2. Description of the Prior ArtThe primary source of energy for the steel industry continues to be coke for the blast furnace. The conventional method for coke manufacture, that is, by slot ovens, requires a blend of high and low volatile coals of proper swelling properties to produce a strong coke without damaging the ovens. Beyond these physical properties, there is a need for desirable chemical properties (i.e. low ash and sulfur content) to permit low-cost production of high quality hot metal. With the continued expansion of the world's productive capacity for steel, a growing shortage of good metallurgical coals is developing, particularly those having the essential low volatile coal ingredients Low-sulfur coals also are

Inventors:
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Gorin, Everett
Reichl, Eric H.
Rice, Charles H.

Inventor's Location:
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FIG. 49