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<b>(21) International Application Number:</b> PCT/US97/17667  <b>(22) International Filing Date:</b> 30 September 1997 (30.09.97)  <b>(30) Priority Data:</b> 08/723,301                      30 September 1996 (30.09.96)      US  <b>(71) Applicant:</b> TRELLIX CORPORATION [US/US]; 51 Sawyer Road, Waltham, MA 02154 (US).  <b>(72) Inventors:</b> BRICKLIN, Daniel, S.; 38 Lakewood Road, Newton, MA 02161 (US). LEVIN, Peter; 26 Barnard Avenue, Watertown, MA 02172 (US). ZIMRING, Micah; 14 Upcrest Road, Boston, MA 02135 (US). KELLY, Winslow, B.; 11 Arlington Road, Natick, MA 01760 (US). ADAMS, George; 191 Tower Road, Lincoln, MA 01773 (US).  <b>(74) Agents:</b> HECKER, Gary, A. et al.; Hecker & Harriman, Suite 1600, 2029 Century Park East, Los Angeles, CA 90067 (US).		<b>(81) Designated States:</b> AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>Without international search report and to be republished              upon receipt of that report.</i>
<b>(54) Title:</b> HYPERMEDIA AUTHORIZING AND PUBLISHING SYSTEM		
<b>(57) Abstract</b>  <p>A method and apparatus for navigating multiple independent windowed images on a computer display screen of a computer system is presented. The images may be of arbitrary size and shape, although a rectangular shaped is typically used. A relationship is defined between the coordinates of points in one image and the coordinates of points in each of the other images. All or a portion of an image is shown in a window for each image. An indicator in one window determines the portion of an image shown in another window. Each image is an independent entity, although its content may be thematically related to the content of other windows. Each image is typically a bitmap. A cursor may be used to control the position of the indicator. Graphic objects and items may optionally be "drag-and-dropped" into any window.</p>		

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## HYPERMEDIA AUTHORIZING AND PUBLISHING SYSTEM

### BACKGROUND OF THE INVENTION

#### 5 1. FIELD OF THE INVENTION

The present invention relates to the field of hypermedia authoring and publishing systems.

#### 10 2. BACKGROUND ART

Hypertext and hypermedia refer to electronic documents or works for display on electronic media such as computer display screen. Hypermedia works do not have the serial structure of printed documents in which information is presented to a reader in a fixed order. Instead, information is presented to a reader in an order interactively determined by the reader.

In a hypermedia work, information is organized into individual portions called "lexia". Lexia can be viewed as containers of data. Data contained in lexia may include text, graphics, motion video and sound data. A lexia of a hypermedia work may contain one or more embedded links to other lexia. An example of a link is a highlighted word of text. Selecting the highlighted word, for example using a mouse, initiates display of the lexia to which the highlighted word is linked. This lexia may contain additional links, both back to the previous lexia and/or to other lexia or documents.

One common use of hypermedia is in computer software help files. Figure 1 is an illustration of an example lexia from a help file such as that

used in the Microsoft Windows (TM) operating system. As shown in Figure 1, lexia 100 includes a title bar 110, a text window 115, and a button bar 140. Title bar 110 contains the title of the lexia. For lexia 100, the title is "How to Use Help." Text window 115 contains the data for lexia 100, which in this

5 case is text data describing the basic operations of Windows Help. Text window 115 also contains a number of link activation areas that provide links to other lexia. These link activation areas, designated items 125, 130 and 135 in Figure 1, are indicated in text window 115 by bold facing and underlining of the words that constitute the links. Link activation area 125

10 consists of the word "links". Link activation area 130 consists of the word "maximize". Link activation area 135 consists of the word "minimize." Link activation areas 125, 130 and 135 link particular locations of lexia 100 to other lexia.

15 Button bar 140 contains a number of additional link activation areas in the form of buttons 120a-120b. Button 120a, labeled "Contents", provides a link to a table of contents lexia. Button 120b, labeled "Back", provides a link to the previously displayed lexia. Because the previously displayed lexia changes according to the path used to get to lexia 100, the lexia linked to by

20 button 120a changes over time. The link provided by button 120a is therefore a dynamic link that links to different lexia at different times. Buttons 120a and 120b link lexia 100 as a whole to other lexia.

Figure 2 shows the lexia that is opened by activating link activation

25 area 125 (i.e. the word "links") of lexia 100. As shown in Figure 2, lexia 200 contains a glossary entry for the term "Links". Like lexia 100 of Figure 1, lexia 200 includes a data window 210, a title bar 215, and link activation buttons

220a and 220b. Lexia 200 also contains link activation areas 225 and 230 comprising the words "Help topics" and "pointer", respectively.

The complex, dynamic inter-linked nature of a hypermedia work  
5 makes it difficult for both authors and readers to form an accurate and meaningful picture of the hypermedia work as a whole. Prior art hypermedia authoring and publishing (or reading) systems have attempted to provide graphical representations of hypermedia works by focusing on ways to show links between lexia.

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One prior art graphical depiction of a hypermedia work is illustrated in Figure 3. As shown in Figure 3, this prior art system depicts each lexia as the target of incoming links and the source of outgoing links. In the example of Figure 3, the hypermedia work consists of ten lexia, represented by boxes  
15 labeled "Lexia 1" through "Lexia 10". The hypermedia work is depicted by three repeated columns of the ten lexia. In the first column, Lexia 1-10 are identified by numbers 301-310, in the second column by numbers 311-320, and in the third column by numbers 321-330. A link from one lexia to another is shown as an arrow from the source lexia to the target lexia. The second  
20 column shows all incoming and outgoing links for each lexia. For example, Lexia 2 has incoming links from Lexias 1, 3, and 6. Accordingly, each of Lexias 1, 3 and 6 contain a link to Lexia 2. Lexia 2 is shown as having outgoing links to Lexias 1, 5 and 9. Accordingly, Lexia 2 contains links to Lexias 1, 5 and 9. Figure 5 is an alternative view of the prior art  
25 representation of Figure 3 showing only the incoming and outgoing links for Lexia 2.

The hypermedia work illustrated in Figure 3 consists of only ten lexia. Even with this small number of lexia, Figure 3 is confusing and complex. As a result, it does not provide a meaningful overview of the structure and content of the underlying hypermedia work. For a typical work containing  
5 several times the number of lexia shown in Figure 3, the graphical representation of Figure 3 is even less satisfactory.

Another prior art method for graphically representing a hypermedia work is shown in Figure 4. Figure 4 shows the same hypermedia work  
10 shown in Figure 3. In the representation shown in Figure 4, Lexia 1-10 are located at movable locations in window 400. Links between lexia are shown as arrows from the source lexia to the target lexia. The position of each lexia can be changed by the user, for example by dragging with a mouse. As a lexia moves, the arrows indicating links remain attached. As is evident from  
15 Figure 4, this representation of a hypermedia work also fails to provide an easily understandable overview of the hypermedia work as a whole.

Authoring a hypermedia work involves creating each lexia to be included in the work and connecting the lexia with appropriate links. A  
20 variety of methods for creating and linking lexia are provided in the prior art.

U.S. Patent No. 4,982,244 discloses a hypertext creation system in which lexia are displayed in the form of cards containing text. A first, blank card is created by activating the appropriate menu command. The blank card is  
25 supplied with an "autolink" button. Selecting the autolink button creates a second card automatically linked to the first, and also creates a link activation button on the first card. By choosing an appropriate menu command, the

second card may also be provided with an autolink button allowing the creation of further links.

Another prior art hypertext creation system is the "Storyspace" software program from Eastgate Systems, Inc. In Storyspace, lexia called "writing spaces" are displayed as boxes on a computer display screen. A link from one writing space to another is created by selecting the source writing space, selecting an appropriate menu command, and selecting the target writing space. The link can be changed to a link from or to a particular location in a lexia by selecting either the source or target writing space, choosing an edit link menu command, and identifying particular text in the writing space as the beginning or end of the link, as appropriate.

Prior art hypermedia authoring and publishing systems, though providing basic mechanisms for creating and displaying links between lexia, fail to provide an easy to use authoring and reading environment that allows authors to easily create and organize and readers to easily navigate and comprehend a hypermedia work.

### SUMMARY OF THE INVENTION

The present invention comprises a novel system for authoring and publishing hypermedia works, including hypertext documents. One feature of one embodiment of the present invention is a scrollable contents map window in which a graphical representation of a hypermedia work is displayed. In one embodiment, the contents map window is displayed across the top portion of a display screen, while a lexia display window is displayed on the display screen below the contents map window. The contents map window contains graphical lexia symbols representing the lexia of the hypermedia work, empty space, and other graphical and text elements. Links between lexia are not ordinarily displayed. Selecting the lexia symbol causes the corresponding lexia to be displayed in the lexia display window. The lexia symbols representing lexia may be arranged in the window in any configuration desired by the author, unconstrained by the actual structure of the underlying hypermedia work, and may be moved around at will by the author and/or a reader. The lexia symbols may be arranged in any manner that aids the author, and/or a reader in organizing and understanding the structure and content of the hypermedia work. Freely movable text labels and other graphical entities may be placed anywhere in the contents map window to aid in creating and/or reading the hypermedia work. In one embodiment, the present invention uses the method for navigating multiple independent windowed images disclosed in U.S. Patent Application Serial No. 08/298,215, attached hereto as Appendix 1.

In one embodiment of the invention, additional graphical entities may be placed in the window to create relationships among lexia corresponding to lexia symbols that are placed on these additional entities. For example, one relation-creating graphical entity is a bar. This bar may be placed anywhere in the window at any orientation. By itself, it performs no function. However, if lexia symbols representing lexia are placed on the bar, links are created between the lexia represented by the lexia symbols according to the relative position of the lexia symbols on the bar. In one embodiment, one end of the bar represents a "previous" direction and the other end a "next" direction.

For any two lexia symbols placed adjacent to each other on the bar, "next" and "previous" links will be created between the underlying lexia. The lexia corresponding to the lexia symbol placed closer to the "previous" end of the bar will be automatically supplied by the invention with a "next" button. Activating the "next" button from the lexia will bring up the lexia represented by the lexia symbol placed nearer the "next" end of the bar. Similarly, the lexia represented by the lexia symbol placed closer to the "next" end will be given a "previous" button that links to the lexia represented by the lexia symbol closer to the "previous" end. Lexia symbols may be moved around on the bar, inserted between other lexia symbols on the bar, added or removed from the bar, with all the links between the underlying lexia automatically updated to correspond to the new arrangement. More complex configurations for the graphical relation-creating entity, for example a grid, may be used, creating more complex relationships between lexia.

In one embodiment of the invention, graphical elements displayed in the contents map window provide "inheritance" characteristics and properties for lexia symbols that are disposed on the graphical elements.

In one embodiment of the invention, a number of different modes of the contents map window can be displayed. Different types of lexia symbols are displayed in each mode. Each type of lexia symbol provides a different  
5 package of information about the underlying lexia. One mode is a basic mode that provides a fundamental view of the hypermedia work. In this mode, the type of lexia symbol used to represent a lexia is a simple symbol such as a bitmap. In one embodiment, the symbol used is a colored dot. This type of symbol provides little information about the underlying lexia other than its  
10 relationship to the structure of the work as a whole. A second mode is a caricature mode. This mode provides more detailed information about the lexia in the underlying work than provided by the basic mode. In this mode, the type of lexia symbol used to represent a lexia is a novel, information rich, dynamic lexia symbol with enhanced mnemonic features and visual cues  
15 called a "caricature". The mnemonic features and visual cues of a caricature, together with its position with respect to other elements in the contents map, provide means for uniquely visually identifying the underlying lexia.

A caricature is not simply a scaled down image of the underlying lexia,  
20 but is derived algorithmically from the content of the underlying lexia. As such, the caricature becomes both a distinctive symbol for the lexia and a representation that aids an author and/or a reader in associating lexia content with a particular caricature, and helps an author and/or reader remember this association during subsequent navigation through a hypermedia work.

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For a lexia that is in the form of a page of text, one embodiment of the invention represents the lexia as a caricature of the paragraph structure of the

underlying page. The caricature uses groups of horizontal lines to represent paragraphs of text. Although the paragraph configuration displayed by the caricature corresponds to the paragraph configuration on the underlying page, there is no direct one-to-one correspondence between the lines  
5 displayed by the caricature and the lines of text in the lexia. The lines displayed on the caricature change dynamically in response to changes made to the structure of the underlying lexia.

In one embodiment, a caricature contains features that provide  
10 information about the access history of a lexia.

In one embodiment, a caricature for a lexia is originally displayed as a symbol such as a rectangle with sharply defined corners. As the lexia corresponding to the caricature is repeatedly accessed, either by an author  
15 while creating a work or by a reader reading the work, the sharp corners of the caricatures are smoothed. The more the underlying lexia is selected, the more the corners get rounded.

In one embodiment, the color of the caricature also provides  
20 information about the underlying lexia. The color of a caricature starts off a bright color such as white or yellow. The longer the underlying lexia is not selected, the darker the color of its caricature becomes. Thus it is easy at a glance to recognize the most used and least used lexia.

25 Caricatures may include additional visual cues, such as a v-shaped notch along an edge. In one embodiment, the position of the notch indicates the relative time, compared to other lexia, when the lexia was created.

Caricatures may also be provided with random or pseudo random features that are not based on any feature of the underlying lexia but that are added to a caricature to help distinguish the caricature from other caricatures.

5 In one embodiment, a v-shaped notch is generated at a randomized position along the top edge of the caricature to give the caricature a unique appearance.

In one embodiment of the invention, a new lexia is created by moving

10 a pointer to an empty location in the contents map window and activating a mouse button. A lexia symbol representing a new lexia is displayed at the indicated location, and an initially empty lexia is displayed in the lexia display window. If the caricature mode of the contents map window is active, the lexia symbol for the new lexia displayed in the contents map

15 window is a caricature. An editing mode may be activated for the lexia display window. In the editing mode, editing tools are provided that allow text and graphics and hypermedia links to be added to the lexia. As the content of the lexia is edited, the caricature displayed in the contents map window changes to reflect the changed content of the lexia.

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One embodiment of the present invention includes a search function that allows an author or a reader to search some or all of the lexia of a work for specific words or phrases. In one embodiment of the invention, all lexia containing the searched for text are highlighted in the contents map window.

25 A reader thus can easily locate and access the lexia containing the desired text.

In one embodiment of the invention, an author may elect to provide a viewer of the author's hypermedia work a contents map having a different configuration than the contents map used by the author to create the work. In one embodiment, the author may designate that certain graphical  
5 elements contained in the contents map be visible only to the author, and not to a viewer.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is an illustration of a lexia.

5           Figure 2 is an illustration of a lexia accessed by activating a link contained in the lexia of Figure 1.

Figure 3 is an illustration of one prior art graphical representation of a hypermedia work.

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Figure 4 is an illustration of a second prior art graphical representation of a hypermedia work.

15           Figure 5 is an alternate illustration of a portion of the prior art graphical representation of Figure 3.

Figure 6 is an illustration of a display screen from one embodiment of the present invention.

20           Figure 7 is an illustration showing the relative position of the contents map window of the embodiment of Figure 6 with respect to the contents map as a whole.

25           Figure 8 is an illustration showing how the position of the contents map window relative to the contents map changes as the scrolling frame is moved in the embodiment of Figure 7.

Figure 9 is an illustration of a contents map displayed at a "Fit in Window" zoom level in one embodiment of the present invention.

Figure 10 is an illustration of a contents map of one embodiment of  
5 the present invention.

Figure 11 is an illustration of a lexia display window of one  
embodiment of the present invention.

10 Figure 12a is an illustration of a display screen for one embodiment of  
the present invention.

Figure 12b is an illustration of a display screen for one embodiment of  
the present invention.

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Figure 12c is an illustration of a display screen for one embodiment of  
the present invention.

Figure 12d is an illustration of a display screen for one embodiment of  
20 the present invention showing a caricature symbol.

Figure 13a is an illustration of one embodiment of a caricature symbol.

Figure 13b is an illustration of a second embodiment of a caricature  
25 symbol.

Figure 13c is an illustration of a third embodiment of a caricature symbol.

Figure 14 is an illustration of a display screen for one embodiment of  
5 the present invention showing dynamic features of a caricature.

Figure 15a is an illustration of a display screen for one embodiment of  
the present invention showing a lexia and a corresponding caricature symbol.

10 Figure 15b is an illustration of a display screen for one embodiment of  
the present invention showing a lexia and a corresponding caricature symbol.

Figure 16a is an illustration of caricatures of one embodiment of the  
present invention.

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Figure 16b is an illustration of caricatures of one embodiment of the  
present invention.

Figure 16c is an illustration of caricatures of one embodiment of the  
20 present invention.

Figure 16d is an illustration of caricatures of one embodiment of the  
present invention.

25 Figure 17a is an illustration of a display screen showing how the  
contents map window can be used to organize and create links between lexia  
in one embodiment of the present invention.

Figure 17b is an illustration of a display screen showing how the contents map window can be used to organize and create links between lexia in one embodiment of the present invention.

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Figure 18a is an illustration of a display screen during the creation of a hypermedia work for one embodiment of the present invention.

Figure 18b is an illustration of the display screen of Figure 18a after  
10 lexia symbols have been placed on a link creation element according to one embodiment of the present invention.

Figure 18c is an illustration of the display screen of an embodiment of the present invention in which ordered links created by an ordered link  
15 creation element are in the form of ordered lists.

Figure 18d is an illustration of the display screen of an embodiment of the present invention including a hierarchical link creation element.

20 Figure 18e is an illustration of the display screen of one embodiment of the present invention including a special purpose formatting element.

Figure 18f shows an example of a link from a lexia to a special purpose element in one embodiment of the present invention.

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Figure 19a shows a table link creation element of one embodiment of the present invention.

Figure 19b shows a table link creation element of one embodiment of the present invention.

5        Figure 20 illustrates a search function provided by one embodiment of the present invention.

Figure 21 is an example of a computer system that can be used to implement the present invention.

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Figure 22 shows a multi-tiered navigation window of one embodiment of the present invention.

Figure 23 is a block diagram of the process used to create a new lexia in  
15 one embodiment of the present invention.

Figure 24 is a block diagram of the process used to display a caricature in one embodiment of the present invention.

20        Figure 25 is a block diagram of the process used to conform a caricature to changes to the underlying lexia in one embodiment of the present invention.

Figure 26 is a block diagram of the process used to modify links in  
25 response to changes to a link creation element in one embodiment of the present invention.

### DETAILED DESCRIPTION OF THE INVENTION

In the following description, numerous specific details are set forth in order to provide a thorough understanding of the present invention. It will  
5 be apparent to one skilled in the art, however, that the present invention may be practiced without these specific details. In other instances, well-known features have not been described in detail in order not to unnecessarily obscure the present invention.

10 Figure 6 is an illustration of a display screen displayed by one embodiment of the present invention on a display device such as a computer monitor. The embodiment of Figure 6 operates on a computer system using a Windows (TM) operating system from Microsoft Corporation. As shown in Figure 6, in this embodiment, the display screen 600 includes a contents map  
15 window 610 and a lexia display window 620. In the configuration shown in Figure 6, contents map window 610 and lexia display window 620 are arranged in a "tiled" configuration with contents map window 610 taking up approximately the top two-fifths of display screen 600 and lexia display  
20 window 620 taking up approximately the bottom three fifths of display screen 600. However, contents map window 610 and lexia display window 620 may be sized and positioned differently, and may overlap, as is well known in the art.

In the embodiment of Figure 6, contents map window 610 shows a  
25 portion of a contents map that graphically displays the lexia of a hypermedia work. Contents map window 610 is scrolled using scrolling frame 640 of navigation window 630 using the method disclosed in U.S. Patent

Application Serial No. 08/298,215 for "Method for Navigating Multiple Independent Windowed Images", a copy of which is attached hereto as Appendix 1. As shown in Figure 7, the relative position of scrolling frame 640 with respect to navigation window 630 is the same as the relative  
5 position of contents map window 610 with respect to the entire contents map 710, shown in outline in Figure 7. Dragging scrolling frame 640 relative to navigation window 630, for example using a mouse, causes contents map window 610 to move with respect to contents map 710 in the same manner as scrolling frame 640 is moved relative to navigation window 630. For  
10 example, dragging scrolling frame 640 so that it is positioned at the lower left corner of navigation window 630 causes contents map window 610 to scroll so that it is positioned at the lower left corner of contents map 710. The resulting configuration is shown in Figure 8.

15 In one embodiment of the present invention, the zoom level of contents map window 610 can be changed as is well known in the art such that the scale of the portion of the contents map 710 shown in contents map window 610 can be varied. In one embodiment, the zoom levels include a "Fit in Window" level in which all of contents map 710 is displayed in  
20 contents map window 610. Figure 9 shows an embodiment in which the contents map 710 is displayed in contents map window at a "Fit in Window" zoom level. As shown in Figure 9, if all of the contents map 710 is displayed in contents map window 610, navigation window 630 and scroll frame 640 are not displayed.

25

Figure 10 shows a contents map 1000 of one embodiment of the present invention. Depending on the zoom level selected for contents map

window 610, all or part of contents map 1000 may be displayed in contents map window 610 at one time.

Contents map 1000 of Figure 10 displays a newly created hypermedia  
5 work that does not yet contain any lexia. At this stage, contents map 1000 consists of a background image. In the embodiment of Figure 10, this background image consists of a single color background 1010 with different colored grid lines creating an image of boxes 1020a-1020d at the left end of contents map 1000. In other embodiments, the background image may  
10 consist of any combination of pictures, drawings, text, and any other graphic elements. The contents map may be provided with an alignment grid with a selectable "snap-to" capability to assist in the placement and alignment of graphical elements placed on the contents map.

15 In the embodiment of Figure 10, boxes 1020a-1020d do not provide any functionality other than providing visually distinguishable areas on background 1010. These distinguishable areas may be used by an author for organizing lexia into different author-defined groups during the creation of a hypermedia work. In other embodiments, means other than lines and boxes  
20 (including, without limitation, other geometric shapes or distinctive colors, borders, backgrounds or designs) may be used to visually distinguish specific areas from other areas of background 1010.

Figure 11 illustrates a lexia display window 1100 of one embodiment of  
25 the present invention. Lexia display window 1100 is used to display the contents of a lexia when a lexia is being edited or read. In one embodiment of

the invention, lexia display window 1100 provides different functionality in an editing mode than in a viewing mode.

As shown in Figure 11, lexia display window 1100 includes a title bar 1120, a summary window 1110, and a main lexia display area 1130. Lexia display window 1100 is shown in Figure 11 in a state in which no lexia is being displayed. If a lexia were being displayed, title bar 1120 would display the title and summary window 1110 a brief summary of the lexia being displayed. The content of the lexia would be displayed in main lexia display area 1130.

Figures 12a and 12b illustrate the creation of a new lexia in one embodiment of the present invention. As shown in Figure 12a, in this embodiment, a new lexia may be created by moving a cursor 1210 to a desired location in contents map window 610, for example by means of a mouse, and entering an appropriate keyboard command or clicking a mouse button. In response to clicking a mouse in contents map window 610, an initially empty lexia is created as shown in Figure 12b. Lexia symbols 1220 and 1230 representing the newly created lexia appear in contents map window 610 and navigation window 630, respectively, at the location corresponding to the position at which the mouse button was clicked. In the embodiment shown in Figure 12b, lexia symbols 1220 and 1230 are basic symbols in the forms of dots. Dot 1230 in navigation window 630 is smaller than dot 1220 in contents map window 610. In addition, a title 1240 for the newly created lexia is displayed in title window 1120, and the contents of the newly created lexia is displayed in main lexia display area 1130. In this embodiment, a user changeable default title is initially provided for a newly created lexia. In this

example, the default title is "1st Created Lexia," and the newly created lexia is empty. Accordingly, no contents is shown initially in main lexia display area 1130.

5           Figure 23 is a block diagram of the process used to create a new lexia in one embodiment of the present invention. As shown in Figure 23, at block 2310, a contents map window, a navigation window, and a lexia display window are displayed on a display screen such as a computer monitor. A notification is received at block 2315 that a user has initiated a lexia create  
10   command, for example by clicking a mouse button. The cursor position at the time the command was given is also received. Lexia symbols for a new lexia, including a lexia symbol for the contents map window and a lexia symbol for the navigation window, are generated at block 2320. These lexia symbols are displayed at positions corresponding to the cursor position  
15   received at block 2315 in the contents map window and the navigation window, respectively, at block 2325. A storage space for the new lexia is created at block 2330, and a default title, such as "2nd Created Lexia", is assigned to the new lexia at block 2335. The new lexia is displayed in the lexia display window at block 2340.

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          In one embodiment of the invention, lexia display window 1100 has an edit mode and a viewing mode. When the edit mode is active, a number of word processing tools, as are well known in the art including text, graphics, table, and spreadsheet tools are available for entering contents into the  
25   currently displayed lexia.

Figure 12c shows the newly created lexia of Figure 12b after the title has been changed from its default title and after text has been added to main lexia display area 1130. In addition, a summary 1245 has been added to summary window 1110. As shown in Figure 12c, the contents of the lexia, as shown in  
5 main lexia display area 1130, now includes a heading 1250 and two paragraphs of text 1255 and 1260, respectively.

In one embodiment of the invention, title 1240 and summary 1245, although they are part of the underlying lexia, are not visible when lexia  
10 display window 1100 is in a viewing mode. A lexia may contain additional data fields that are part of the lexia that are accessible in the edit mode and not in the viewing mode of display window 1100. For example, there may be a "nickname" field for a nickname that may be given to a lexia by the author, or an index field that contains a number or other index, or a keyword field  
15 that contains keywords for the lexia.

In one embodiment of the invention, contents map window 610 can be displayed in different modes as well as in different zoom levels. Different modes display different types of lexia symbols to represent lexia in contents  
20 map window 610. For example, for the mode shown in Figures 12b and 12c, the type of lexia symbol displayed for a lexia is a simple symbol such as dot.

A different display mode for contents map window 610 is shown in Figure 12d. In Figure 12d, contents map window 610 also is shown at a  
25 greater zoom level than in Figures 12b and 12c. Contents map window 610 thus shows a smaller portion of the whole contents map than in Figures 12b and 12c. Accordingly, in Figure 12d, scrolling frame 640, which corresponds

to the portion of the contents map displayed in contents map window 610, comprises a smaller portion of navigation window 630 than in Figures 12b and 12c.

5           For the display mode of contents map window 610 of Figure 12d, the lexia symbols used to represent lexia are information rich, dynamic lexia symbols with enhanced mnemonic features and visual cues called "caricatures". The mnemonic features and visual cues of a caricature, together with its position with respect to other elements in the contents map,  
10   provide means for uniquely visually identifying the underlying lexia.

The visual cues of a caricature identify distinguishing features of the underlying lexia. A caricature is not a static, predefined symbol, but is constructed dynamically based on the content and history of the underlying  
15   lexia. A caricature, as its name implies, is not generally an exact, miniature replica of the underlying lexia. Instead, it is a separate graphical image that is constructed so as to exaggerate certain distinguishing aspects as, for example, distinctive features of the visual appearance of the underlying lexia. As such, the caricature becomes both a distinctive symbol for the lexia and a  
20   representation that aids an author and/or a reader in associating lexia content with a particular caricature, and helps an author and/or reader remember this association during subsequent navigation through a hypermedia work. In one embodiment, the appearance of a caricature is periodically refreshed to reflect changes that may have occurred in the underlying lexia. In one  
25   embodiment, the appearance of a caricature is refreshed after each change that is made to an underlying lexia. In one embodiment, the appearance of a

caricature for a lexia is frozen upon expiration of a predetermined time limit or upon user command.

In Figure 12d, caricature 1270 represents "Overview" lexia 1290  
5 displayed in lexia display window 620. As shown in Figure 12d, Overview  
lexia 1290 is a text lexia. Overview lexia 1290 contains a heading 1250 and two  
paragraphs of text 1255 and 1260, respectively. Paragraph 1255 contains two  
full lines and one partial line approximately two-thirds of a full line in  
length. Paragraph 1260 contains three full lines of text and a partial fourth  
10 line containing a single word. Visual distinguishing features of Overview  
lexia 1290 are a short heading, a relatively short first paragraph whose last  
line is two-thirds of a full line in length, and a second paragraph somewhat  
longer than the first paragraph whose last line is a single word.

15 In the embodiment of Figure 12d, caricature 1270 consists of a stylized  
image of a page of text, reflecting the fact that the underlying lexia is a text  
lexia. As shown in greater detail in Figure 13a, caricature 1270 consists of a  
rectangle 1274 inside of which are lines representing paragraphs of text.  
Specifically, caricature 1270 includes a short bold line 1271; a first paragraph  
20 1272 consisting of two lines, one of which full length and the other  
approximately two-thirds of a full length; and a second paragraph 1273  
consisting of three lines, two of which are full length and one of which is a  
short stub. Short bold line 1271 of caricature 1270 represents underlined  
heading 1250 of Overview lexia 1290. First paragraph 1272 of caricature 1270  
25 represents first paragraph 1255 of Overview lexia 1290. Second paragraph  
1273 of caricature 1270 represents second paragraph 1260 of Overview lexia  
1290. Although paragraphs 1272 and 1273 of caricature 1270 contain two and

three horizontal straight lines, respectively, while paragraphs 1255 and 1260 of underlying Overview lexia 1290 contain three and four actual lines of text, respectively, the relative shapes and sizes of paragraphs 1272 and 1273 of caricature 1290 are visually generally the same as the relative shapes and sizes of paragraphs 1255 and 1260 of Overview lexia 1290. Thus although caricature 1270 is not an exact replica of Overview lexia 1290, the relative shapes and sizes of its visual features associate caricature 1270 visually with Overview lexia 1290. Further, the relative shapes and sizes of its visual features distinguish caricature 1270 from caricatures representing lexia having different paragraph forms.

Figures 13b and 13c illustrate other embodiments of caricatures for Overview lexia 1290. However, it will be understood that the caricatures of the present invention are not limited to the specific caricatures shown. In addition to the example caricatures of Figures 13a, 13b, and 13c, a wide variety of other caricatures that visually distinguish one lexia from another by emphasizing distinctive features can be used.

In caricature 1310 of Figure 13b, a separate straight line is used to represent each line of text in the underlying lexia 1290. Each full length straight line in caricature 1310 represents a full line of text in the underlying lexia and each partial length straight line in caricature 1310 represents a partial line in the underlying lexia. Caricature 1310 consists of bold line representing heading 1250 of lexia 1290, first paragraph 1320 consisting of two full length straight lines and one partial length straight line representing first paragraph 1255 of lexia 1290, and second paragraph 1325 consisting of three

full length straight lines and one partial length straight line representing second paragraph 1260 of lexia 1290.

In caricature 1350 of Figure 13c, solid blocks 1355, 1360, and 1365  
5 represent heading 1250 and paragraphs 1255 and 1260, respectively, of lexia 1290. The shapes of blocks 1355, 1360 and 1365 correspond to the general relative shapes of the corresponding blocks of text of the underlying lexia.

Figure 14 illustrates how the appearance of a caricature of the present  
10 invention dynamically changes to reflect changes to the underlying lexia represented by the caricature. Figure 14 shows the display screen of the embodiment of Figure 12d after a new paragraph 1410 has been added to Overview lexia 1290. New paragraph 1410 may be added, for example, by typing in the new text using the word processing tools in the editing mode of  
15 lexia display window 620. In the embodiment of Figure 14, addition of paragraph 1410 has made the text area of lexia 1290 larger than lexia display window 620. Accordingly, a scroll bar 1420 and a scroll button 1425 have been added to lexia display window 620 to allow the scrolling of the portion of lexia 1290 displayed in lexia display window 620.

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In the embodiment shown in Figure 14, new paragraph 1410 contains the same number of lines as existing paragraph 1260, all of which are essentially full-width. As shown in Figure 14, addition of paragraph 1410 to lexia 1290 causes a corresponding paragraph representation 1415 to be added  
25 to caricature 1270 displayed in contents map window 610. Because new paragraph 1410 has the same number of lines as existing paragraph 1260, paragraph representation 1415 corresponding to paragraph 1410 has the same

number of straight lines, three, as paragraph representation 1273 corresponding to paragraph 1260. Because the text lines of new paragraph 1410 are essentially full-width lines, the lines of paragraph representation 1415 of caricature 1270 are also full width.

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Figures 15a and 15b show two other examples of lexia and corresponding caricatures.

Figure 15a shows a lexia 1510 called "Lexia Data" in lexia display window 620 consisting of a heading 1511 and a two-line paragraph 1512. The corresponding caricature 1515 displayed in contents map window 610 features a short bold line 1516 representing heading 1511 and a paragraph representation 1517 corresponding to paragraph 1512 consisting of a full width straight line and a short straight line.

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Figure 15b shows a lexia called "Links" in lexia display window 620 consisting of a heading 1521 and a two-column, four entry table 1522. The corresponding caricature 1525 displayed in contents map window 610 features a short bold line 1526 representing heading 1521 and a table representation 1527 for table 1522 consisting two columns of straight lines corresponding to the structure of the text in table 1522.

In the embodiments of caricatures shown in Figures 14, 15a and 15b, the aspect ratios of the paragraph and table representations used in the caricatures are similar to the aspect ratios of the actual paragraphs and tables in the underlying lexia. However, it is not necessary to maintain the same aspect ratios in a caricature as in the underlying lexia. Also, it is not necessary

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to have the same number of paragraph representations in a caricature as there are paragraphs in the underlying lexia. If the lexia contains a table, it is not necessary for a table representation used in the corresponding caricature to contain the same number of columns and/or rows as the original table.

5

The caricatures of the present invention can be used to improve recognition of the underlying lexia by exaggerating visual features that a person typically uses to distinguish one item from another and by minimizing those features that a person tends to ignore. For purposes of distinguishing one caricature from another and for associating a caricature with the content of the underlying lexia, the existence of a table, or the fact that a paragraph or heading is centered, may be more important than the configuration of the table or the length of the paragraph or heading. Similarly, for a very long lexia, the appearance of the first portion of the lexia may be sufficient to distinguish the lexia from other lexia. Accordingly, only a representation for the first portion of the lexia need be displayed in the caricature. For example, for a lexia containing ten paragraphs, it may be sufficient to display representations of only the first four paragraphs in the corresponding caricature. Thus, by appropriately choosing the criteria used for creating caricatures, the vertical dimension of a caricature, if desired, can be compressed significantly compared to the vertical dimension of the underlying lexia. A vertically long lexia can then be represented by a relatively shorter caricature.

25           Figures 16a-16d illustrate embodiments of caricatures of the present invention that provide information about characteristics of the underlying

lexia other than information about the contents or visual appearance of the lexia.

Figure 16a illustrates embodiments of caricatures of the present invention 1600, 1605 and 1610 in which the degree to which the corners of each caricature are rounded corresponds to the number of times that the lexia represented by a caricature has been selected by an author during editing or by a viewer during viewing. The rounding of corners of caricatures is a metaphor for the tendency of paper documents to become dog-eared the more they are handled.

In Figure 16a, caricature 1600 has sharp corners, caricature 1605 has slightly rounded corners, and caricature 1610 has more rounded corners, indicating that of these three caricatures, the lexia represented by caricature 1610 has been selected the most number of times and the lexia represented by caricature 1600 the least. It will be apparent to those skilled in the art that the degree of rounding of corners may signify some characteristic other than the relative number of times a lexia represented by a caricature has been selected, that the rounding can be applied to less than all corners of a caricature, and that other aspects of a caricature can be changed to indicate the relative number of times the lexia represented by a caricature has been selected.

Figure 16b illustrates embodiments of caricatures of the present invention 1615, 1620 and 1625 in which coloring of the background of a caricature represents information about the caricature. In one embodiment, the background color of a caricature varies from white to successively darker shades of gray. In this embodiment, the shade of the background color of a

caricature corresponds to the relative length of time since the last time the lexia represented by a caricature was selected. This progressive shading with time is a metaphor for the tendency for paper documents to become faded and yellowed over time.

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In Figure 16b, the background color of caricature 1615 is a lighter shade than the background color of caricature 1620, which in turn is a lighter shade than the background color of caricature 1625. Accordingly, the lexia represented by caricature 1615 is the most recently selected lexia of the lexia represented by caricatures 1615, 1620 and 1625, and the lexia represented by caricature 1625 is the least recently selected. It will be apparent to those skilled in the art that the relative length of time since the lexia represented by a caricature has been selected may be indicated on a caricature by some other means, that different color and shading schemes can be used, and that the variation in color of caricatures may indicate information other than the relative time since the lexia represented by a caricature has been selected. For example, in one embodiment, the variation of color over time represents the time since the lexia was created instead of the time since the lexia was last selected.

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Figure 16c illustrates embodiments of caricatures of the present invention 1630, 1635 and 1640 in which the location of a notch along the top edge of a caricature is used to provide a distinguishing feature for a caricature. The notch is a metaphor for pages being torn from a pad. In one embodiment, the location of the notch indicates a relative time at which the lexia represented by a caricature was created. In another embodiment, the notch is a random or pseudo random feature whose position is not based on

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any feature of the underlying lexia but that is added to a caricature to help distinguish the caricature from other caricatures. In one embodiment, instead of a single notch being placed at a random location, different numbers of notches are placed in different locations to provide a randomized  
5 distinctive appearance. For example, one caricature may have a single notch near the center of its top edge, while another may have one notch to the left and two notches to the right of the center of the top edge. It will be apparent to those skilled in the art that other features other than the location and number of notches can be used to add distinctive random features to a  
10 caricature.

In the embodiment of Figure 16c, the nearer a notch is to the top left corner of a caricature, the earlier a lexia represented by a caricature was created. Of caricatures 1630, 1635, and 1640 in Figure 16c, caricature 1630 has a  
15 notch 1631 closest to the caricatures top left corner. Accordingly, the lexia represented by caricature 1630 was created earlier than the lexia represented by caricatures 1635 and 1640. Caricature 1640 has a notch 1641 furthest from its top left corner. Accordingly, the lexia represented by caricature 1640 was created later than the lexia represented by caricatures 1635 and 1640. It will be  
20 apparent to those skilled in the art that the relative time at which a lexia is created can be represented by other means than the position of a notch along the top edge of the caricature representing the lexia, that a notch may be located on other edges than a top edge of a caricature, that indications other than a notch can be used, and that the position of a notch along an edge of a  
25 caricature can provide other information than the relative time at which the lexia represented by a caricature was created.

Figure 16d shows embodiments of caricatures of the present invention incorporating features of the caricatures of Figures 14, 15a-b, and 16a-c.

Of the three caricatures 1645, 1650 and 1655 of Figure 16d, caricature  
5 1645 has the sharpest corners, the darkest shading, and a notch furthest from its top left corner. Accordingly, relative to the three lexia represented by caricatures 1645, 1650 and 1655, the lexia represented by caricature 1645 has been selected the least, was last selected a longer time ago, and was the last created. Caricature 1645 also indicates that the underlying lexia contains a  
10 table with four entries.

Caricature 1655 has the lightest shade of color, the most rounded corners, and a notch along the top edge closer to the top left corner than caricature 1645 but further from the top left corner than caricature 1650.  
15 Accordingly, the lexia represented by caricature 1645 was selected more recently than the lexia represented by caricatures 1645 and 1655, has been selected more often than the other two lexia, and was created after the lexia represented by caricature 1650 but before the lexia represented by caricature 1645. Caricature 1655 also indicates that the underlying lexia contains a  
20 heading and a single short paragraph.

It will be apparent to those skilled in the art that other aspects of the visual appearance of a caricature can be used to provide information about the underlying lexia. Such other aspects can include, without limitation, the  
25 size and/or aspect ratio of a caricature, the caricature's color scheme, designs, text and graphics that are included in a caricature, animation exhibited by a caricature, and other visual features.

Figure 24 is a block diagram of the process used to display a caricature in one embodiment of the present invention. As shown in Figure 24, when a new lexia is created, a default caricature, such as a empty rectangle with sharp corners, is generated at block 2405. At block 2406, a randomized appearance feature, such as a notch along a randomized location at the top edge of the caricature, is generated at block 2406 and added to the caricature. A lexia selection counter that counts the number of times the lexia represented by the caricature has been selected is initialized to zero at block 2408, and the caricature is displayed in the contents map window at block 2410. The lexia selection counter is incremented by one at block 2412, and the appearance of the caricature is conformed to the lexia selection counter value at block 2414. The appearance of the caricature changes at certain predetermined values of the lexia selection counter, for example in the manner described above with respect to the embodiment of Figure 16a. For a new lexia for which the lexia selection counter is at an initial value of 1, no change in appearance of the caricature is required.

At block 2416, the caricature is highlighted in the contents map window reflecting that the lexia corresponding to the caricature is the currently selected lexia. At block 2418, a determination is made as to whether the lexia represented by the caricature is still selected. If the lexia is still selected, a determination is made at block 2420 as to whether any changes have been committed to the lexia, for example by typing in text in the lexia display window and executing a "save" command. If no changes have been committed, the process returns to block 2418.

If changes have been committed, the appearance of the caricature is conformed to the changes to the lexia at block 2422, and the process returns to block 2418.

- 5           If it is determined that the lexia represented by the caricature is no longer selected at block 2418, the highlighting of the caricature in the contents map window is removed at block 2424 and a not selected timer is started at block 2426. The not selected timer keeps track of the amount of time that has passed since the last time the lexia represented by the caricature was selected.
- 10       The next selection of the lexia is awaited at block 2428.

- At block 2430 a determination is made as to whether the lexia has been selected. If the lexia has not been selected, a determination is made at block 2436 as to whether the timer increment that triggers a change in the
- 15       appearance of the caricature has been reached. If that time increment has not been reached, the process returns to block 2428. If the time increment has been reached, the appearance of the caricature is conformed to the value of the not selected timer at block 2438. For example, the color of the caricature may be changed in the manner described above with respect to the
- 20       embodiment of Figure 16b. The process then returns to block 2428.

- If it is determined at block 2430 that the lexia has been selected, the not selected timer is reset to zero at block 2432 and the appearance of the caricature is conformed to a not selected timer value of zero at block 2434.
- 25       The process then returns to block 2412.

Figure 25 is a block diagram of the process used to conform a caricature to changes to the underlying lexia in one embodiment of the present invention. As shown in Figure 25, the contents of the lexia is examined at block 2510 and the distinguishing features, such as headings, paragraphs, tables, graphic frames, etc., are identified at block 2520. Representations for the identified distinguishing features are generated at 2530, and, in the embodiment of Figure 25, the representations are sized to fit the caricature at block 2540.

10 In one embodiment, instead of sizing the representations for the content of the underlying lexia to fit the caricature as in the embodiment of Figure 25, the representations are "clipped" so that only the portions of the representations that fit into a caricature are included in the caricature. For example, if a lexia contains ten paragraphs for which there are ten paragraph representations, but the caricature and paragraph representations are sized 15 such that only the first three and a half of the ten paragraph representations fit into the caricature, then only those first three and a half paragraph representations are included in the caricature. In one embodiment, if the representations for the content of a lexia generated using one method result 20 in representations of which only a portion fit a caricature, representations are generated using a different method to attempt to generate representations a greater portion of which will fit a caricature.

Figures 17a and 17b show one way in which the contents map window 25 of the present invention can be used by an author of a hypermedia work to organize and create links between lexia in one embodiment of the present invention. Figure 17a shows an embodiment of a display screen in which the

display mode for the contents map window is the same as in Figure 12c. In this display mode, lexia are represented by colored dots. Figure 17b shows an embodiment of a display screen in which the display mode for the contents map window is the same as in Figure 12d. In this display mode, the lexia  
5 symbols used to represent lexia are caricatures.

The display screens 1700 shown in Figures 17a and 17b both include a contents map window 1710, a lexia display window 1720, a navigation window 1730, and a scrolling frame 1740. Contents map window 1710  
10 contains lexia symbols representing three lexia. In Figure 17a, the lexia symbols used to represent the three lexia are colored dots 1745, 1750 and 1755, respectively. In Figure 17b, the lexia symbols used to represent the three lexia are caricatures 1746, 1751, and 1756, respectively. In both Figures 17a and 17b, the three lexia are represented in navigation window 1730 by small colored  
15 dots 1760, 1761, and 1762 respectively.

The portions of the contents map shown in contents map window 1710 of Figures 17a and 17b contain grid lines 1765 that form a box 1770 in contents map window 1710. Box 1770 has no function other than providing a  
20 visually separate area in the contents map that can be used by the author to organize lexia. In Figure 17a, dots 1750 and 1755, representing two lexia, have been placed by the author of in box 1770. Similarly, in Figure 17b, caricatures 1751 and 1756 have been placed by the author in box 1770.

25 The embodiments of Figures 17a and 17b allow an author and a viewer to create freely movable floating text labels that can be positioned anywhere on the contents map. These floating text labels allow an author or viewer to

place text that is useful to the author or viewer adjacent to individual lexia symbols or groups of lexia symbols to aid the author in organizing and authoring and the viewer in viewing and understanding the hypermedia work. In one embodiment of the invention, an author can choose whether  
5 or not a floating text label created by the author is made visible to a viewer of the created hypermedia work.

In Figures 17a and 17b, a floating text label 1766 containing the text "Glossary Items" has been placed by the author in box 1770. Floating text label  
10 1766 signals to the author or the viewer that the lexia symbols located in box 1770 are considered by the author to be "glossary items." What is meant by "glossary items" is solely at the discretion of the author. In the embodiment of Figures 17a and 17b, placing lexia symbols in box 1770 or grouping lexia symbols in any other manner on the contents map does not imply or create  
15 any links or any other structural relationship between the lexia represented by the lexia symbols.

In the embodiments of Figures 17a and 17b, the contents of a currently selected lexia is displayed in lexia display window 1720. In the example of  
20 Figures 17a and 17b, the name of the currently selected lexia, "Overview", is displayed in title bar 1775, and a summary description is displayed in summary window 1776.

The currently selected lexia is also identified in contents map 1710 and  
25 navigation window 1730 by highlighting the lexia symbol representing the selected lexia.

In the embodiment of Figure 17a, lexia symbol 1745 representing the selected lexia in contents map window 1710 is highlighted by changing its color from its normal color to a highlighted color. In Figure 17a highlighting of lexia symbol 1745 is indicated by representing lexia symbol 1745 by a white  
5 dot.

In the embodiment of Figure 17b, caricature 1746 representing the selected lexia in contents map window 1710 is highlighted by changing its color from its normal color to a highlighted color. In Figure 17a highlighting  
10 of caricature 1746 is indicated by short lines 1747 extending radially from caricature 1746.

In Figures 17a and 17b, lexia symbol 1762 representing the selected lexia in navigation window 1730 is highlighted by changing its color from its  
15 normal color. In Figures 17a and 17b highlighting of lexia symbol 1762 is indicated by representing lexia symbol 1762 by a white dot.

As will be apparent to those skilled in the art, any of a variety of other means can be used to highlight the lexia symbols of a selected lexia to identify  
20 a selected lexia.

One method that can be used to create links between lexia using the contents map of the present invention is shown in Figures 17a and 17b. In the example shown in Figures 17a and 17b, a link is created from the word  
25 "data" in the second line of the first paragraph of the lexia displayed in lexia display window 1720 to the lexia represented by lexia symbol 1755 and caricature 1756, respectively, in contents map window 1710.

As shown in Figures 17a and 17b, the first step in creating the link, (indicated by circled number "1") is to identify the origin of the link in the lexia displayed in lexia display window 1720. In the embodiment shown in  
5 Figures 17a and 17b, the origin of the link is identified by positioning a mouse cursor 1781 over the origin and clicking a mouse button. In the embodiment shown in Figures 17a and 17b, the origin is identified by a box 1782 around the word "data".

10 In one embodiment of the invention, clicking a mouse button on a location in the lexia display window brings up a pop-up menu that allows a variety of actions to be selected. One of the actions that can be selected is creating a link. In one embodiment, the creating a link is the default mode of action for a mouse click on the lexia display window.

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In the embodiment of Figures 17a and 17b, once the origin of a link has been identified, the target lexia of the link is identified. In the embodiment of Figures 17a and 17b, the target lexia is identified by positioning a mouse cursor 1790 over the lexia symbol in contents map window 1710 representing  
20 the target lexia and selecting the lexia, for example by clicking a mouse button. A link is then automatically created between the origin identified in lexia display window 1720 and the lexia represented by the selected lexia symbol. In one embodiment of the invention, a target lexia can be specified by selecting the corresponding lexia symbol either in contents map window  
25 1710 or in navigation window 1730.

The step of positioning a cursor over the symbol for the target lexia is indicated by the circled number "2" in Figures 17a and 17b. As shown in Figures 17a and 17b, in this embodiment, positioning a cursor over a lexia symbol in contents map window 1710 causes the underlying lexia symbol to  
5 be identified both in contents map window 1710 and in navigation window 1730 by a spaced outline around the periphery of the lexia symbol.

Accordingly, positioning cursor 1790 over lexia symbol 1755 in contents map window 1710 of Figure 17a causes spaced outlines 1792 and 1793 to be displayed around lexia symbol 1755 in contents map window 1710 and lexia  
10 symbol 1760 in navigation window 1730, respectively. Similarly, in the embodiment of Figure 17b, positioning cursor 1790 over lexia caricature 1756 in contents map window 1710 of Figure 17b causes spaced outlines 1795 and 1793 to be displayed around caricature 1756 and lexia symbol 1760, respectively.

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In one embodiment of the invention, similar outlines appear around lexia symbols in the content map window and the navigation window when a cursor is positioned over a location that is an origin of a link in the lexia display window. In this case, the outline identifies the lexia symbols  
20 representing the lexia that is the target of the link that begins at the cursor location.

In the embodiments of Figures 17a and 17b, positioning a cursor over a lexia symbol in contents map window 1710 causes a pop-up label 1799 to be  
25 displayed that shows the title of the lexia represented by the lexia symbol over which the cursor is positioned. In the examples of Figures 17a and 17 b, the title of the lexia is "Lexia Data". In one embodiment of the invention, the

title and/or the summary of a lexia are displayed when a cursor is positioned over a lexia symbol representing the lexia. In other embodiments, other data fields of the underlying lexia may be displayed, and different data fields may be displayed in an editing mode than in a viewing mode. The fields that are  
5 displayed may be user selectable. For example, in one embodiment, an author may elect to display a nickname field and a summary field during editing, and a title field and a summary field during viewing.

In the embodiment of Figure 17a, the activation area for the link that is  
10 created from the lexia represented by lexia symbol 1745 to the lexia represented by lexia symbol 1755 consists of a word from the text of the lexia represented by lexia symbol 1745, namely the word "data." In this case, activation area for a link comprises text taken from the source lexia. In other  
15 embodiments, the activation area for a link may comprise text taken from the source lexia, text taken from the target lexia, or a data field such as a title or summary extracted from either the source or target lexia, as selected by the user.

The present invention allows the placement of special purpose or  
20 special function graphical elements onto the contents map that operate on lexia symbols that are placed or "dropped" on or near the special purpose elements. The special purpose elements include elements that provide formatting and that create links.

25 The operation of an element that creates links in one embodiment of the present invention is shown in Figures 18a-c.

Figure 18a shows a display screen 1800 during the creation of a hypermedia work for one embodiment of the present invention. Display screen 1800 contains contents map window 1810, lexia display window 1820, navigation window 1830, and scrolling frame 1840. The position of scrolling frame 1840 indicates the portion of the contents map that is being displayed in contents map display window 1810. In Figure 18a, the display mode being used for contents map window 1810 is a mode in which lexia symbols in the form of colored dots are used to represent lexia.

The portion of the contents map displayed in contents map window 1810 contains a number of lexia symbols that have been arranged by the author of the hypermedia work being created into groups that are useful to the author. Lexia symbols 1850, 1851 and 1852 form one group. Lexia symbol 1851 is highlighted, indicating that the lexia represented by lexia symbol 1851 is the currently selected lexia whose content is being displayed in lexia display window 1820. Lexia symbols 1853, 1854, 1855, and 1856 form a second group. Lexia symbols 1857, 1858, 1859, and 1860 form a third group. The author has also created floating text labels 1870, 1871, and 1872 adjacent to the three groups of lexia symbols, respectively, to help the author identify the groups.

The three groups of lexia displayed in contents map window 1810 are also displayed as groups of lexia symbols 1861, 1862 and 1863, respectively, in the portion of navigation window 1830 within scrolling window 1840. Navigation window 1830 also contains three additional groups of lexia symbols 1864, 1865 and 1866. These lexia symbols are outside of the portion of the contents map being displayed in contents map window 1810 and are therefore not currently displayed in contents map window 1810. A lexia

symbol contained in navigation window 1830 but not currently displayed in contents map window 1810 can be displayed by moving scrolling window 1840 to encompass the desired lexia symbol.

5           In the embodiment of Figure 18a, the author has also caused a special function element 1875 to be created and displayed in contents map display window 1810. In one embodiment of the present invention, special function element 1875 may be created by an author by positioning a cursor over the desired location for the special function element and clicking a mouse  
10 button. In response, a pop-up menu appears from which the author can choose the type of element the author wishes to create. In one embodiment of the invention, the menu choices for types of elements include lexia, formatting elements, link creation elements, and others.

15           The graphical representation of a special function element displayed in contents map window 1810 is not restricted to any particular form and size. Different representations may be used for different types of special function elements. Representations of special function elements may include, without limitation, text, geometric designs, drawings, images, photographs  
20 and symbols, and may be static, dynamic, or animated.

          In the embodiment of Figure 18a, special function element 1875 is displayed in the form of a bar in contents map window 1810. Special function element 1875 is also displayed in the form of a smaller bar 1876 in navigation  
25 window 1830. Thus the same general form of representation for special function element 1875 is used in contents map window 1810 and navigation

window 1830. In other embodiments, different forms of representation may be used in each of navigation window 1830 and contents map window 1810.

In the embodiment of Figure 18a, a special function element displayed  
5 as a bar constitutes an ordered link creation element. This type of element creates ordered links between lexia represented by lexia symbols placed, for example by "dragging and dropping" using a mouse, on or near the image of the element displayed in contents map window 1810. In one embodiment of the invention, a symbol must be placed directly on a special function element  
10 in order for the special function element to operate on the lexia represented by the lexia symbol. In another embodiment, a symbol placed sufficiently near but not directly on a special function element is considered to be located on the element such that the element operates on the corresponding lexia. In one embodiment, a special function element has a "snap-to" feature such  
15 that symbols placed sufficiently near but not on the element are automatically moved onto the element.

Figure 18b shows the display window 1800 of Figure 18a after lexia symbols 1850, 1851, and 1853 have been dragged and dropped, using a mouse,  
20 onto ordered link creation element 1875. The resultant configuration of lexia symbols is also shown in navigation window 1830. In the embodiment of Figure 18b, placing lexia symbols on an ordered link creation element creates links among the lexia represented by the lexia symbols placed on the link creation element according to the order of placement of the lexia symbols on  
25 the link creation element. In the embodiment of Figure 18a, "next" and "previous" links are created between the lexia represented by any two adjacent lexia symbols on ordered link creation element 1875.

In Figure 18b, lexia display window 1820 shows "previous" and "next" link activation buttons 1880 and 1881, respectively, created by placing lexia symbol 1851 between lexia symbols 1850 and 1853 on ordered link creation element 1875. Lexia symbol 1851 is highlighted, indicating that the lexia represented by lexia symbol 1851 is the currently selected lexia that is being displayed in lexia display window 1820.

In the embodiment of Figure 18b, placing a first lexia symbol to the right of a second lexia symbol on an ordered link creation element such as ordered link creation element 1875 creates a "previous" link from the lexia represented by the first lexia symbol to the lexia represented by the second lexia symbol. Accordingly, in the embodiment of Figure 18b, previous links are established from the lexia represented by lexia symbol 1851 to the lexia represented by lexia symbol 1850, and from the lexia represented by lexia symbol 1853 to the lexia represented by lexia symbol 1851. In the embodiment of Figure 18b, the lexia represented by lexia symbol 1851 is displayed in lexia display window 1820. The previous link from the lexia represented by lexia symbol 1851 to the lexia represented by lexia symbol 1850 is represented by previous button 1880. Activating previous button 1880 causes the lexia represented by the lexia symbol 1850 to become selected and displayed in lexia display area 1820.

In a similar manner, in the embodiment of Figure 18b, placing a first lexia symbol to the left of a second lexia symbol on an ordered link creation element such as ordered link creation element 1875 creates a "next" link from the lexia represented by the first lexia symbol to the lexia represented by the

second lexia symbol. Accordingly, in the embodiment of Figure 18b, next links are established from the lexia represented by lexia symbol 1850 to the lexia represented by lexia symbol 1851, and from the lexia represented by lexia symbol 1851 to the lexia represented by lexia symbol 1853. In the embodiment  
5 of Figure 18b, the next link from the lexia represented by lexia symbol 1851 to the lexia represented by lexia symbol 1853 is represented by next button 1881. Activating next button 1881 causes the lexia represented by the lexia symbol 1853 to become selected and displayed in lexia display area 1820.

10 Link activation buttons 1880 and 1881 created by ordered link creation element 1875 may have labels other than the "Previous" and "Next" labels shown in Figure 18b. For example, in one embodiment, the labels used for link activation buttons 1880 and 1881 are the titles extracted from the target lexia. In other embodiments, other labels may be used.

15

In one embodiment of the invention, the arrangement of lexia symbols on a link creation element is changeable. The order of lexia symbols on a link creation element can be changed, lexia symbols can be freely added and removed, at any location on a link creation element, and the spacing  
20 between lexia symbols on a link creation element can vary. In one embodiment, the links created by the link creation element are automatically revised according to any changes made to the composition and configuration of lexia symbols on the link creation element.

25 In one embodiment of the present invention, the ordered links created by placing lexia symbols on ordered link creation element 1875 may be in the form of an ordered list instead of in the form of next/previous links. In one

embodiment, the type of link created by ordered link creation element 1875 can be selected by an author when the link creation element is created, and can also be changed by editing the link creation element after creation.

5           Figure 18c shows an embodiment in which the ordered links created by ordered link creation element 1875 have been selected by the author to be in the form of ordered lists. In this embodiment, as compared to the embodiment of Figure 18b, an additional lexia symbol 1856 has been dropped onto ordered link creation element 1875 between lexia symbols 1851 and 1853.

10   Ordered link creation element 1875 now contains four lexia symbols. In this embodiment, a link is created from each lexia represented by a lexia symbol on ordered link creation element 1875 to each lexia represented by each of the other lexia symbols on ordered creation element 1875. Because there are a total of four lexia symbols on ordered link creation element 1875 in Figure

15   18c, for each lexia symbol, there are three other lexia symbols on ordered link creation element 1875. Accordingly, for each lexia represented by a lexia symbol on ordered link creation element 1875, links are created to three other lexia. These links are represented in a lexia by a list of the titles of the lexia that are the targets of the links. The embodiment of Figure 18c automatically

20   extracts the titles from the lexia represented by lexia symbols on ordered link creation element 1875 and inserts these titles, in the form of a list, as link activation areas into the other lexia represented by lexia symbols on ordered link creation element 1875. The titles are arranged in an order corresponding to the order that the lexia symbols are arranged on ordered link creation

25   element 1875. In the embodiment of Figure 18c, the title of the lexia in which the links are being created is also extracted and displayed as part of the list of titles. However, this title does not form a link activation area. It is included

to provide a complete list of the lexia that are grouped on link creation element 1875. In another embodiment, the title of the lexia in which the links are being created is omitted from the list of titles.

5           Figure 18c shows the resulting list 1890 of titles that is inserted in the lexia represented by highlighted lexia symbol 1851 in one embodiment of the invention. List 1890, contained in a frame 1835, consists of the titles of the lexia represented by the lexia symbols arranged on ordered link creation element 1875 in the order in which the corresponding lexia symbols 1850,  
10 1851, 1856, and 1853 appear on ordered link creation element 1875. Title 1891, "Table of Contents," is thus the title of the lexia represented by lexia symbol 1850, title 1892, "Overview," is the title of the lexia represented by lexia symbol 1851 (which is also the currently displayed lexia into which the list is being inserted), title 1893, "Example 1" is the title of the lexia represented by  
15 lexia symbol 1856, and title 1994, "Example 2," is the title of the lexia represented by lexia symbol 1853. Titles 1891, 1893 and 1894 constitute link activation areas to the corresponding lexia. Selecting any of the titles 1891, 1893 and 1894 in list 1890, for example by positioning a cursor over a title and activating a mouse button, causes the lexia having the selected title to be  
20 displayed. Title 1892 is the title of the currently displayed lexia, and does not constitute a link activation area.

In a similar manner, lists of links are inserted into the lexia represented by lexia symbols 1850, 1856 and 1853.

25

In the embodiment of Figure 18c, the list of links inserted into each of the lexia represented by lexia symbols on ordered link creation element 1875

consists of a list of the titles of the lexia extracted from the lexia. In other embodiments, the list may consist of other and/or additional items. For example, the list may consist of the title and the summary for each lexia, or the summary only, or the nickname, or some other data field extracted from  
5 each of the underlying lexia.

In one embodiment of ordered link creation element 1875, a criteria other than the relative position of lexia symbols on ordered link creation element 1875 may be used to determine the target lexia of "next" and  
10 "previous" links or the links contained on a table of links created by link creation element 1875. In one embodiment, ordered link creation element 1875 includes an "autosort" capability that sorts the lexia represented by lexia symbols placed on the element according to a user selectable criteria. For example, in one embodiment, the lexia are sorted according to the lexia titles.  
15 If the links created by this embodiment of an ordered link creation element are represented in the form of "next" and "previous" links in a lexia, the target lexia of such "next" and "previous" links are the lexia whose titles come immediately after and immediately before the lexia in which the links are being created in an alphabetical listing of their titles. Alternatively, if the  
20 links are represented by a list of titles to the target lexia, the target lexia are arranged in the list according to the alphabetical order of their titles. In other embodiments, other sort criteria may be used. In one embodiment, the lexia symbols are automatically rearranged on link creation element 1875 to reflect the autosorted order of the underlying lexia. In another embodiment, the  
25 autosorting feature does not change the arrangement of the lexia symbols.

In one embodiment of the invention, if any data field of a first lexia is changed, and that data field is used in a second lexia, for example for identifying a link, the change to the data field is reflected in the second lexia. For example, in the embodiment of Figure 18c, if the title of the lexia  
5 represented by lexia 1856 is changed from "Example 1" to "A Simple Example", the new title "A Simple Example" will appear in list of links 1890 in the place of the old title "Example 1" after the change is made.

In one embodiment of the invention, a list of links such as list 1890 of  
10 Figure 1890 is editable in lexia display window 1820 when lexia display window is in an editing mode. Changes made in the list are reflected back into the underlying lexia and into contents map window 1810, as appropriate. For example, if list of links 1890 is edited in lexia display window 1820 so as to interchange the positions of the titles "Table of Contents" and "Overview",  
15 the order of the corresponding lexia symbols 1850 and 1851 is reversed in contents map window 1810. Similarly, if the title of a new lexia is added to list 1890 in lexia display window 1820, a corresponding lexia symbol is added to the lexia symbols on ordered link creation element 1875 in contents map window 1810.

20

The special purpose graphical elements of the present invention such as ordered link creation element 1875 may include "inheritance properties" that are automatically or optionally applied to lexia represented by lexia symbols placed on the special purpose graphical elements. Examples of  
25 inheritance properties are page and text formats that are automatically applied to a lexia when its lexia symbol is placed on the special purpose graphical elements. One embodiment of the invention includes graphical

formatting elements that perform no other function other than providing inheritance properties to lexia represented by lexia symbols placed on such formatting elements.

5           In the embodiment of Figure 18c, ordered link creation element 1875 contains inheritance properties that specify the layout, placement and appearance of the lists of links that are added to lexia represented by lexia symbols that have been placed on ordered link creation element 1875. These inheritance properties specify that the list is to be displayed in a frame at a  
10 specified location on the underlying lexia, that particular font types, sizes and colors are to be used in the list, and that the background color of the frame into which the list is placed is to have a specified color. A consistent look is thus created for the lexia corresponding to the lexia elements placed on ordered link creation element 1875.

15

          In one embodiment, the inheritance properties provided by a link creation element may include items unrelated to the links being created by the link creation element. For example, an inheritance property may specify the general page layout to be applied to each lexia represented by a lexia  
20 symbol placed on the link creation element. The link creation element may specify such items as the position of titles, text, and graphic frames on the underlying lexia, the types, colors, and sizes of fonts used, the background wallpaper, if any used for the lexia, and other page layout features.

25           Figure 26 is a block diagram of the process used to modify links in response to changes to a link creation element in one embodiment of the present invention. As shown in Figure 26, the process starts when

notification is received that a change has been made to a link creation element at block 2610. At block 2612 a determination is made as to whether the change involved the removal of a lexia symbol from the link creation element. If a lexia symbol was removed from the link creation element, a  
5 determination is made at block 2620 as to whether the link creation element imposes inheritance properties on the lexia represented by lexia symbols placed on the link creation element. If the link creation element imposes inheritance properties, those inheritance properties are removed from the lexia represented by the removed lexia symbol at block 2622. Links to and  
10 from the lexia represented by the removed lexia symbol are removed at block 2624. A determination is made at block 2626 as to whether there are any other remaining lexia symbols on the link creation element. If there are no other lexia symbols on the link creation element, the process ends at block 2632.

15

If there are other lexia symbols remaining on the link creation element, the relative positions of those lexia symbols with respect to each other is determined at block 2628, and links corresponding to the relative positions of the lexia symbols on the link creation element are created at  
20 block 2630.

25

If a determination is made at block 2620 that the link creation element does not impose any inheritance properties, the process skips block 2622 and goes directly to block 2624.

If it is determined at block 2612 that the change to the link creation element does not involve removal of a lexia symbol, a determination is

made at block 2614 as to whether the change involves addition of a lexia symbol to the link creation element. If the change does not involve the addition of a lexia symbol, the process continues to block 2626.

5           If the change does involve the addition of a lexia symbol, a determination is made at block 2616 as to whether the link creation element imposes any inheritance properties. If the link creation element does not impose any inheritance properties, the process continues to block 2626.

10           If the link creation element does impose inheritance properties, the inheritance properties are applied to the lexia represented by the lexia symbol that has been placed on the link creation element at block 2618. The process then continues to block 2626.

15           In the embodiment of Figure 26, inheritance properties are imposed by a special purpose element at the time a lexia symbol is placed on the special purpose element, and are stored as part of the underlying lexia. In another embodiment, inheritance properties of a special purpose element are imposed only when needed. For example, in one embodiment of the  
20           invention, formatting inheritance properties are only imposed on the lexia when the lexia is being formatted, either for display on a display screen or for generating a caricature or an exportable representation of the lexia. In this embodiment, when a lexia symbol is selected for display, a determination is made as to whether the lexia symbol is on any special purpose element that  
25           imposes formatting inheritance properties. If such a special purpose element is found, its inheritance properties are incorporated in the displayed lexia. If a lexia symbol is subsequently removed from a special purpose element that

imposes inheritance properties, the next time the lexia symbol is selected, the lexia will be displayed without those inheritance properties.

In one embodiment, special purpose formatting elements provide  
5 format and layout related inheritance properties without providing other  
functions such as creating links. Figure 18e shows one embodiment of a  
special purpose formatting element 1888 of the present invention. As shown  
in Figure 18e, in this embodiment, special purpose formatting element 1888  
is displayed in contents map display window 1810 as a shaded rectangle with  
10 rounded corners containing a white rectangle with a black line under the  
rectangle. Formatting element 1888 is also displayed in navigation window  
1830 as shaded rectangle 1889. Lexia symbol 1855 has been placed onto  
formatting element 1888 in contents window 1810. Accordingly, the  
formatting inheritance properties of formatting element 1888 are applied to  
15 the lexia represented by lexia symbol 1855.

The lexia represented by lexia symbol 1855 is displayed in lexia display  
window 1820. In the embodiment of Figure 18e, the formatting inheritance  
properties of formatting element 1888 for the lexia represented by a lexia  
20 placed on formatting element 1888 specify a page layout consisting of a frame  
for a graphic centered at the top of the lexia, a headline having a first  
designated font centered below the graphic frame, and a body of text having a  
second designated font left justified below the headline. These features are  
shown in lexia display window 1820 of Figure 18e as frame 1882, headline  
25 1883, and body text 1884, respectively. The same page layout is applied to the  
lexia represented by any other lexia symbol placed on formatting element  
1888.

In one embodiment of the invention, special purpose elements may be placed on other special purpose elements. For example, a link creation element may be placed on a formatting element. The formatting inheritance  
5 properties of the formatting element will then be applied to the links created by the link creation element and/or the lexia represented by lexia symbols on the link creation element.

In one embodiment of the invention, a special purpose element such  
10 as ordered link creation element 1875 may be manipulated and edited in contents map window 1810. For example, a special purpose element may be selected, dragged and dropped, and changed in length, size, and orientation. In one embodiment of the invention, moving a special purpose element, for example by dragging and dropping using a mouse, moves the special purpose  
15 element without moving any lexia symbols that had been placed onto the special purpose element. As a result, links that had been created between the lexia represented by the lexia symbols that are no longer on the special purpose element are destroyed. In another embodiment, the author may select an option for the special purpose element that causes lexia symbols  
20 placed on the special purpose element to be "glued" to the element so that when the element moves, the lexia symbols placed on it move as well. In this case, links created between lexia by the special purpose element are preserved. In one embodiment, such "gluing" optionally only applies one way from the element to the lexia symbols placed on the element such that  
25 moving the element moves the lexia symbols placed on the element, but moving a lexia symbol does not move the element. In one embodiment, selecting a special purpose element allows parameters of the special purpose

element to be edited. In one embodiment, the editable parameters include the function performed by the element (for example, whether the element is to be a link creation element, a formatting element, or another type of element), the type of function (for example, the specific type of link that is to be created, in the case of a link creation element, or the format that is to be applied, in the case of a formatting element), whether lexia symbols become glued to the element once placed on the element so that if the element is moved, the lexia symbols move as well, whether the element is displayed when the contents map window is displayed in either an editing mode, a viewing mode, or both, whether the element provides any inheritance properties that are applied to lexia represented by lexia symbols placed on the element, and other parameters. An element may also include editable data fields associated with the element, similar to the data fields associated with a lexia, such as data fields a name, a nickname, a summary description, an index value, or other data.

In one embodiment of the invention, links can be created from a lexia to a special purpose element in the same manner as links are created between lexia in the embodiment of Figures 17a and 17b. For example, a link between a currently displayed lexia and a special purpose element may be created by clicking on the desired location for the link activation area for the link in the lexia display window and then selecting the special purpose element in the contents map display window as the target of the link. Depending upon the option chosen by the user, the link activation area for the link may be represented by text or data fields from the source lexia, text or data fields from the target special purpose element, or text or data fields from the lexia

represented by any lexia symbols that have been placed on the special purpose element.

Figure 18f shows an example of a link from a lexia to a special purpose  
5 element in one embodiment of the present invention. The link was created  
in a manner similar to that described above with respect to the embodiments  
of Figures 17a and 17b. In Figure 18f, lexia symbol 1852 is highlighted and the  
lexia represented by lexia symbol 1852 is displayed in lexia display window  
1820. A link has been created from the lexia represented by lexia symbol 1852  
10 to special purpose element 1875 in contents map window 1810. The link  
activation area for the link was designated by positioning a cursor over the  
desired location in lexia display window 1820 and clicking a mouse button.  
The target of the link was then selected by positioning the cursor over special  
purpose element 1875 clicking a mouse button. Figure 18f shows the  
15 subsequent state of the display screen. Cursor 1841 remains positioned over  
special purpose element 1875 in contents map window 1810. A border 1843  
around special purpose element 1875 indicates that cursor 1841 is positioned  
over special purpose element 1875. As a result of creation of the link, a link  
activation area 1844 has been inserted into the source lexia at the location  
20 specified for the link activation area for the link. The makeup of the link  
activation area 1844 inserted in a source lexia as a result of creation of a link  
to a special purpose element depends on the type of special purpose element  
to which the link is established and on the type of activation area  
representation selected by the user. In the embodiment of Figure 18f, the  
25 special purpose element 1875 to which the link has been established is an  
ordered link creation element. The corresponding configuration of the link  
activation area 1844 for the embodiment of Figure 18f is a list of link

activation areas comprising the titles of the lexia represented by the lexia symbols on special purpose element 1875. In other embodiments, the link activation area to a special purpose element may consist of text or data fields from the source lexia, text or data fields from the special purpose element, text or data fields from the lexia represented by lexia symbols located on the special purpose element, or other items.

Figure 18d shows an embodiment of the present invention that includes a special purpose element 1895 that creates a parent-child hierarchical relationship between a lexia or a group of lexia and another lexia or a group of lexia. In Figure 18d, hierarchical link creation element 1895, represented by a dotted arrow, has been added to contents map window 1810 of the embodiment of Figure 18c. Hierarchical link creation element 1895 creates a parent-child link between lexia represented by lexia symbol 1852 at the tail of the arrow and, in the embodiment of Figure 18d, ordered link creation element 1875 at the head of the arrow. In other embodiments, hierarchical link creation element 1895 may connect a lexia symbol to a lexia symbol, a special purpose element to a lexia symbol, a special purpose element to another special purpose element.

20

The links created by hierarchical link creation element 1895 are shown in lexia display window 1820. In Figure 18d, lexia symbol 1852 is highlighted in contents map window 1810. Accordingly, the contents of the lexia represented by lexia symbol 1852 is displayed in lexia display window 1820.

25 The links created by hierarchical link creation element 1895 in the embodiment of Figure 18d appear as a list of links 1897. Link list 1897 consists of a list of the titles extracted from each of the lexia on hierarchical link

creation element 1895. Each title functions as a link activation area activating a link from the lexia represented by lexia symbol 1852 to each of the lexia represented by lexia symbols 1850, 1851, 1856 and 1853 on ordered link creation element 1875.

5

In other embodiments, the links created by hierarchical link creation element 1875 in the parent lexia represented by lexia symbol 1852 may take forms other than list 1897 in Figure 18d. For example, in one embodiment, the links are added to the parent lexia in the form of a pull down menu.

10 Other manifestations of links created by the link creation elements of the present invention will be apparent to those skilled in the art.

In the embodiment of Figure 18d, the links created by hierarchical link creation element 1895 are one way links. In this embodiment, hierarchical link creation element 1895 creates links from the lexia symbol or other element at the tail of hierarchical link creation element 1895 to the lexia symbol or other element at the head of hierarchical link creation element 1895, but does not create links the other way.

20 In one embodiment of the invention, hierarchical link creation element 1895 is created by clicking a mouse button on contents map window 1810, choosing a "create hierarchical link" option from a pop up window, and indicating the tail and head locations of the desired hierarchical link.

25 In the embodiment of Figure 18d, hierarchical link creation element 1895 creates links from the lexia represented by lexia symbol 1852 to each of the lexia represented by the lexia symbols on ordered link creation element

1875. One embodiment of the invention includes hierarchical link creation elements that create links only to the lexia represented by lexia symbols placed at particular locations on link creation elements such as ordered link creation element 1875. For example, one hierarchical link creation element  
5 creates a link only to the lexia represented by the first lexia symbol on a link creation element. Another example hierarchical link creation element creates a link only to the lexia represented by the last lexia symbol on a link creation element. In one embodiment, a hierarchical link creation element, displayed as an arrow in the contents map window of the present invention,  
10 creates a link only to the lexia represented by a lexia symbol, if any, located at the position indicated by the tip of the arrow. Other variations of the hierarchical link creation element of the present invention will be apparent to those skilled in the art.

15 Figure 19a shows a table link creation element 1910 of one embodiment of the present invention. In this embodiment, a table link creation element appears as a grid in contents map window 1910. It is also displayed as a smaller grid 1902 in navigation window 1830. Table link creation element 1910 creates links between lexia represented by lexia symbols  
20 placed at the intersection points of the grid lines making up table link creation element 1910. In the embodiment of Figure 19a, table link creation element 1910 contains nine intersection points. Six of the nine intersection points are occupied by lexia symbols 1853, 1855, 1854, 1856, 1912 and 1914, respectively.

25

The links created by the table link creation element of the present invention can have a variety of forms. In the embodiment of Figure 19a,

links are created from each lexia represented by a lexia symbol placed at an intersection point of the table link creation element to each lexia represented by lexia symbols, if any, located immediately above, below, to the left, and to the right of the lexia symbol.

5

Lexia display window 1820 of Figure 19a shows the links created for the lexia represented by highlighted lexia symbol 1856 by table link creation element 1910 in the embodiment of Figure 19a. Lexia symbol 1855 is located immediately above, lexia symbol 1914 is located immediately below, lexia symbol 1854 is located immediately to the left, and lexia symbol 1912 is located immediately to the right, of lexia symbol 1856 on table link creation element 1910. Accordingly, table link creation element 1910 creates a link from the lexia represented by lexia symbol 1856 to the lexia represented by lexia symbols 1855, 1914, 1854 and 1912. These links are represented by link activation buttons 1915, 1920, 1925 and 1927, respectively. Activating link activation button 1915 will bring up the lexia represented by lexia symbol 1855. Activating link activation button 1920 will bring up the lexia represented by lexia symbol 1914. Activating link activation button 1925 will bring up the lexia represented by lexia symbol 1854. Activating link activation button 1927 will bring up the lexia represented by lexia symbol 1912.

In the embodiment of Figure 19a, link activation buttons 1915, 1920, 1925 and 1927 are labeled "Up", "Down", "Left" and "Right", respectively. In other embodiments, other labels may be used. In one embodiment, the labels used are the names of the target lexia extracted from the target lexia. In other

embodiments, the labels used may consist of data from other data fields of a lexia such as a summary, a nickname, or other data.

Figure 19b shows an embodiment of the present invention in which  
5 the links created by table link creation element 1910 are in the form of a table 1900. In Figure 19b, lexia symbol 1912 is highlighted in contents map window 1810 and the lexia represented by lexia symbol 1912 is displayed in lexia display window 1820. In the embodiment of Figure 19b, for each lexia  
10 represented by a lexia symbol occupying a grid intersection point of table link creation element 1910, a table is created containing links to each lexia represented by each other lexia symbol occupying an intersection point of table link creation element 1910. The links are arranged in the table in a manner that corresponds to the position of the corresponding lexia symbols on table link creation element 1910.

15

Lexia display window 1820 of Figure 19b shows the table 1900 in the  
lexia represented by lexia symbol 1912 created by placing lexia symbol 1912 on  
table link creation element 1910 in the location shown in Figure 19b. Table  
1900 contains entries corresponding to the lexia symbols located on table link  
20 creation element 1910. For the lexia represented by lexia symbol 1912, the  
table entry consists of an identifier for the lexia represented by lexia symbol  
1912. In the embodiment of Figure 19b, the identifier used is the title of the  
lexia as extracted from the lexia. For lexia other than the lexia represented by  
lexia symbol 1912, the entries in table 1900 consist of link activation areas to  
25 the respective lexia. In the embodiment of Figure 19b, the link activation  
areas consist of the titles of the target lexia as extracted from the lexia

themselves. In other embodiments, other data fields of the underlying lexia, such as a summary or nickname, may be used.

Table 1900 consists of three columns of entries corresponding to the  
5 three vertical grid lines of table link creation element 1910.

The first column contains link activation areas 1930 and 1931, which create links to the lexia represented by lexia symbols 1853 and 1854, respectively, located on the first vertical grid line 1950 of table link creation  
10 element 1910. The first column of table 1900 thus corresponds to the first vertical grid line 1950 of table link creation element 1910.

The second column of table 1900 contains link activation areas 1932, 1933 and 1934, which create links to the lexia represented by lexia symbols  
15 1855, 1856, and 1914, respectively, located on the second vertical grid line 1951 of table link creation element 1910. The second column of table 1900 thus corresponds to the second vertical grid line 1951 of table link creation element 1910.

20 The third column of table 1900 contains lexia identifier 1935 corresponding to the lexia represented by lexia symbol 1912 on the third vertical grid line 1952 of table link creation element 1910. The third vertical grid line 1952 of table link creation element 1910 contains no lexia symbols other than lexia symbol 1912 itself. Accordingly, there are no other entries is  
25 the third column of table 1900. However, if there were additional lexia symbols on third vertical grid line 1952, corresponding link activation areas

would be created in corresponding locations in the third column of table 1900.

In one embodiment of the invention, instead of containing an identifier such as the title of the lexia, table 1900 contains a blank entry at the table location corresponding to the lexia in which table 1900 is being created.

It will be apparent to those skilled in the art that links created by placing lexia symbols on a table link creation element of the present invention can be represented in a variety of manners other than the link activation buttons of Figure 19a and the link activation areas of table 1900 of Figure 19b. It will also be apparent to those skilled in the art that the link creation elements of the present invention, which create links between the lexia represented by lexia symbols placed or "dropped" on the element, can have a variety of other configurations than the example configurations shown in Figures 18a-d and 19a-b.

The present invention provides a search function that allows searches to be made of the content of each of the lexia of a hypermedia work. In one embodiment of the present invention, the lexia symbol representing each lexia that contains the searched for content is indicated both in the contents map window and in the navigation window of the present invention. In one embodiment of the invention, the search function includes the ability to search non-displayed data of a lexia, such as the title, summary, and nickname. In one embodiment, a search can be limited to specified portions or data fields of lexia. For example, a search can be limited to the non-

displayed nicknames of lexia, or to nicknames and summaries, or to titles and displayed content.

Figure 20 illustrates a search function provided by one embodiment of the present invention. Figure 20 shows the results of a search for the text phrase "link creation element" in the hypermedia work of Figure 19a. In this embodiment, each lexia that contains the searched for phrase is indicated by means of a ring around the corresponding lexia symbol. According to Figure 20, of the lexia whose corresponding lexia symbols are displayed in contents map window 1810, the lexia represented by lexia symbols 1850, 1856, and 1812 contain the searched-for phrase "link creation element". In addition, the hypermedia work of Figure 20 contains two other lexia that contain the searched for phrase. The lexia symbols for these lexia are not located in the portion of the contents map displayed in contents map window 1810, but are represented by lexia symbols 2010 and 2015 displayed in navigation window 1830, which displays an image of the entire contents map.

The search function of the present invention provides a navigable graphical display of the results of a search. Any of the lexia containing the searched for content can be accessed by selecting an indicated lexia symbol representing the lexia either in contents map window 1810 or in navigation window 1830. In Figure 20, the lexia corresponding to lexia symbol 1856 has been selected, for example by using a mouse button, and is displayed in lexia display window 1820. In this embodiment, when a lexia containing searched for content is displayed in lexia display window 1820, the searched for content is indicated in lexia display window 1820. As shown in Figure 20, the searched for phrase "link creation element" is found four times in the

portion of the lexia represented by lexia symbol 1856 displayed in lexia display window 1820. In the embodiment of Figure 20, these four occurrences 2020, 2025, 2030 and 2035 of the phrase "link creation element" are indicated by bold and italicized text.

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It will be apparent to those skilled in the art that searches other than simple text searches can be performed by the present invention. It will also be apparent to those skilled in the art that a variety of display elements other than a ring around a lexia symbol can be used to identify lexia containing the searched for item in contents map window 1810 and navigation window 1830.

In one embodiment of the invention, in addition to highlighting the searched for item in a displayed lexia, any links in the displayed lexia to other lexia containing the searched for item are also identified by highlighting. In one embodiment, the search function may search for items such as links. For example, a search can be requested for all links to or from a specific lexia. The results of different searches may be identified by different types or colors of highlighting.

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In one embodiment of the invention, the results of a search may be saved for later retrieval. In one embodiment, the results of a search remain displayed until a specified user action or time-out occurs. For example, in one embodiment, a user may elect to have the results of a search remain displayed until a user requests another search or until the user issues a cancellation command.

25

In the embodiment of Figure 20, navigation window 1830 provides an overview of the entire contents map of the hypermedia work depicted in Figure 20. In the embodiment of Figure 20, navigation window 1830 contains 23 lexia symbols. Accordingly, the hypermedia work depicted in Figure 20  
5 contains 23 lexia.

Hypermedia works may be created that contain a thousand or more lexia. Because of limited resolutions of computer display monitors, it may not be possible to distinctly display a thousand or more lexia symbols in a  
10 navigation window the size of navigation window 1830. For hypermedia works containing large numbers of lexia, one embodiment of the present invention utilizes multi-tiered navigation windows according to the method of patent application Serial No. 08/298,215. As shown in Figure 22, in this embodiment, three views of the contents map of a hypermedia work are  
15 used.

An overview of the entire contents map is provided by top level navigation window 2220. Top level navigation window 2200 contains intermediate scrolling frame 2230 and contents map window scrolling frame  
20 2225. Intermediate scrolling frame 2230 indicates the portion of the contents map that is displayed in intermediate level navigation window 2210. Contents map window scrolling frame 2225 indicates the portion of the contents map that is displayed in contents map window 2200. Either of the two scrolling frames 2225 and 2230 may be moved, for example by dragging  
25 with a mouse, within top level navigation window 2220, thereby causing the portion of the contents map displayed in contents map window 220 to change. In one embodiment, dragging intermediate scrolling frame 2230 in

top level navigation window 2220 moves contents map scrolling frame 2225 in the same manner such that the position of contents map scrolling frame 2225 with respect to intermediate scrolling frame remains fixed. Dragging contents map scrolling frame 2225 in top level navigation window 2220, however, does not cause intermediate scrolling frame 2225 to move.

Intermediate navigation window 2210 displays the portion of the contents map indicated by intermediate scrolling frame 2230 in top level navigation window 2220. Intermediate navigation window 2210 contains scrolling frame 2215. Scrolling frame 2215 indicates the portion of the part of the contents map displayed in intermediate navigation window 2210 that is displayed in contents map window 2200. Dragging scrolling frame 2215 in intermediate navigation window 2210 changes the portion of the contents map displayed in contents map window 2200.

15

In the multi-tiered embodiment of Figure 22, therefore, the portion of the contents map displayed in contents map window 2200 can therefore be changed by moving scrolling frame 2215 in intermediate navigation window 2210 or by moving intermediate scrolling frame 2230 and/or contents map scrolling frame 2225 in top level navigation window 2220.

20

In one embodiment, the scale of top level navigation window 2220 and intermediate navigation window 2210 is chosen such that individual lexia symbols can be distinctly displayed in intermediate navigation window 2210, but not necessarily in top level navigation window 2220. In one embodiment top level navigation window 2220 displays groups of lexia and/or regions containing lexia. If the search function of the embodiment of Figure 20 is

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used with the embodiment of Figure 22, all areas containing the searched for content are indicated in top level navigation window 2220. Individual lexia containing the searched for content are indicated in intermediate navigation window 2210 and in contents map window 2200.

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One embodiment of the present invention allows the lexia for hypermedia works created with the present invention to be exported as hypertext markup language ("HTML") documents, for example in order to publish works on the World Wide Web or for use in intranets. In one  
10 embodiment of the present invention, an applet written in the JAVA computer language provides contents map window functionality to the resulting HTML documents.

The present invention can be implemented by means of software  
15 programming on any of a variety of one or more computer systems as are well known in the art, including, without limitation, computer systems such as that shown in Figure 21. The computer system shown in Figure 21 includes a CPU unit 2100 that includes a central processor, main memory, peripheral interfaces, input-output devices, power supply, and associated  
20 circuitry and devices; a display device 2110 which may be a cathode ray tube display, LCD display, gas-plasma display, or any other computer display; an input device 2130, which may include a keyboard, mouse, digitizer, or other input device. The computer system may or may not include non-volatile storage 2120, which may include magnetic, optical, or other mass storage  
25 devices, and a printer 2150. The computer system may also include a network interface 2140, which may consist of a modem, allowing the computer system to communicate with other systems over a

communications network such as the Internet. Any of a variety of other configurations of computer systems may also be used.

Thus a novel hypermedia authoring and publishing system has been  
5 presented. Although the present invention has been described with respect to certain example embodiments, it will be apparent to those skilled in the art that the present invention is not limited to these specific embodiments.

5

## Appendix 1

5

**UNITED STATES PATENT APPLICATION**

**FOR**

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**METHOD AND APPARATUS  
FOR NAVIGATING  
MULTIPLE INDEPENDENT  
WINDOWED IMAGES**

15

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## BACKGROUND OF THE INVENTION

### 1. FIELD OF THE INVENTION

5           The present invention relates to the field of user interfaces for computers, and more particularly to a method and apparatus for navigating multiple windowed images that may be used to provide an improved graphical user interface for computer systems.

### 10 2. BACKGROUND ART

          The means by which a computer user communicates with a computer is referred to as the "user interface." A user interface typically consists of computer hardware such as a computer display screen, a keyboard, and a mouse, as well as computer software that interprets a user's keyboard and  
15 mouse input and provides the images shown on the computer display screen.

          Two categories of user interfaces are text-based user interfaces and graphical user interfaces. With text-based user interfaces, communications  
20 between a user and a computer typically consist of written words and messages. User input to the computer with a basic text-based interface consists of text messages and commands typed on the keyboard, and computer output to the user consists of text messages displayed on the computer display screen. More "user friendly" text based interfaces provide  
25 additional features such as pull-down command menus and mouse input that make it easier for a user to enter text-based commands.

With graphical user interfaces, also referred to as "GUI's," communications between a user and a computer consist of graphical images as well as written words and messages. A typical graphical user interface provides features such as pull-down menus and pictorial representations called "icons" that allow the user to perform many computer operations simply by using a mouse to point and click on an appropriate icon or menu displayed on the computer display screen.

Graphical user interfaces typically also feature "windows." A "window" is a portion of a display screen that is dedicated to a particular purpose. Two common examples of operating systems that provide windowing graphical user interfaces are Microsoft Windows™ and the Apple Macintosh™ operating systems. A GUI that utilizes "windows" typically divides the display screen into movable, resizable, rectangular windows. Each window may be dedicated to a different file or program, or a single program may use multiple windows to display information in different ways.

A property commonly associated with a window is the ability to "scroll" or "pan" the window. Scrolling or panning is used when the item displayed in a window, for example a graphic image in a drawing program or a document in a word processing program, is too large to be displayed in the window all at the same time. In this case, the window can often be "scrolled" or "panned" to a new position relative to the underlying image or document such that the window shows portions of the underlying image or document that previously were outside of the portion shown in the window. The term "scrolling" shall be used herein to refer to both scrolling and panning.

A means typically provided to a user to allow the user to scroll a window are "scroll bars." A scroll bar typically consists of an image of a bar that is displayed along one side of the window. A box that indicates the position of the window with respect to the underlying image or document is displayed on the bar. The box can be "dragged" along the bar by a mouse. The new position of the box indicates the new position of the window in relation to the underlying image. After the box is dragged to the new position and released, the image shown in the window is replaced with an image corresponding to the window's new position. Two scroll bars are commonly used: a vertical scroll bar alongside one of the sides of the window for scrolling the image shown in the window in a vertical direction and a horizontal scroll bar along the top or bottom of the window for scrolling the image in a horizontal direction. The scroll bars thus allow the user to navigate the image or document underlying the window.

If more than one window is shown on a display screen, each window typically has its own scroll bars. Each window scrolls independently: scrolling the image displayed in one window does not scroll the image displayed in other windows. Figure 1 shows a typical prior art display screen P100 containing two windows P110 and P120. Window P110 is for a word-processing program. It shows a portion P115 of a written document showing different printer fonts and sizes. Window P120 is for a painting program. It shows a portion P125 of a bitmapped image of a locomotive. Window P110 has a vertical scroll bar P130 with a scroll box P135 along its right hand side, and a horizontal scroll bar P140 with a scroll box P145 along its bottom. Window P120 has a vertical scroll bar P150 with a scroll box P155 along its

right hand side, and a horizontal scroll bar P160 with a scroll box P165 along its bottom.

Figure 2 shows how moving the scroll boxes along the scroll bars for a window moves the position of the window with respect to the underlying image or document. In Figure 2, vertical scroll box P135 of window P110 has been dragged vertically downwards from its position in Figure 1. Accordingly, window P110 has been moved to a position further down the document shown in window P110. Horizontal scroll box P145 of window P110 has also been dragged a distance to the right along horizontal scroll bar 140, scrolling window P110 to the right. In a similar manner horizontal scroll box P165 of window P120 has been dragged a distance to the right along horizontal scroll bar 160, scrolling window P120 to the right as well.

Certain prior art programs may display two views of an image simultaneously. The painting program shown in Figure 2, for example, incorporates a "zoom" mode that shows a magnified view of the displayed image. Figure 3 shows the painting program window P120 of Figure 2 with the zoom mode activated and the window as a whole resized to a larger size. Because the image displayed is magnified, window P120 in Figure 3 only shows a portion of the image displayed in window P120 of Figure 2. Rectangle P200 shown in outline form in window P120 in Figure 2 represents the portion of the image shown in window P120 of Figure 2 that is displayed magnified in window P120 of Figure 3. As shown in Figure 3, window P120, in addition to showing the magnified image in its main display area, also includes a small auxiliary window P300 in its upper left-hand corner. Auxiliary window P300 shows an unmagnified view of the same portion of

the image shown in magnified form in the main display area of window P120. Thus the prior art program shown in Figure 3 shows the same image in two windows, but at different scales.

5           As in the unmagnified mode shown in Figure 2, window P120 of Figure 3 incorporates scroll bars P150 and P160 and scroll boxes P155 and P165, respectively, that can be used to control the position of window 120 with respect to the underlying image. Auxiliary window P300 does not have separate scroll bars. Instead, scroll bars P150 and P160 of window P120 are  
10 used to scroll both window P120 and auxiliary window P300. For the prior art program shown in Figure 3, scrolling of window P120 and auxiliary window P300 is accomplished as follows. As a scroll box in a scroll bar is dragged by a mouse to a new location, the auxiliary window P300 scrolls in real time. That is, as the scroll box is dragged, auxiliary window P300 scrolls to follow the  
15 movement of the scroll box. Window P120, however, does not scroll with the movement of the scroll box. Instead, window P120 jumps to the final scrolled position after the scroll box has been moved and the mouse button is released. Figure 4 shows the images displayed in window P120 and auxiliary window P300 after the scroll boxes P155 and P165 have been moved from  
20 their position in Figure 3. Rectangle P210 shown in outline form in Figure 2 represents the position of windows P120 and P300 in Figure 4.

The window navigation scheme of the prior art shown in Figures 1 and 2, in which each window shows an independent image, does not provide  
25 any coordination between the scrolling of one window and the other. Each window must be scrolled independently. In the window navigation scheme of the prior art shown in Figures 3 and 4, scroll bars P150 and P160 control the

scrolling of both window P120 and auxiliary window P300. However, the images shown in windows P120 and P300 are not separate, independent images, but are the same image shown at different magnification scales.

Furthermore, windows P120 and P300 do not scroll in a coordinated manner:

- 5 auxiliary window P300 scrolls in real time with movement of the scroll boxes, while window P120 only jumps from the initial position to a final position.

The prior art does not provide a method by which multiple, independent images may be navigated in a convenient, coordinated manner.

### SUMMARY OF THE INVENTION

The present invention comprises a method and apparatus for navigating multiple independent windowed images on a computer display screen of a computer system. The images may be of arbitrary size and shape, 5 although a rectangular shape is typically used. A relationship is defined between the coordinates of points in one image and the coordinates of points in each of the other images. Each image is an independent entity, although its content may be thematically related to the content of other windows. Each 10 image is typically a bitmap. A window displaying all or a portion of each image is displayed on a display screen. A cursor may be moved into the window for any of the images. Graphic objects and items may optionally be "drag-and-dropped" into any window.

15 In one embodiment of the present invention, two windows are displayed. One window shows an image that is the same size as the window, such that the window displays the entire image. This window may be referred to as a "first level" window. A second window displays an image that is larger than the window, such that the window only displays a portion 20 of the underlying image at a time. This window may be referred to as a "second level" window. The image for each window is independent of the image in the other window - that is, each image is stored as a separate image, although the images may be related in terms of what is shown in the images, or the images may even be separate copies of the same image. The first level 25 window displays an "indicator" that represents the position of the second level window relative to the second level window image. Unlike the scroll boxes of the prior art, the indicator of the present invention is movable in

two dimensions about the first level window. For example, if the second level window is positioned such that it shows the central portion of its underlying image, the indicator would be positioned in the center of the first level window. If the second level window is positioned such the it shows the lower right hand corner of the underlying image, the indicator would be positioned in the lower right hand corner of the first level window.

Examples of indicators that may be used include, but are not limited to, icons, cursors, wire frame boxes, and highlighting.

In addition to indicating the position of the second level window with respect to its underlying image, the indicator in the first level window can be used to navigate the second level window image. To navigate the second level window image, the indicator is moved, for example by dragging it with a mouse, from one location to another in the first level window. As the mouse is moved, the position of the second level window with respect to its underlying image changes such that the position of the second level window with respect to its underlying image corresponds in a relative manner to the position of the indicator with respect to the first level image shown in the first level window. Besides dragging the indicator with a mouse, a variety of other means may be used to change the indicator's position with respect to the first level window. For example, in one embodiment of the invention, "clicking" on any location of the first level window with a mouse repositions the indicator at the location clicked.

The present invention may be also be used with multiple levels of windows. In one multiple level embodiment, a hierarchy of windows is used, with each lower level window being navigable by means of an indicator

in the next higher level window. In certain embodiments of the present invention, graphic objects or items may be added by a user to any window, with corresponding graphic objects or items automatically being added to the other windows.

5

The present invention may be implemented by appropriate software running in a general purpose computer system comprising a central processing unit, a keyboard, internal memory, a mouse, and a computer display. The present invention may also be implemented in dedicated or  
10 special purpose computer systems, such as bank teller machines and reservations systems, and in other systems comprising display means, such as television sets, navigational devices, video games, motion simulators, and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows a display screen displaying two windows of the prior art.

5

Figure 2 shows the display screen of Figure 1 after the prior art windows of Figure 1 have been scrolled to new positions relative to the underlying image and document.

10

Figure 3 shows one of the prior art windows of Figure 2 resized to a larger size that displays an image in magnified form.

Figure 4 shows the prior art window of Figure 3 scrolled to a new position relative to the underlying image.

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Figure 5 shows the relationship between windows and underlying images in an embodiment of the present invention having two windows.

Figure 6 shows the effect of changing the position of an indicator in one window on the portion of the image displayed in a second window for the embodiment shown in Figure 5.

Figure 7 shows the effect of changing the position of an indicator in one window on the portions of the image displayed in a second window for an embodiment of the invention incorporating smooth scrolling.

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Figure 8 shows the proportional relationship between the position of an indicator in one window with the position of a second window with respect to its underlying image in one embodiment of the present invention.

5        Figure 9 shows how moving the indicator of Figure 8 to a new location changes the corresponding position of the second window with respect to its underlying image.

10       Figure 10 shows an embodiment of the present invention with three windows.

Figure 11 shows a flow chart for one embodiment of the present invention.

15       Figure 12 shows an embodiment of the present invention in which data items may be added to images shown in windows.

### DETAILED DESCRIPTION OF THE INVENTION

In the following description, numerous specific details are set forth in order to provide a more thorough understanding of the present invention. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In other instances, well-known features have not been described in detail in order not to unnecessarily obscure the present invention.

Figure 5 illustrates an embodiment of the present invention with two windows and two underlying images. In the embodiment shown in Figure 5, window 500 and window 505 are displayed on a computer display screen 520. Display screen 520 may be any kind of display screen, including but not limited to a cathode ray tube ("CRT") display, a liquid crystal display ("LCD"), a fluorescent display, and a projected display. Window 500 is associated with image 510. Window 505 is associated with image 515. In this embodiment, window 500 displays all of image 510, while window 505 shows only a portion of image 515. Window 500 contains a rectangular "indicator" 530 that indicates the relative position of the portion of image 515 shown in window 505 with respect to image 515 as a whole. This portion of image 515 is indicated by rectangle 525. Window 500 may be referred to as a "first level window." Window 505 may be referred to as a "second level window."

Indicator 530 allows a user to navigate second level window 505 about underlying image 515. The position of indicator 530 relative to first level window 500 corresponds to the position of second level window 505 with respect to image 515. By changing the position of indicator 530 relative to first

level window 500, the position of the portion of image 515 shown in second level window 505 changes in a corresponding manner. A variety of means may be used to change the position of indicator 530. Examples include "dragging" indicator 530 with a mouse, or positioning a cursor at a desired position for indicator 530 and clicking a mouse button, causing indicator 530 to move to the new desired location. Figure 6 shows how when indicator 530 is moved from its former position 600 along the direction indicated by arrow 615, the position of rectangle 525, representing the portion of image 515 displayed in second level window 505, moves from its original location 610 in the direction indicated by arrow 625 in a similar manner.

Figure 8 shows how the size and position of indicator 530 in first level window 500 of the embodiment of the invention shown in figure 5 is related to the size and relative position of the portion 525 of image 515 shown in second level window 505. As shown in figure 8, image 515 has a height "H2" and a width "W2." Rectangle 525, which represents the portion of image 515 displayed in second level window 505, has a height "H3" and a width "W3." The center 810 of rectangle 525 is located a horizontal distance " $x_{2i}$ " and a vertical distance " $y_{2i}$ " from a reference point 815 at the lower left corner of image 515.

Also shown in Figure 8 is first level window 500 containing indicator 530. As shown in Figure 8, first level window 500 has a height "H1" and a width "W1." Indicator 530 has a height "H4," a width "W4," and a center 800 located a horizontal distance " $x_{1i}$ " and a vertical distance " $y_{1i}$ " from a reference point 820 located at the lower left corner of first level window 500.



In the embodiment shown in figure 8, the ratio of each horizontal distance and dimension with respect to image 515 to the corresponding horizontal distance and dimension with respect to first level window 500 is set to a constant  $k_1$  that is equal to ratio of the width "W2" of image 515 to the width "W1" of first level window 500. Thus,  $k_1 = W2/W1$ . In a similar manner, the ratio of each vertical distance and dimension with respect to image 515 to the corresponding vertical distance and dimension with respect to first level window 500 is set to a constant  $k_2$  that is equal to ratio of the height "H2" of image 515 to the height "H1" of first level window 500. Thus,  $k_2 = H2/H1$ . Stated differently, the coordinates  $(x_2, y_2)$  of any point in image 515 are related to the coordinates  $(x_1, y_1)$  of any point in first level window 500 by the following functions (a) and (b):

(a):  $x_2 = (k_1)(x_1)$

(b):  $y_2 = (k_2)(y_1)$

where  $k_1 = W2/W1$  and  $k_2 = H2/H1$ .

Functions (a) and (b) thus define the coordinates of any point in image 515 in terms of the coordinates of any point in first level window 500 for the embodiment shown in figure 8. Because first level window 500 displays the entire image 510, defining the coordinates of points in image 515 in terms of the coordinates of points in window 500 is equivalent to defining coordinates of points in image 515 in terms of coordinates of points in image 510. In the more general case, where a higher level window does not display all of the underlying image, it may be desirable to define points in a lower level window in terms of points in the image underlying the higher level window rather than the higher level window itself.

Functions (a) and (b) describe an essentially linear relationship between the coordinates of a point in first level image 510 and a point in second level image 515. In other embodiments, there may be a different functional relationship between second level image 515 and first level image 500. Any functional relationship that provides a definite functional relationship between a point in a higher level image and a point in a lower level image may be used with the present invention. A general statement of such a function is:

$$10 \quad P_2 = f(P_1)$$

where:  $P_1$  is a point in an upper level image

$P_2$  is a corresponding point in a lower level image

The functions relating the images to each other may have many parts and be quite complex. The images need not be rectangular as in the embodiment of figure 6, and need not all have the same general shape. For example, one image may be rectangular, while another is circular or oval, or each may have a completely irregular shape. All that is required is that the relationship between points in one image and points in another is somehow defined.

20

For the embodiment shown in figure 6, functions (a) and (b) can be used to determine a distance  $D_2$  between two points  $(x_{2f}, y_{2f})$  and  $(x_{2i}, y_{2i})$  in image 515 based on the coordinates of the two corresponding points  $(x_{1f}, y_{1f})$  and  $(x_{1i}, y_{1i})$  in first level window 500:

25

$$(c): \quad D_2 = \text{SQRT}[(x_{2f} - x_{2i})^2 + (y_{2f} - y_{2i})^2] = \text{SQRT}[k_1^2(x_{1f} - x_{1i})^2 + k_2^2(y_{1f} - y_{1i})^2]$$

For horizontal distances,  $y_1$  is a constant. Accordingly, equation (c) reduces to:

5 (d)  $D_{2x} = \text{SQRT}[k_1^2(x_{1f} - x_{1i})^2] = k_1(x_{1f} - x_{1i}) = k_1 D_{1x}$

where  $D_{2x}$  = the horizontal distance between the points  
in image 515, and

$D_{1x}$  = the horizontal distance between the corresponding  
points in first level window 500.

10

Similarly, for vertical distances,  $x_1$  is constant. Accordingly, equation (c) reduces to:

(e)  $D_{2y} = \text{SQRT}[k_2^2(y_{1f} - y_{1i})^2] = k_2(y_{1f} - y_{1i}) = k_2 D_{1y}$

15 where  $D_{2y}$  = the vertical distance between the points  
in image 515, and

$D_{1y}$  = the vertical distance between the corresponding  
points in first level window 500.

20 For an illustrative example, assume that image 515 is a bitmap having  
a width  $W_2$  of 800 pixels and a height  $H_2$  of 720 pixels, that first level window  
500 has a width  $W_1$  of 400 pixels and a height  $H_1$  of 240 pixels, and that  
rectangle 525 (which corresponds to the size to second level window 505) has  
a width  $W_3$  of 400 pixels and a height  $H_3$  of 240 pixels. In this example,  
25 therefore:

$$k_1 = W_2/W_1 = 800/400 = 2$$

$$k_2 = H_2/H_1 = 720/240 = 3$$

Using these numbers, several other parameters can be calculated. For example, in the embodiment of figure 8, if it is desired that the size of indicator 530 with respect to window 500 is the same as the size of rectangle 525 with respect to image 515, its dimensions can be calculated using equations (d) and (e). The width W4 of indicator 530 can be calculated using equation (d), and the height H4 of indicator 530 can be calculated using equation (e), as follows:

$$W3 = D2_x = k_1 D1_x = k_1 (W4)$$

$$W4 = W3/k_1 = 400/2 = 200 \text{ pixels.}$$

$$H3 = D2_y = k_2 D1_y = k_2 (H4)$$

$$H4 = H3/k_2 = 240/3 = 80 \text{ pixels.}$$

An indicator with dimensions of 200 pixels wide by 80 pixels high in first level window 500 therefore has the same size relative to first level window 500 as the portion of image 515 shown in window 505 and represented by rectangle 525 has to image 515 as a whole. Although in many cases it is desirable that the size of indicator 530 is proportional to the size of the portion of image 515 shown in second level window 505, in other instances it may be desirable that indicator 530 has a larger or smaller size and/or shape. In general, any indicator that has a reference point associated with it that corresponds to a reference point associated with the window for which the position of the indicator determines the portion of image displayed can be used with the present invention.

In the embodiment shown in figures 6, 8 and 9, the portion of image 515 shown in second level window 505 (indicated by rectangle 525) is determined from the coordinates of the center 800 of indicator 530. In this embodiment, the center 800 is therefore the reference point for indicator 530.

5 Assuming that the coordinates  $(x_{1i}, y_{1i})$  of center 800 for the initial position of indicator 530 shown in Figure 8 are (140, 100) (units in pixels), the corresponding coordinates  $(x_{2i}, y_{2i})$  of the center 810 of rectangle 525 can be calculated from the coordinates of the center 800 of indicator 530 using the functions (a) and (b) listed above:

10 
$$x_{2i} = k_1 x_{1i} = (2)(140) = 280 \text{ pixels}$$

$$y_{2i} = k_2 y_{1i} = (3)(100) = 300 \text{ pixels}$$

The coordinates of center 810 of rectangle 525 are therefore (280, 300).

Figure 9 shows the position of indicator 530 in first level window 500 after it has been moved from its position in Figure 8 in the manner shown in figure 6. In its new location, the coordinates of the center 800 of indicator 530 are  $(x_{1f}, y_{1f})$ . The coordinates  $(x_{2f}, y_{2f})$  of the center 810 of rectangle 525 corresponding to the new location of indicator 530 can again be calculated from the coordinates of the center 800 of indicator 530 using the functions (a) and (b). If, for example, the new coordinates of the center 800 of indicator 530 are (300, 200), the new coordinates of center 810 of rectangle 525, are:

$$x_{2f} = k_1 x_{1f} = (2)(300) = 600 \text{ pixels}$$

$$y_{2f} = k_2 y_{1f} = (3)(200) = 600 \text{ pixels}$$

In this manner, the portion of image 515 located in rectangle 525 at the new location may be determined so that it may be displayed in second level window 505.

In certain embodiments of the present invention, only portions of image 515 corresponding to the initial and final positions of indicator 530 are displayed in second level window 530. In other embodiments, intermediate portions of image 515 are displayed to create the appearance of smooth  
5 scrolling from an initial to a final position. Figure 7 shows an example of an embodiment in which an intermediate portion 700 of image 515 is displayed between the initial portion of image 515 indicated by the outline 610 and the portion indicated by the final position of rectangle 525. In the embodiment of figure 7, since only one intermediate portion is shown, the transition from  
10 the initial portion of image 515 shown in window 505 to the final portion of image 515 shown in window 505 will have a jerky appearance. By displaying additional intermediate portions of image 515 in window 505, a smoother transition may be attained.

15 The number and position of the intermediate portions displayed may be determined in a variety of ways, and may depend on factors such as the distance the indicator is moved in the first level window, the ratio of the size of the first level window to the second level window, whether the indicator is moved by dragging it or by clicking on a new location, and on a trade-off  
20 between the increase in the smoothness of scrolling associated with increasing numbers of intermediate portions and the decrease in response time associated with increased overhead resulting from such increasing numbers of intermediate portions displayed.

25 In one embodiment of the present invention, one or more intermediate portions of the image 515 is displayed in second level window 505 for each change in position of center 800 of indicator 530 in window 500

that is equal to a predetermined increment, or for each change in the position of center 810 of rectangle 525 with respect to image 515 that is equal to a predetermined increment. For example, for the embodiment shown in figures 8 and 9 described above in which the first level window 500 has dimensions of 400 by 240 pixels, an increment of size 20 pixels for the movement of the center 800 of indicator 530 may be selected. In the example shown in figures 8 and 9, the center 800 of indicator 530 moved from an original location (140,100) to a final location (300, 200). The total distance moved by center 800 is:

$$10 \quad \text{SQRT}[(300 - 140)^2 + (200 - 100)^2] = 188.67$$

Using the criteria of an intermediate position for each incremental movement of 20 pixels, a total of nine intermediate positions would be displayed in this example. Choosing a smaller increment increases the number of intermediate positions, and accordingly increases the smoothness of the scrolling. An increment of 10 pixels would result in eighteen intermediate positions being displayed. An increment of one pixel would result in one-hundred eighty eight intermediate positions being displayed.

In some embodiments, it is desirable that an increment smaller than one pixel is used. An example of such an embodiment is one in which the second level image is several times the size of the first level image. In such an embodiment, moving one pixel in the first level window is equivalent to moving several pixels with respect to the second level image. Accordingly, for each pixel the indicator is moved in the first level window, it may be desirable to display several intermediate positions of the second level window with respect to the second level image. If, for example, it is desired to display four intermediate positions for the second level window for each

one pixel moved by the first level indicator, the equivalent specified increment is one-quarter pixel.

Two examples of how indicator 530 can be moved from one location to  
5 another are by positioning a mouse cursor at the desired location of the  
center 800 of indicator 530 and clicking a mouse button (in which case,  
depending on the specific implementation, indicator 530 "jumps" in a single  
step or moves smoothly in a straight line to the new location) or by clicking  
on and dragging indicator 530 with a mouse. In one embodiment of the  
10 invention, clicking on the indicator causes indicator 530 to be centered  
around the position of the cursor when the mouse when clicked, and  
dragging the mouse drags the center 800 of indicator 530 to a new location.

If the position of indicator 530 is changed by dragging with a mouse, in  
15 one embodiment of the invention, the position of the mouse, which  
represents the position of the center 800 of indicator 530, is monitored. Each  
time the center 800 of indicator 530 is moved an increment equal to the  
specified increment (or a specified multiple of the increments, if the  
increment is less than one pixel), the position of the center 800 of indicator  
20 530 is recorded, and the corresponding position of the center 810 of rectangle  
525 for each intermediate position is calculated using the functions that  
define the relationship between points in window 500 and points in image  
515. These calculated positions of center 810 of rectangle 525 are then used to  
determine the portions of image 515 to be displayed in window 505, and those  
25 portions are sequentially displayed. As indicator 530 continues to be dragged  
by the mouse, this process is repeated each time the indicator has moved a  
distance equal to the specified increment or multiple of increments. When

the mouse button is released, the final position of indicator 530 is determined, and the final portion of image 515 to be displayed in window 505 is determined and displayed.

5           If the position of indicator 530 is changed by clicking the mouse on the new desired location of center 800 of indicator 530, causing indicator 530 to move to the new position, the number and location of portions of image 515 to be displayed in second level window 505 may be determined by identifying a straight line path (which is coextensive with arrow 615 in figure 7) between  
10 the initial and final positions, determining points along that path located at increments equal to the specified increment, and then determining the portions of image 515 corresponding to the incremental points along the path in the same manner as for the dragging mode. Other methods for determining intermediate portions of 515 to be displayed in second level  
15 window 505 may also be used. As in the other examples, the smaller the specified increment, the greater the number of intermediate positions, and the smoother the scrolling.

The multiple image navigation method of the present invention is  
20 not limited to two windows and two images, but may be used with any number of windows, constrained only by system limitations of the particular computer system in which the invention is used. Figure 10 shows an embodiment of the present invention incorporating a third level window 1000 and a third level image 1005, in addition first and second level windows  
25 500 and 505, respectively, and first and second level images 510 and 515, respectively. Third level image 1005 is stored independently of first and second level images 510 and 515, though it may be related to image 510

and/or image 515 in theme and content. In the embodiment shown in figure 10, third level image 1005 is larger than either second level image 515 or first level image 510, while third level window 1000 is the same size as windows 500 and 505. However, all images and windows may be of arbitrary size and  
5 shape.

As in the two window embodiment shown in figure 5, all of image 510 is displayed in window 500, while only the portion of image 515 is displayed in window 505. An indicator 530 in window 500 is used to control the  
10 portion of image 515 displayed in window 505. Rectangle 525 indicates the portion of image 515 displayed in window 505. Because image 1005 is larger than third level window 1000, only a portion of image 1005 is displayed in window 1000. Rectangle 1010 indicates the portion of image 1005 displayed in  
window 1000.

15

In addition to indicator 530 located in first level window 500, the embodiment of figure 10 includes a second indicator 1015 located in window 505. In this embodiment, indicator 530 may be referred to as a "first level indicator" and indicator 1015 may be referred to as a "second level indicator."  
20 Second level indicator 1015 is used to determine the portion of image 1005 that is displayed in window 1000 in a manner similar to the manner that first level indicator 530 is used to determine the portion of image 515 that is displayed in second level window 505.

25

As in the embodiment shown in figure 5, in the embodiment of figure 10, there is defined a functional relationship between points P<sub>1</sub> in first level image 510 and a corresponding point P<sub>2</sub> in second level image 515:

$$P_2 = f_1(P_1)$$

In a similar manner, there is defined a functional relationship between points  $P_2$  in second level image 515 and a corresponding point  $P_3$  in third level image 1010:

5 
$$P_3 = f_2(P_2).$$

In addition, there is associated with first level indicator 530 a first reference point that is used to define a corresponding point in second level image 515 that is used to determine the portion of image 515 that is displayed  
10 in second level window 505. In the embodiment of figure 10, this first reference point is the center 800 of first level indicator 530, and it determines the portion of second level image 515 displayed in second level window 505 by defining a point 810 in image 515 that represents the position of the center 1020 of second level window 505 with respect to second level image 515. In a  
15 similar manner, there is associated with second level indicator 1015 a second reference point that is used to define a corresponding point in third level third level image 1005 that is used to determine the portion of image 1005 that is displayed in third level window 1000. In the embodiment of figure 10, this second reference point is the center 1025 of second level indicator 1015,  
20 and it determines the portion of third level image 1005 displayed in third level window 1000 by defining a point 1040 in image 1005 that represents the position of the center 1030 of third level window 1000 with respect to third level image 1005.

25 First level indicator 530 and second level indicator 1015 may be used to navigate images 515 and 1005 as follows. First level indicator may be moved by means of a mouse in the manner described for the two window

embodiment of figure 5. As first level indicator is moved, its position with respect to a fixed reference point in first level window 500 is monitored. Any point in window 500 may be used as a fixed reference point. In the example described with respect to figure 5, the lower right-hand corner of first level window 500 was used as the fixed reference point to determine the position of center 800 of indicator 530. In the example of the embodiment of figure 10 described here, the center 1050 of first level window 500 is used. The position of center 800 of first level indicator 530 with respect to first level window 500 at any time may be viewed as a vector V1 with its tail at the center 1050 of window 500 and its head at the center 800 of indicator 530.

Second level indicator 1015 may be moved with respect to second level window 505 in the same manner that first level indicator 530 may be moved with respect to first level window 500. As second level indicator is moved, its position with respect to a reference point in second level window 505 is monitored. An example of a reference point that may be used is center 1020 of second level window 505. The position of center 1025 of second level indicator 1015 with respect to second level window 505 at any time may be viewed as a vector V2 with its tail at the center 1020 of second level window 505 and its head at the center 1025 of second level indicator 1015.

The portion of second level image 515 displayed in second level window 505 may be determined from vector V1. Using the function  $f_1$  that defines the relationship between points in first level image 510 and second level image 515, vector V1' is calculated. Vector V1' represents a vector whose tail is at the center 1060 of second level image 515 and whose head is at the center 810 of rectangle 525 that indicates the portion of image 515 that is

displayed in second level window 505. Vector V1 thus defines the portion of image 515 that is displayed in second level window 505.

The portion of third level image 1005 displayed in second level  
5 window 1000 may be determined in a similar manner from vectors V1' and V2. Vector V1' represents the offset of center 1020 of second level window 505 from the center of second level image 515. Vector V2 represents the offset of the center 1025 of second level indicator 1015 from the center 1020 of second level window 505. The sum V3 of V1' and V2 therefore represents  
10 the offset of the center 1025 of second level indicator 1015 from the center of image 515. The portion of third level image 1005 displayed in third level window 1000 may be determined from vector V3 the same way that the portion of second level image 515 displayed in second level window 505 is determined from vector V1. Using the function  $f_2$  that defines the  
15 relationship between points in second level image 515 and third level image 1005, vector V3' is calculated. Vector V3' represents a vector whose tail is at the center 1065 of third level image 1005 and whose head is at the center 1040 of rectangle 1010 that indicates the portion of image 1005 that is displayed in third level window 1000. Vector V3, the sum of vectors V1' and V2, thus  
20 defines the portion of image 1005 that is displayed in third level window 1000.

In the embodiment shown in figure 10, moving first level indicator 530 with respect to first level window 500 causes the portion of image 515  
25 displayed in second level window 505 to change, but does not change the relative position of second level indicator 1015 with respect to second level window 505. In this embodiment, moving first level indicator 530 changes

vector V1, but does not cause a change in vector V2. Vector V2 is changed when second level indicator 1015 is moved within second level window 505. In other embodiments, moving first level indicator 530 may cause a change in the relative position of second level indicator 1015. For example, in one  
5 embodiment, the system may be designed such that whenever first level indicator 530 is moved, second level indicator 1015 is centered in second level window 505.

In the embodiment shown in figure 10, all of first level image 510 is  
10 displayed in first level window 500. In order to be able to be positioned over any desired portion of image 500, therefore, there is no need for first level indicator 530 to move beyond the boundaries of window 500. Indicator 530 is therefore constrained to move only within first level window 500. Attempting to move first level indicator 530 beyond a boundary of window  
15 500 causes first level indicator 530 simply to abut the boundary.

The situation is different with respect to second level window 505, however. Second level image 515 is larger than second level window 505. Second level indicator 1015 cannot therefore be positioned over any desired  
20 portion of second level image 515 if indicator 1015 is constrained to remain only within the boundaries of second level window 505. In the embodiment shown in figure 10, second level indicator 1015 may be dragged across the boundaries of second level window 505. Doing so causes second level window 505 to scroll at a predetermined rate with respect to second level  
25 image 515 in a direction perpendicular to the boundary across which second level indicator 1015 has been moved. For example, if second level indicator

1015 is moved across the left boundary of second level window 505, second level window 505 scrolls to the left across second level image 515.

As second level window 505 scrolls in response to second level  
5 indicator 1015, the position of center 1020 of second level window 505 with respect to second level image 515 changes. Accordingly, the position of first level indicator 530 with respect to first level window 500 needs to be changed to correspond to the new location of the center 1020 of second level window 505. That may be accomplished by determining vector  $V1'$  for the new  
10 location of center 1020, and by means of the function defining the relationship between points in images 510 and 515 determining the vector  $V1$  that identifies the corresponding location of first level indicator 530 with respect to first level window 500. The portion of third level image displayed in third level window 1000 may then be determined from vectors  $V1'$  and  $V2$   
15 as described above.

As in the two window embodiment of figure 7, when an indicator is moved, the windows that show portions of images as determined from the position of the indicator may dynamically scroll as the indicator is moved,  
20 may jump from an initial to a final image portion, and/or may show intermediate portions between initial and final image portions. In one embodiment of the invention, the portions of second level image displayed in second level window 505 are scrolled dynamically as first level indicator 530 is moved, while for the same movement of first level indicator 530, only  
25 portions of third level image 1005 corresponding to initial and final positions of first level indicator 530 are displayed in window 1005. In the same embodiment, the portions of third level image 1005 displayed in third level

window 1000 are scrolled dynamically as second level indicator 1015 is moved.

In certain embodiments of the present invention, a window such as  
5 third level window 1000 in Figure 10, that does not itself have an indicator,  
but that can be scrolled by moving an indicator in a higher level window  
(such as second level indicator 1015), may also be scrolled by dragging the  
window itself. In one example of such a draggable window, clicking a mouse  
in the window creates a "handle" by which the window can be dragged. As  
10 the window is dragged, any higher level windows and indicators are  
repositioned to correspond to the dragged window's new location.

Although three windows are used in the embodiment shown in figure  
10, it will be apparent to those skilled in the art that the present invention  
15 may be extended to embodiments having any number of windows,  
depending on the response time desired and the hardware and software  
characteristics of a particular computer system.

Figure 11 is a flow chart showing the steps used in one embodiment of  
20 the current invention featuring multiple indicators and multiple images.

Beginning at block 1100, the cursor position and mouse button status  
are monitored. At decision block 1105, further action is taken if the mouse  
button is depressed. Otherwise, the monitoring of the cursor position and  
25 mouse button status continues at block 1100.

If the cursor is not positioned over a window that has an indicator, no further action is taken and the cursor position and status continues to be monitored at block 1100. If the cursor is positioned over a window with an indicator when the mouse button is depressed, the position of the cursor  
5 with respect to a reference point of the window (such as the center of the window as in the embodiment of figure 10) is determined at block 1115. Next, at block 1120, the positions of the other windows with respect to their underlying images, corresponding to the new relative position of the cursor, are determined based on the functions that define the relations between  
10 points in the images underlying the various windows. At block 1125, the other windows are scrolled to the new positions determined at block 1120 by displaying intermediate portions of the underlying images as described with respect to the embodiment of figure 7 above. At block 1130, the indicator in the window in which the cursor is positioned is moved to correspond to the  
15 new cursor position.

At this point, the mouse button is depressed, the cursor is in a window with an indicator, and all windows and the indicator have been repositioned to correspond to the cursor position. At block 1135, the cursor position and  
20 mouse button status are again monitored.

If the mouse button remains pressed and the cursor position changes, as determined at decision block 1145, that is an indication that the indicator is being dragged by the mouse. Any active timer (any timer that is still running  
25 or any timer that has expired but has not been cleared, as described in more detail below) is cleared at block 1185. At decision block 1150, it is determined whether the new cursor position is outside the boundaries of the window. If

it is not, the new cursor position is determined at block 1115, and from there the process continues as described above.

If the new cursor is outside the boundaries of the window, a timer is  
5 started at block 1190 and the cursor position and mouse button is again  
monitored beginning at block 1135. The timer ensures that actions that result  
from dragging the cursor outside of the window are initiated only if the  
cursor remains at rest outside the window with the mouse button pressed for  
a predetermined period of time. In one embodiment of the invention, this  
10 period of time is 20 milliseconds. As long as the mouse button remains  
depressed, the cursor position remains unchanged, and the timer has not  
expired, no further action will take place. A determination will be made at  
decision block 1140 that the mouse button has not been released. Following  
that, it will be determined at block 1145 that the cursor position has not  
15 changed, and at block 1195 that there is no active timer that has expired, and  
the cursor and mouse button status will again be monitored at block 1135.

If the mouse button remains depressed and the cursor position  
remains unchanged, eventually the timer will expire. When the timer has  
20 expired, as determined at decision block 1195, a decision is made at decision  
block 1155 as to whether the image underlying the window is larger than the  
window, which means that the window is a scrollable window (such as  
window 505 in figure 10), or whether the image underlying the window is  
not larger than the window, indicating that the whole image is displayed in  
25 the window so that there is no need for scrolling. If the window is a non-  
scrollable window, the indicator can move to the boundary of the window  
and no farther. Accordingly, at block 1160 the position of the indicator that

corresponds to a position such that the indicator abuts the boundary of the window is determined. From this position, the corresponding positions of the other windows are determined at block 1120, and from there the process continues as before.

5

If at decision block 1155 it is found that the window is a scrollable window, then it is determined at decision block 1165 whether the window is positioned at the boundary of the underlying image in the direction in which the cursor is positioned, indicating that the window has already scrolled to the edge of the underlying image and can scroll no farther. If so, no further repositioning of windows takes place, and the cursor position and mouse button status are again monitored at block 1135.

If the window is not already at the boundary of the underlying image, it can be scrolled. Accordingly, the window is scrolled a predetermined increment in the direction corresponding to the cursor position at block 1170. In one embodiment of the invention, the rate at which the window is scrolled depends upon how far the cursor is moved outside of the window. Such scrolling requires that positions of the indicator(s) in other window(s) that indicate the position of the scrolled window must be changed to account for the scrolling of the window. The new corresponding positions of the other indicator(s) is determined at block 1175, and the indicators are moved to the new positions at block 1180. The timer is restarted at block 1182, and the corresponding positions of the other windows are then determined at block 1120 as before. The cursor position and mouse button status are again monitored at block 1135.

If the mouse button is released as determined at block 1140, any active timers are cleared at block 1142, and the process begins anew at block 1100. If the mouse button remains depressed but the cursor is moved, any active timers are cleared at block 1185 and the process resumes at block 1150.

5

If the mouse button remains depressed and the cursor remains positioned at its location outside of the window, the window will continue to scroll the predetermined increment for every cycle of the timer. In this circumstance, after it has been determined at decision blocks 1140, 1145, and  
10 1195 that the mouse button has not been released, that the cursor position has not changed, and the timer that was reset at block 1182 has expired, the scrolling process begins again at decision block 1155.

In order to allow the appropriate portions of the images associated  
15 with the multiple windows of the present invention to be rapidly displayed, it is desirable that the images are stored in a computer system's RAM memory so as to be rapidly available. Since, however, the present invention is intended to be used with images including very large bitmaps (on the order of millions of pixels in size), system memory size limitations may prevent all  
20 images from being stored in RAM memory in uncompressed form. Accordingly, in certain embodiments of the invention, the images are compressed, using any of a variety of well known compression methodologies. The images are stored in compressed form, and are incrementally decompressed as required as the portion of an image displayed  
25 in a window is changed.

An additional feature of certain embodiments of the present invention is the ability to paste items into any of the displayed windows. For any item pasted into any window, a corresponding item is added to the images for the other windows in the corresponding location. The graphical representations  
5 of the items in each window are independent, and may be, but need not be, similar in appearance to the corresponding items in the other windows. An item may be nothing more than a graphic image or a string of text, or it may have additional items associated with it such as text or image data.

10 Figure 12 shows an example of a two window embodiment of the present invention that includes the feature of pasted items. Figure 12 shows a display screen 1200 containing a first level window 1205 and a second level window 1210. First level window shows a seating chart for the passenger compartment of an airplane. Second level window 1210 shows a portion of a  
15 second level image comprising a larger scale image of a seating chart for the same airplane. First level indicator 1215, depicted as a rectangular frame, is used to select the portion of the second level image that is displayed in second level window 1210. For the embodiment shown in figure 12,  
indicator 1215 extends the full height of first level window 1205. Accordingly,  
20 first level indicator 1215 is constrained to move only to the left or the right. Moving first level indicator to the right or the left in first level window 1205 causes the portion of second level image displayed in second level window 1210 to scroll in the manner described above for the embodiments of the invention shown in figures 5 to 10.

25

Display screen 1200 contains an item window 1220 that allows a user to select any of displayed items with a mouse or other means and "drag and

drop" the selected item into either of first or second level windows 1205 and 1210, respectively. The two items available in the item window 1220 of the embodiment shown in figure 12 are a "Meal" item 1225 indicated by an icon in the shape of a dish and a "Special Help" item 1230 indicated by an icon in the shape of a first aid cross. Meal item 1225 may be used to indicate a seat at which a passenger requires a special meal. Special help item 1230 may be used to indicate a seat at which a passenger requires special assistance of some kind.

10 In the embodiment shown in figure 12, two items have been placed in the portion of the second level image displayed in second level window 1210: a "Meal" item 1235 and a "Help" item 1240. In second level window 1210, the same icons are used to indicate an item as are shown in item window 1220. In the embodiment shown in figure 12, placing an item in second level window causes a corresponding item to be placed in first level window 1205. However, in the embodiment of figure 12, different icons are used in first level window 1205 to indicate an item than in second level window 1210. In first level window 1205, a simple "x" is used to mark the location of any item, regardless of whether it is a "Meal" item or a "Help" item. Accordingly, "x" 1245 in first level window 1205 corresponds to "Meal" item 1235 in second level window 1210, and "x" 1250 in first level window 1205 corresponds to "Help" item 1240 in second level window 1210. Three other items are shown in first level window 1205. Corresponding items would be displayed in second level window 1210 if first level indicator were moved to the locations of these other items in first level window 1205.

The present invention allows data, in the form of text, graphics, video, sound or other form to be associated with a displayed item. In the embodiment shown in figure 12, the data associated with an item may be displayed by selecting the icon for the item displayed in second level window 5 1210. Various methods of selecting the item, such as "clicking" with a mouse may be used. Selecting an item in second level window 1210 causes an "active item" indicator to be displayed at the item selected and an item data window to be displayed on display screen 1200. Figure 12 shows the display screen 1200 after "Meal" item 1235 has been selected with a mouse.

10 Accordingly, "active item" indicator 1255 (consisting in this embodiment in a rectangular frame drawn in dotted lines) is displayed around item 1235 in second level window 1210, and item data window 1260 is displayed to the right of second level window 1210 at a predetermined position. The purpose of active item indicator 1255 is to indicate to the user with which item the

15 data displayed in item data window 1260 is associated. The purpose of item data window 1260 is to display the data associated with the selected item.

In the embodiment shown in figure 12, the data associated with "Meal" item 1235 is the text: "Meal Details: Low Fat Vegetarian." In other 20 embodiments, other or additional forms of data may be associated with an item. Such additional forms of data may be accessed by using a different manner of selecting the item (for example by "double clicking" on an item instead of "single clicking"), and item data window 1260 may provide a menu or other control means to allow a user to select which data the user desires to

25 access. Upon such other data being accessed, it may be displayed in the same or in a separate window, or, in the case of sound data, may be played over a computer speaker or sound board. In certain embodiments of the invention,

a user may be allowed to enter or edit data in a item data window that is to be associated with an item. In other embodiments, some or all of the data associated with an item may be displayed in a read-only manner.

5           Thus a novel system for displaying data in the form of multiple, independent windowed images, and for quickly and easily navigating such windowed images has been presented. Although certain specific illustrative embodiments have been described herein, it will be apparent to those skilled in the art that the present invention is not limited to those specific  
10   embodiments.

CLAIMS

1. A hypermedia editing system for editing a hypermedia work comprising a plurality of lexia, said hypermedia editing system comprising:
- 5 a display screen;
- a contents map window displayed on said display screen, said contents map window displaying a portion of a contents map for said hypermedia work;
- a plurality of freely movable lexia symbols displayed in said contents
- 10 map window, each of said lexia symbols representing one of said plurality of lexia of said hypermedia work;
- a special function graphical element displayed in said contents map window, said special function graphical element applying a special function to any of said plurality of lexia symbols placed within a predetermined
- 15 distance of said special function graphical element.
2. A hypermedia editing system for editing a hypermedia work comprising:
- a display screen;
- 20 a hypermedia work display window displayed on said display screen;
- a plurality of graphical elements displayed in said hypermedia work display window, said graphical elements comprising a first special function element, said first special function element specifying a first special function to be applied to graphical elements located within a first distance from said
- 25 first special function element.

3. The hypermedia editing system of claim 2 wherein said first special function is applied to items represented by said graphical elements located within said first distance from said first special function element.

5 4. The hypermedia editing system of claim 3 wherein said hypermedia work comprises a plurality of lexia and wherein said plurality of graphical elements displayed in said hypermedia work display window comprise a plurality of lexia symbols representing lexia of said hypermedia work.

10

5. The hypermedia editing system of claim 4 wherein said first special function is applied to lexia represented by lexia symbols located within said first distance from said first special function element.

15

6. The hypermedia editing system of claim 2 wherein said graphical elements comprise a plurality of special function elements, and wherein said first special function is applied to a second special function element located within said first distance from said first special function element.

20

7. The hypermedia editing system of claim 2 wherein said first special function comprises applying formatting to graphical elements located within said first distance from said first special function element.

25

8. The hypermedia editing system of claim 2 wherein said first special function comprises creating links between graphical elements located within said first distance from said first special function element.

9. The hypermedia editing system of claim 5 wherein said first special function comprises applying formatting to lexia represented by lexia symbols located within said first distance from said first special function  
5 element.

10. The hypermedia editing system of claim 5 wherein said first special function comprises creating links between lexia represented by lexia symbols located within said first distance from said first special function  
10 element.

11. The hypermedia editing system of claim 6 wherein said first special function comprises applying formatting to said second special function element.  
15

12. The hypermedia editing system of claim 11 wherein said formatting is applied to graphical elements located within a second distance from said second special function element.

20 13. The hypermedia editing system of claim 6 wherein said graphical elements located within a first distance from said first special function element comprise a second special function element and an other graphical element and wherein said first special function comprises creating links between said second special function element and said other graphical  
25 element.

14. The hypermedia editing system of claim 6 wherein said graphical elements located within a first distance from said first special function element comprise a second special function element and a lexia symbol representing a lexia of said hypermedia work and wherein said first  
5 special function comprises creating a link between said second special function element and said lexia represented by said lexia symbol.

15. The hypermedia editing system of claim 2 wherein said first special function element specifies a plurality of special functions to be applied  
10 to graphical elements located within a first distance of said first special function element.

16. The hypermedia editing system of claim 15 wherein said plurality of special functions specified by said first special function element  
15 comprise formatting and link creation.

17. The hypermedia editing system of claim 5 wherein said first distance is zero.

20 18. The hypermedia editing system of claim 5 wherein graphical symbols located within said first distance from said first special function element are automatically moved to said first special function element.

25 19. The hypermedia editing system of claim 8 wherein said links created between said graphical elements located within said first distance from said first special function element correspond to relative positions of said graphical elements with respect to said first special function element.

20. The hypermedia editing system of claim 10 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element correspond to relative positions of said lexia symbols with respect to said first special function element.

21. The hypermedia editing system of claim 19 wherein said links created between said graphical elements located within said first distance from said first special function element comprise links between graphical elements disposed immediately adjacent to each other.

22. The hypermedia editing system of claim 20 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element comprise links between lexia represented by lexia symbols disposed immediately adjacent to each other.

23. The hypermedia editing system of claim 19 wherein said links created between said graphical elements located within said first distance from said first special function element comprise links between each of said graphical elements located within said first distance from said first special function element and each other of said graphical elements located within said first distance from said first special function element .

24. The hypermedia editing system of claim 20 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element comprise links between each lexia represented by a lexia symbol located within said first distance from said first special function element and each lexia represented by each other of said lexia symbols located within said first distance from said first special function element .

25. The hypermedia editing system of claim 20 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element are represented in said lexia by link activation areas.

26. The hypermedia editing system of claim 22 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element are represented in said lexia by link activation areas.

27. The hypermedia editing system of claim 24 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element are represented in said lexia by link activation areas.

28. The hypermedia editing system of claim 26 wherein said link activation areas comprise link activation buttons.

29. The hypermedia editing system of claim 27 wherein said link activation areas are represented in said lexia by lists of link activation areas.

5 30. The hypermedia editing system of claim 10 wherein said links created between said lexia represented by lexia symbols located within said first distance from said first special function element are represented in said lexia by link activation areas.

10 31. The hypermedia editing system of claim 30 wherein said link activation areas comprise text labels.

15 32. The hypermedia editing system of claim 31 wherein said lexia comprise data fields and wherein said text labels comprise text labels extracted from said data fields of said lexia.

33. The hypermedia editing system of claim 29 wherein said link activation areas comprise text labels.

20 32. The hypermedia editing system of claim 33 wherein said lexia comprise data fields and wherein said text labels comprise text labels extracted from said data fields of said lexia.

25 33. The hypermedia editing system of claim 27 wherein said link activation areas are represented in said lexia by tables of link activation areas.

34. The hypermedia editing system of claim 2 wherein said first special function is user selectable from among a plurality of special functions.

35. The hypermedia editing system of claim 10 wherein said first special function element is depicted in said hypermedia work display window as a bar.

5

36. The hypermedia editing system of claim 10 wherein said first special function element is depicted in said hypermedia work display window as a plurality of bars arranged to form a grid.

10

37. The hypermedia editing system of claim 2 wherein said graphical elements are movable such that a graphical element located within said first distance from said first special function element is movable beyond said first distance from said first special function element to a location at which said first special function is no longer applied to said moved graphical element.

15

38. The hypermedia editing system of claim 19 wherein said graphical elements are movable such that a graphical element located at one relative location within said first distance from said first special function element is movable to a second relative location within said first distance from said first special function element and wherein said links created according to said first special function are automatically updated to correspond to movement of said graphical element from said first relative position to said second relative position.

20  
25

39. The hypermedia editing system of claim 2 wherein said first special function element is movable, and wherein moving said first special function element causes said graphical elements located within said first distance from said first special function element to move in a corresponding  
5 manner.

40. A display system for representing the content of sets of data comprising:  
a display screen;  
10 a plurality of graphical elements representing sets of data displayed on said display screen, a first of said graphical elements comprising a caricature based upon a first parameter related to a first of said sets of data.

41. The display system of claim 40 wherein said sets of data  
15 comprise lexia of a hypermedia work.

42. The display system of claim 40 wherein said first set of data comprises formatted display data displayable on said display screen, and wherein said first parameter comprises a visual appearance of said display  
20 data when displayed on said display screen.

43. The display system of claim 42 wherein said caricature comprises a caricature of a first portion of said visual appearance of said display data.  
25

44. The display system of claim 43 wherein said formatted display data comprises text data arranged in a plurality of paragraphs, and wherein said caricature comprises caricatures of a first portion of said plurality of paragraphs.

5

45. The display system of claim 43 wherein a size of said first portion of said visual appearance of said display data is dependent on a size of said first graphical element.

10

46. The display system of claim 40 wherein said caricature comprises a pseudo-randomly generated feature.

47. The display system of claim 46 wherein said pseudo-randomly generated feature comprises the location of a visual feature of said caricature.

15

48. The display system of claim 47 wherein said visual feature comprises a notch along a perimeter of said caricature.

49. The display system of claim 40 wherein a change to said first set of data that results in a change to said first parameter leads to a corresponding change to said caricature.

20

50. The display system of claim 40 wherein said first parameter comprises a time related to said first set of data.

25

51. The display system of claim 50 wherein said time related to said first set of data comprises a time of creation of said first set of data.

52. The display system of claim 50 wherein said time related to said first set of data comprises a time related to an access history of said first set of data.

5

53. The display system of claim 40 wherein said caricature based on said first parameter comprises a shape of said first graphical element.

54. The display system of claim 53 wherein said shape of said first graphical element comprises a rectangle, and wherein a degree of rounding of corners of said rectangle depends upon a value of said first parameter.

10

55. The display system of claim 54 wherein said first parameter comprises a count of a number of times that said first set of data is accessed.

15

56. The display system of claim 40 wherein said caricature based on said first parameter comprises a color.

57. The display system of claim 56 wherein said color depends upon a value of said first parameter.

20

58. The display system of claim 49 wherein said caricature is updated to reflect a change made to said first set of data.

59. The display system of claim 40 wherein a visual appearance of said first graphical element and a relative position of said first graphical element on said display screen distinguishes said first set of data from other sets of data.

5

60. A hypermedia display system for displaying a hypermedia work comprising a plurality of lexia, said display system comprising:

a display screen;

a hypermedia work display window displayed on said display screen;

10

a plurality of graphical elements representing a plurality of lexia displayed in said hypermedia work display window, said graphical elements comprising a plurality of displayable types, said displayable types comprising a basic type and content-based type, a currently displayed of said plurality of displayable types corresponding to a selected display mode for said

15 hypermedia work display window.

61. The hypermedia display system of claim 60 wherein an appearance of said basic displayable type of graphical element is identical for each graphical element representing a lexia.

20

62. The hypermedia display system of claim 60 wherein an appearance of said content-based displayable type of graphical element is based on a parameter related to a lexia represented by said graphical element.

25

63. The hypermedia display system of claim 61 wherein an appearance of said content-based displayable type of graphical element is based on a parameter related to a lexia represented by said graphical element.

64. The hypermedia display system of claim 62 wherein an appearance of said content-based displayable type of graphical element is based on a plurality of parameters related to a lexia represented by said graphical element.

5

65. The hypermedia display system of claim 62 wherein said parameter related to a lexia represented by said graphical element comprises a pseudo-random parameter assigned to said graphical element.

10

66. The hypermedia display system of claim 62 wherein said parameter related to a lexia represented by said graphical element comprises a visual appearance of said lexia when said lexia is displayed on said display screen.

15

67. The hypermedia display system of claim 62 wherein said parameter related to a lexia represented by said graphical element comprises a time parameter related to said lexia.

20

68. The hypermedia display system of claim 67 wherein said time parameter is related to a time of creation of said lexia.

69. The hypermedia display system of claim 67 wherein said time parameter is related to a time of selection for display of said lexia.

25

70. The hypermedia display system of claim 62 wherein said parameter related to a lexia represented by said graphical element comprises is related to a frequency of selection for display of said lexia.

- 5           71. A hypermedia editing system for editing a hypermedia work comprising:
- a display screen;
  - a hypermedia work display window displayed on said display screen;
  - a plurality of freely movable graphical elements representing a
- 10 plurality of lexia of said hypermedia work displayed in said hypermedia work display window;
- a plurality of freely movable user configurable text labels displayed in said hypermedia work display window.

- 15           72. In a computer system, a method for creating a graphical element representing a set of data, said method comprising the steps of:
- examining a set of data;
  - identifying a first parameter of said set of data;
  - generating a first representation corresponding to said first parameter;
- 20 incorporating said first representation in a graphical element representing said set of data.

73. The method of claim 72 wherein said set of data comprises a lexia of a hypermedia work.

74. The method of claim 72 wherein said set of data comprises data displayable on a display device and wherein said first parameter comprises a visual appearance of a portion of said data when displayed on said display device.

5

75. The method of claim 72 further comprising the steps of:  
reexamining said set of data after a triggering event has occurred;  
identifying any change to said first parameter of said set of data;  
if a change to said first parameter has occurred, revising said first  
10 representation corresponding to said first parameter according to said change;  
incorporating said revised first representation in said graphical  
element representing said set of data.

76. The method of claim 72 further comprising the steps of:  
15 identifying a second parameter of said set of data;  
generating a second representation corresponding to said second  
parameter;  
incorporating said second representation in said graphical element  
representing said set of data.

20

77. The method of claim 72 further comprising the steps of:  
identifying a plurality of additional parameters of said set of data;  
generating additional representations corresponding to said additional  
parameters;  
25 incorporating said additional representations in said graphical element  
representing said set of data.

78. In a computer system, a method for creating a link between a first lexia and a second lexia of a hypermedia work comprising the steps of:  
displaying said first lexia in a lexia display window on a display screen;  
displaying a graphical element representing said second lexia in a  
5 hypermedia work display window on said display screen;  
selecting a location for an activation area for said link in said lexia display window;  
selecting said graphical element in said hypermedia work display window.

10

79. The method of claim 78 further comprising the steps of:  
extracting a label for said link activation area from a data field of said  
lexia;  
displaying said label in said lexia display window.

15

80. The method of claim 79 wherein said link activation area comprises said label.

81. In a computer system, a method for displaying results of  
20 searching for data contained in a plurality of sets of data comprising the steps of:  
displaying a graphical element corresponding to each of a plurality of said sets of data on a display screen;  
identifying each set of data comprising said searched for data by  
25 highlighting each of said graphical elements corresponding to each of said sets of data comprising said searched for data on said display screen.

82. The method of claim 81 wherein said sets of data comprise lexia of a hypermedia work.

83. The method of claim 81 further comprising the steps of:  
5 displaying a set of data comprising said searched for data on said display screen;  
highlighting said searched for data of said set of data displayed on said display screen.

10 84. The method of claim 82 wherein said searched for data comprises data representing a hypermedia link.

85. The method of claim 82 wherein said graphical elements representing said lexia comprise lexia symbols displayed in a hypermedia  
15 work display window on said display screen.

86. The method of claim 82 wherein said step of displaying a graphical element corresponding to each of a plurality of said sets of data on a display screen comprises the step of:  
20 displaying first graphical elements representing a first portion of the lexia of a hypermedia work in a first hypermedia work display window and displaying second graphical elements representing a second portion of the lexia of a hypermedia work in a second hypermedia work display window.

25 87. The method of claim 86 wherein said second portion comprises a portion of said first portion.

88. The method of claim 87 wherein said first portion comprises all of the lexia of said hypermedia work.

89. In a computer system, a method for editing a hypermedia work  
5 comprising the steps of:

displaying a hypermedia work display window on a display screen;

displaying a plurality of graphical elements comprising a first special  
function element in said hypermedia work display window;

10 applying a first special function to graphical elements located within a  
first distance from said special function element.

90. The method of claim 89 wherein said step of applying said first  
special function to graphical elements located within a first distance from  
said first special function element comprises the step of applying said first  
15 special function to items represented by said graphical elements located  
within said first distance from said first special function element.

91. The method of claim 90 wherein said hypermedia work  
comprises a plurality of lexia and wherein said plurality of graphical  
20 elements displayed in said hypermedia work display window comprise a  
plurality of lexia symbols representing lexia of said hypermedia work.

92. The method of claim 91 wherein said step of applying said first  
special function to graphical elements located within a first distance from  
25 said first special function element comprises the step of applying said first  
special function to lexia represented by lexia symbols located within said first  
distance from said first special function element.

93. The method of claim 89 wherein said graphical elements located within a first distance from said first special function element comprise a second special function element and wherein said step of applying said first  
5 special function to graphical elements located within a first distance from said first special function element comprises the step of applying said first special function to said second special function element.

94. The method of claim 89 wherein said first special function  
10 comprises applying formatting to said graphical elements located within a first distance from said first special function element.

95. The method of claim 89 wherein said first special function  
15 comprises creating links between said graphical elements located within said first distance from said first special function element.

96. The method of claim 89 wherein said graphical elements located within a first distance from said first special function element comprise a  
lexia symbol representing a lexia and wherein said first special function  
20 comprises creating a link between said lexia and said second special function element.

97. The method of claim 89 wherein said first special function  
comprises a plurality of special functions.  
25

98. The method of claim 92 wherein said first distance is zero.

99. The method of claim 89 further comprising the step of moving said graphical symbols located within said first distance from said first special function element to said special function element.

5 100. The method of claim 95 wherein said links created between said graphical elements located within said first distance from said first special function element correspond to relative positions of said graphical elements with respect to said first special function element.

10 101. The method of claim 100 wherein said links created between said graphical elements located within said first distance from said first special function element comprise links between each of said graphical elements located within said first distance from said first special function element and each other of said graphical elements located within said first  
15 distance from said first special function element.

102. The method of claim 101 wherein said graphical elements located within said first distance from said first special purpose element comprise lexia symbols representing lexia of a hypermedia work and wherein  
20 said links created between said graphical elements located within said first distance from said first special function element are represented in said lexia by link activation areas.

103. The method of claim 102 wherein said lexia comprise data fields  
25 and wherein said link activation areas comprise text labels extracted from said data fields.

104. The method of claim 102 wherein said link activation areas comprise tables of link activation areas.

105. The method of claim 89 further comprising the steps of:

5 moving a graphical element from within said first distance from said first special purpose element to without said first distance from said first special purpose element;

undoing application of said first special function from said moved graphical element.

10

106. The method of claim 100 further comprising the steps of:

moving a graphical element located at a first location within said first distance from said first special purpose element to a second location within said first distance from said first special purpose element;

15 updating links created according to said first special purpose element to correspond to said second location of said graphical element.

107. In a computer system, a method for editing a hypermedia work comprising the steps of:

20 displaying a plurality of freely movable graphical elements representing a plurality of lexia of a hypermedia work on a display screen in a hypermedia work display window;

displaying a plurality of freely movable user configurable text labels in said hypermedia work display window.

25

108. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for creating a graphical element representing a set of data, said method comprising the steps of:

- 5       examining a set of data;  
          identifying a first parameter of said set of data;  
          generating a first representation corresponding to said first parameter;  
          incorporating said first representation in a graphical element  
representing said set of data.

10

109. The program storage device of claim 108 wherein said set of data comprises a lexia of a hypermedia work.

110. The program storage device of claim 108 wherein said set of data  
15 comprises data displayable on a display device and wherein said first  
parameter comprises a visual appearance of a portion of said data when  
displayed on said display device.

111. The program storage device of claim 108 wherein said method  
20 further comprises the steps of:  
          reexamining said set of data after a triggering event has occurred;  
          identifying any change to said first parameter of said set of data;  
          if a change to said first parameter has occurred, revising said first  
representation corresponding to said first parameter according to said change;  
25       incorporating said revised first representation in said graphical  
element representing said set of data.

112. The program storage device of claim 108 wherein said method further comprises the steps of:

identifying a second parameter of said set of data;

generating a second representation corresponding to said second  
5 parameter;

incorporating said second representation in said graphical element representing said set of data.

113. The program storage device of claim 108 wherein said method  
10 further comprises the steps of:

identifying a plurality of additional parameters of said set of data;

generating additional representations corresponding to said additional  
parameters;

incorporating said additional representations in said graphical element  
15 representing said set of data.

114. A program storage device readable by a machine, tangibly  
embodying a program of instructions executable by the machine to perform  
method steps for creating a link between a first lexia and a second lexia of a  
20 hypermedia work, said method comprising the steps of:

displaying said first lexia in a lexia display window on a display screen;

displaying a graphical element representing said second lexia in a  
hypermedia work display window on said display screen;

selecting a location for an activation area for said link in said lexia  
25 display window;

selecting said graphical element in said hypermedia work display  
window.

115. The program storage device of claim 114 wherein said method further comprises the steps of:

5 extracting a label for said link activation area from a data field of said  
lexia;  
displaying said label in said lexia display window.

116. The program storage device of claim 115 wherein said link activation area comprises said label.

10

117. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for displaying results of searching for data contained in a plurality of sets of data, said method comprising the steps of:

15 displaying a graphical element corresponding to each of a plurality of  
said sets of data on a display screen;

identifying each set of data comprising said searched for data by  
highlighting each of said graphical elements corresponding to each of said  
sets of data comprising said searched for data on said display screen.

20

118. The program storage device of claim 117 wherein said sets of data comprise lexia of a hypermedia work.

119. The program storage device of claim 117 wherein said method further comprises the steps of:

displaying a set of data comprising said searched for data on said display screen;

5 highlighting said searched for data of said set of data displayed on said display screen.

120. The program storage device of claim 118 wherein said searched for data comprises data representing a hypermedia link.

10

121. The program storage device of claim 118 wherein said graphical elements representing said lexia comprise lexia symbols displayed in a hypermedia work display window on said display screen.

15 122. The program storage device of claim 118 wherein said method step of displaying a graphical element corresponding to each of a plurality of said sets of data on a display screen comprises the step of:

displaying first graphical elements representing a first portion of the lexia of a hypermedia work in a first hypermedia work display window and

20 displaying second graphical elements representing a second portion of the lexia of a hypermedia work in a second hypermedia work display window.

123. The program storage device of claim 122 wherein said second portion comprises a portion of said first portion.

25

124. The program storage device of claim 123 wherein said first portion comprises all of the lexia of said hypermedia work.

125. A program storage device readable by a machine, tangibly embodying a program of instructions executable by the machine to perform method steps for editing a hypermedia work, said method comprising the  
5 steps of:

displaying a hypermedia work display window on a display screen;  
displaying a plurality of graphical elements comprising a first special function element in said hypermedia work display window;  
applying a first special function to graphical elements located within a  
10 first distance from said special function element.

126. The program storage device of claim 125 wherein said method step of applying said first special function to graphical elements located within a first distance from said first special function element comprises the  
15 step of applying said first special function to items represented by said graphical elements located within said first distance from said first special function element.

127. The program storage device of claim 126 wherein said  
20 hypermedia work comprises a plurality of lexia and wherein said plurality of graphical elements displayed in said hypermedia work display window comprise a plurality of lexia symbols representing lexia of said hypermedia work.

128. The program storage device of claim 127 wherein said method step of applying said first special function to graphical elements located within a first distance from said first special function element comprises the step of applying said first special function to lexia represented by lexia symbols located within said first distance from said first special function element.

129. The program storage device of claim 125 wherein said graphical elements located within a first distance from said first special function element comprise a second special function element and wherein said method step of applying said first special function to graphical elements located within a first distance from said first special function element comprises the step of applying said first special function to said second special function element.

15

130. The program storage device of claim 125 wherein said first special function comprises applying formatting to said graphical elements located within a first distance from said first special function element.

131. The program storage device of claim 125 wherein said first special function comprises creating links between said graphical elements located within said first distance from said first special function element.

20

132. The program storage device of claim 125 wherein said graphical elements located within a first distance from said first special function element comprise a lexia symbol representing a lexia and wherein said first special function comprises creating a link between said lexia and said second  
5 special function element.

133. The program storage device of claim 125 wherein said first special function comprises a plurality of special functions.

10 134. The program storage device of claim 125 wherein said first distance is zero.

135. The program storage device of claim 125 further comprising the step of moving said graphical symbols located within said first distance from  
15 said first special function element to said special function element.

136. The program storage device of claim 131 wherein said links created between said graphical elements located within said first distance from said first special function element correspond to relative positions of  
20 said graphical elements with respect to said first special function element.

137. The program storage device of claim 136 wherein said links created between said graphical elements located within said first distance from said first special function element comprise links between each of said  
25 graphical elements located within said first distance from said first special function element and each other of said graphical elements located within said first distance from said first special function element.

138. The program storage device of claim 137 in which said graphical elements located within said first distance from said first special purpose element comprise lexia symbols representing lexia of a hypermedia work and  
5 wherein said links created between said graphical elements located within said first distance from said first special function element are represented in said lexia by link activation areas.

139. The program storage device of claim 138 wherein said lexia  
10 comprise data fields and wherein said link activation areas comprise text labels extracted from said data fields.

140. The program storage device of claim 138 wherein said link activation areas comprise lists of link activation areas.  
15

141. The program storage device of claim 138 wherein said link activation areas comprise tables of link activation areas.

142. The program storage device of claim 125 wherein said method  
20 further comprises the steps of:

moving a graphical element from within said first distance from said first special purpose element to without said first distance from said first special purpose element;

undoing application of said first special function from said moved  
25 graphical element.

143. The program storage device of claim 136 wherein said method further comprises the steps of::

moving a graphical element located at a first location within said first distance from said first special purpose element to a second location within  
5 said first distance from said first special purpose element;

updating links created according to said first special purpose element to correspond to said second location of said graphical element.

144. A program storage device readable by a machine, tangibly  
10 embodying a program of instructions executable by the machine to perform method steps for editing a hypermedia work, said method comprising the steps of:

displaying a plurality of freely movable graphical elements  
representing a plurality of lexia of a hypermedia work on a display screen in a  
15 hypermedia work display window;

displaying a plurality of freely movable user configurable text labels in said hypermedia work display window.

CLAIMS

I claim:

1. A system for displaying images on a display means comprising:  
a first window displaying a portion of a first image on said display  
5 means;  
a first indicator displayed at a first position with respect to said first  
window, said first indicator being movable in two dimensions with respect to  
said first window;  
a first indicator control means for moving said first indicator from said  
10 first position with respect to said first window to a second position with  
respect to said first window;  
a second window displaying a portion of a second image on said  
display means, said second image comprising an image that is independent of  
said first image, said portion of said second image comprising less than a  
15 whole of said second image, said portion of said second image being  
determined by movement of said first indicator from said first position to  
said second position with respect to said first window such that a first portion  
of said second image is displayed in said second window when said first  
indicator is located at said first position with respect to said first window, a  
20 second portion of said second image is displayed in said second window  
when said first indicator is located at said second position with respect to said  
first window, and intermediate portions of said second image are displayed  
sequentially in said second window after said first portion is displayed in said  
second window and before said second portion is displayed in said second  
25 window.

2. The system of claim 1 wherein said portion of said first image displayed in said first window comprises a whole of said first image.

3. The system of claim 1 wherein said portion of said first image  
5 displayed in said first window comprises less than a whole of said first image.

4. The system of claim 1 wherein a content of said first image is thematically related to a content of said second image.

10 5. The system of claim 1 wherein said display means comprises a computer display.

6. The system of claim 1 wherein said first indicator comprises a highlighted region.

15

7. The system of claim 1 wherein said first indicator comprises an outline.

8. The system of claim 1 wherein said first indicator comprises an  
20 indicator having dimensions relative to said first image that correspond to dimensions of said second window relative to said second image.

9. The system of claim 1 further comprising:

a second indicator displayed at a position with respect to said second window;

a second indicator control means for controlling said position of said  
5 second indicator with respect to said second window;

a third window displaying a portion of a third image on said display means, said portion of said third image comprising less than a whole of said third image, said portion of said third image being determined by said position of said second indicator with respect to said second window.

10

10. The system of claim 9 wherein said third image is larger than said second image.

11. A system for displaying images on a display means comprising:  
a first window displaying a portion of a first image on said display  
means;  
a first indicator displayed at a first position with respect to said first  
5 window;  
a first indicator control means for controlling said first position of said  
first indicator with respect to said first window;  
a second window displaying a portion of a second image on said  
display means, said portion of said second image comprising less than a  
10 whole of said second image, said portion of said second image being  
determined by said first position of said first indicator;  
a second indicator displayed at a second position with respect to said  
second window;  
a second indicator control means for controlling said second position  
15 of said second indicator with respect to said second window;  
a third window displaying a portion of a third image on said display  
means, said portion of said third image comprising less than a whole of said  
third image, said portion of said third image being determined by said second  
position of said second indicator.

20

12. The system of claim 11 wherein said portion of said first image  
displayed in said first window comprises a whole of said first image.

13. The system of claim 11 wherein said portion of said first image  
25 displayed in said first window comprises less than a whole of said first image.

14. The system of claim 11 wherein said first image is independent of said second image and said third image.

15. The system of claim 11 wherein a content of said first image is thematically related to a content of said second image.

16. The system of claim 11 wherein a content of said second image is thematically related to a content of said third image.

17. The system of claim 14 wherein a content of said first image is thematically related to a content of said second image.

18. The system of claim 11 wherein said display means comprises a computer display.

19. The system of claim 11 wherein said first indicator comprises a highlighted region.

20. The system of claim 11 wherein said second indicator comprises a highlighted region.

21. The system of claim 11 wherein said first indicator comprises an outline.

22. The system of claim 11 wherein said second indicator comprises an outline.

23. The system of claim 11 wherein said first indicator comprises an indicator having dimensions relative to said first image that correspond to dimensions of said second window relative to said second image.

5 24. The system of claim 11 wherein said second indicator comprises an indicator having dimensions relative to said second image that correspond to dimensions of said third window relative to said third image.

25. A method for navigating images displayed on a display means  
10 comprising the steps of:

displaying in a first window on a display means a portion of a first image;

displaying a first indicator at a first position with respect to said first window, said first indicator being movable in two dimensions with respect to  
15 said first window;

displaying in a second window on said display means a first portion of a second image based on said first position of said first indicator with respect to said first window, said first portion of said second image comprising less than a whole of said second image;

20 moving by means of a first indicator control means said first indicator from said first position with respect to said first window to a second position with respect to said first window;

displaying a second portion of said second image in said second window based on said second position of said first indicator with respect to  
25 said first window after displaying intermediate portions of said second image in said second window between said first portion and said second portion of said second image.

26. The method of claim 25 wherein a content of said first image is thematically related to a content of said second image.

5 27. The method of claim 25 wherein said display means comprises a computer display.

28. The method of claim 25 wherein said first indicator comprises a highlighted region.

10

29. The method of claim 25 wherein said first indicator comprises an outline.

30. The method of claim 25 wherein said first indicator comprises  
15 an indicator having dimensions relative to said first image that correspond to dimensions of said second window relative to said second image.

31. The method of claim 25 further comprising the steps of:  
designating a minimum increment of movement of said first indicator  
20 that will result in a change in the portion of said second image displayed in said second window;

displaying in said second window a predetermined number of said intermediate portions of said second image for each increment of movement of said first indicator equal to said minimum increment.

25

32. The method of claim 31 in which said first image comprises a bitmapped image and said minimum increment is equal to one pixel.

33. The method of claim 31 in which said predetermined number of intermediate portions is dependent upon the relative sizes of said first and second images.

5

34. The method of claim 25 further comprising the steps of:  
displaying a second indicator at a position with respect to said second window;

controlling by means of a second indicator control means said position  
10 of said second indicator with respect to said second window;

displaying in a third window on said display means a portion of a third image based on said position of said second indicator, said portion of said third image comprising less than a whole of said third image.

35. A method for navigating images displayed on a display means comprising the steps of:

displaying in a first window on said display means a portion of a first image;

5 displaying a first indicator at a first position with respect to said first window;

controlling by means of a first indicator control means said first position of said first indicator with respect to said first window;

10 displaying in a second window on said display means a portion of a second image based on said first position of said first indicator with respect to said first image, said portion of said second image comprising less than a whole of said second image;

displaying a second indicator at a second position with respect to said second window;

15 controlling by means of a second indicator control means said second position of said second indicator with respect to said second window;

20 displaying in a third window on said display means a portion of a third image based on said second position of said second indicator with respect to said second image, said portion of said third image comprising less than a whole of said third image.

36. The method of claim 35 wherein said first image is independent of said second image and said third image.

25 37. The method of claim 35 wherein said display means comprises a computer display.

38. The method of claim 35 wherein said first indicator comprises an indicator having dimensions relative to said first image that correspond to dimensions of said second window relative to said second image.

5 39. The method of claim 35 wherein said second indicator comprises an indicator having dimensions relative to said second image that correspond to dimensions of said third window relative to said third image.

40. The method of claim 25 further comprising the steps of:  
10 associating a first data item with a section of said first image;  
displaying a first icon representing said first data item in said first window when said portion of said first image displayed in said first window comprises said section of said first image with which said first data item is associated.

15 41. The method of claim 25 further comprising the steps of:  
associating a data item with a section of said second image;  
displaying an icon representing said data item in said second window when said portion of said second image displayed in said second window  
20 comprises said section of said second image with which said data item is associated.

42. The method of claim 40 further comprising the steps of:  
associating said first data item with a section of said second image;

displaying a second icon representing said first data item in said second  
5 window when said portion of said second image displayed in said second  
window comprises said section of said second image with which said first  
data item is associated.

43. The method of claim 42 wherein said first icon is different from  
10 said second icon.

44. The method of claim 43 further comprising the steps of:  
displaying a first set of data when said first icon is selected; and  
displaying a second set of data when said second icon is selected.

15

45. The method of claim 44 wherein said first set of data is not  
identical to said second set of data.

46. The method of claim 35 further comprising the steps of:  
20 associating a first data item with a section of said first image;  
displaying a first icon representing said first data item in said first  
window when said portion of said first image displayed in said first window  
comprises said section of said first image with which said first data item is  
associated.

25

47. The method of claim 35 further comprising the steps of:  
associating a data item with a section of said second image;  
displaying an icon representing said data item in said second window  
when said portion of said second image displayed in said second window  
5 comprises said section of said second image with which said data item is  
associated.

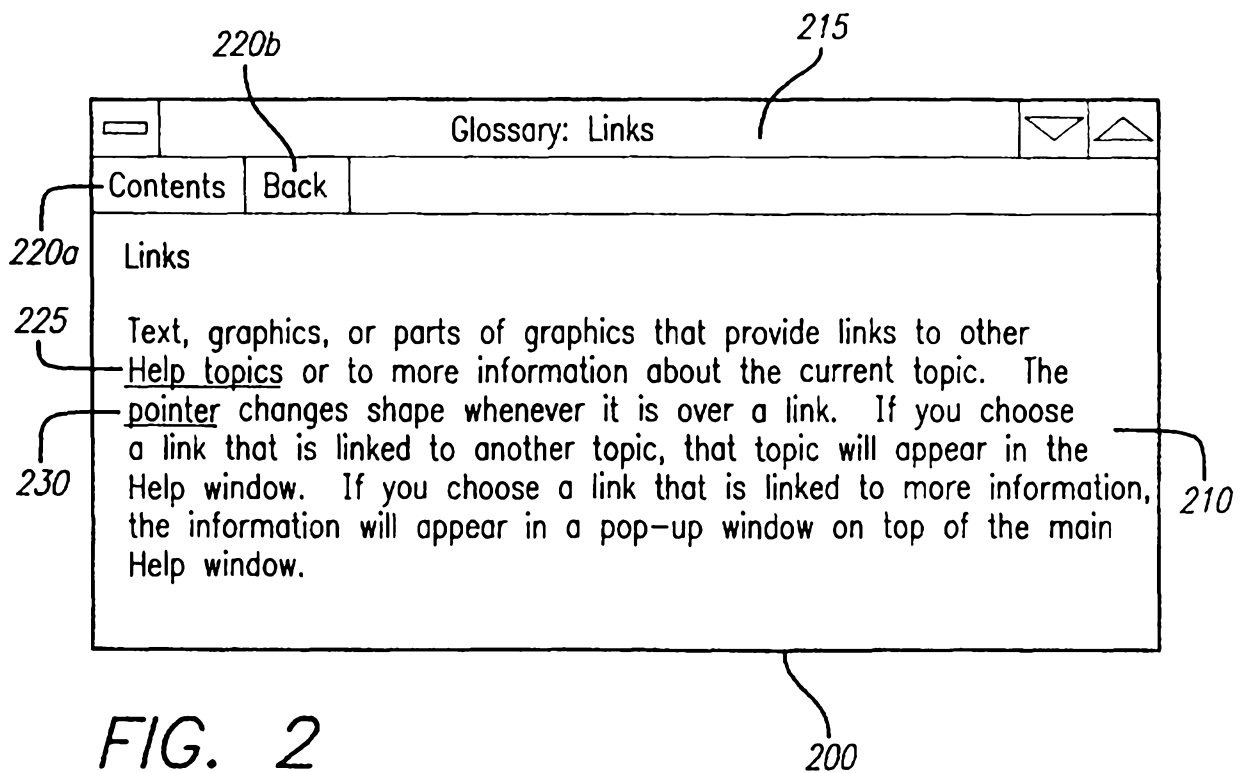
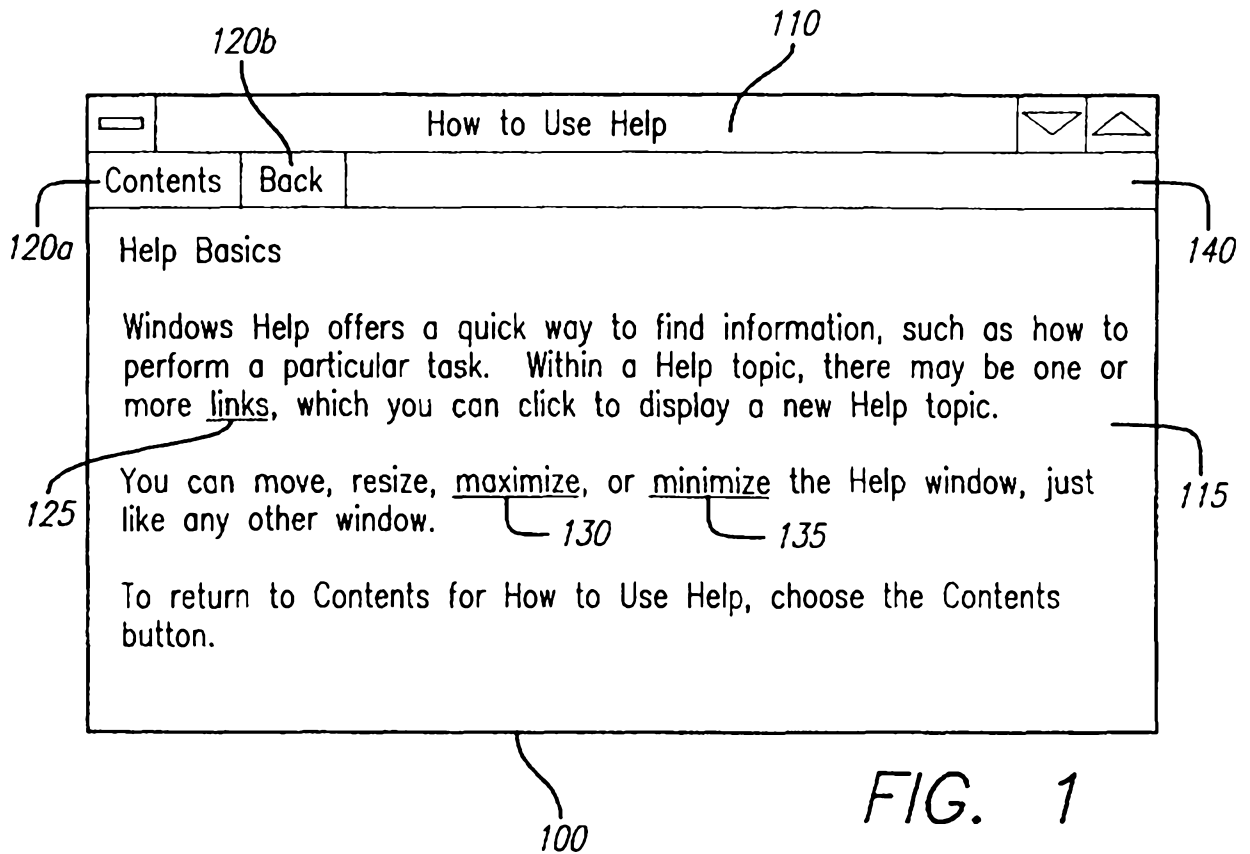
48. The method of claim 46 further comprising the steps of:  
associating said first data item with a section of said second image;  
10 displaying a second icon representing said first data item in said second  
window when said portion of said second image displayed in said second  
window comprises said section of said second image with which said first  
data item is associated.

15 49. The method of claim 48 wherein said first icon is different from  
said second icon.

20 50. The method of claim 48 further comprising the steps of:  
displaying a first set of data when said first icon is selected; and  
displaying a second set of data when said second icon is selected.

25 51. The method of claim 50 wherein said first set of data is not  
identical to said second set of data.

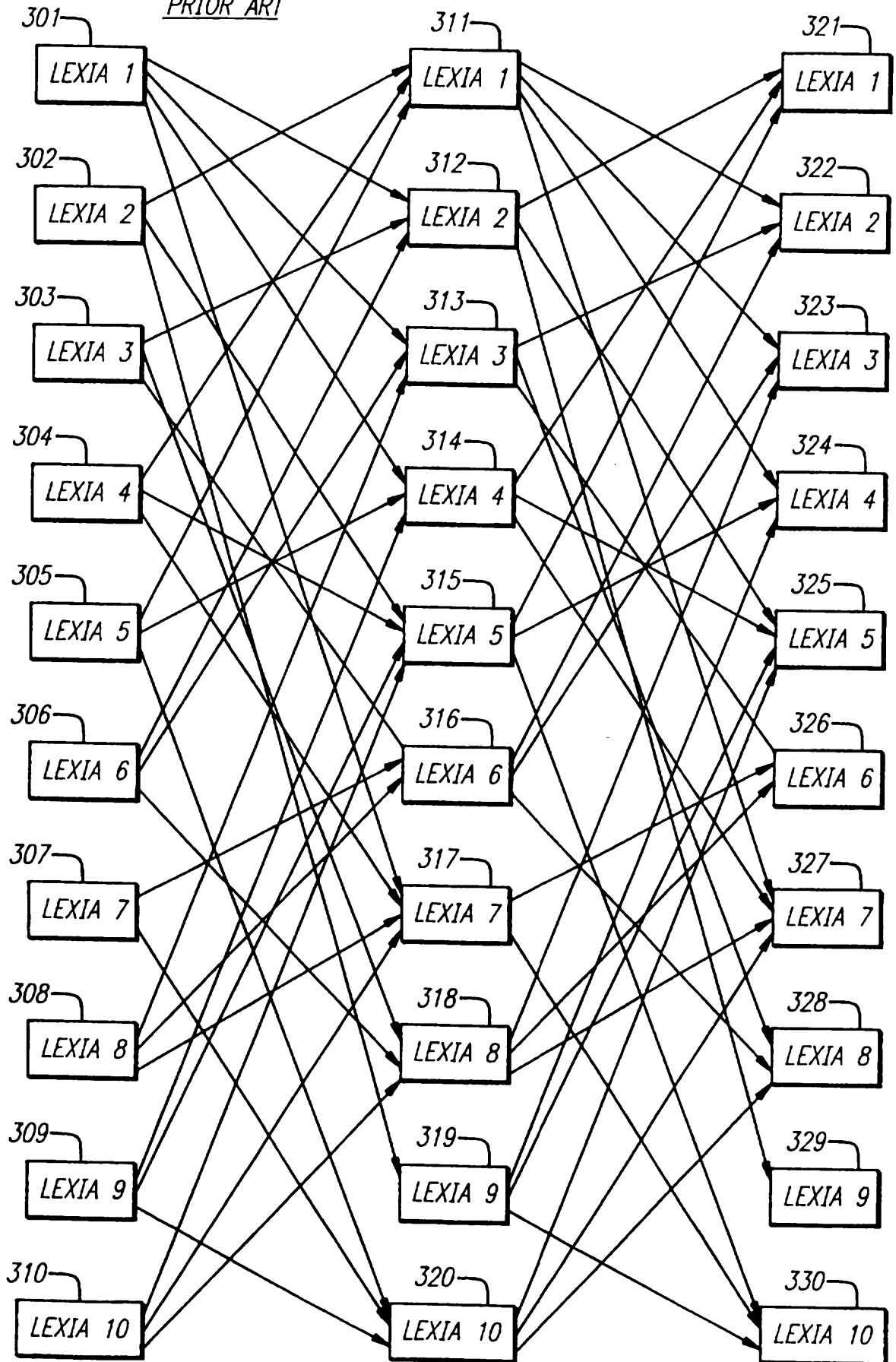
1/29



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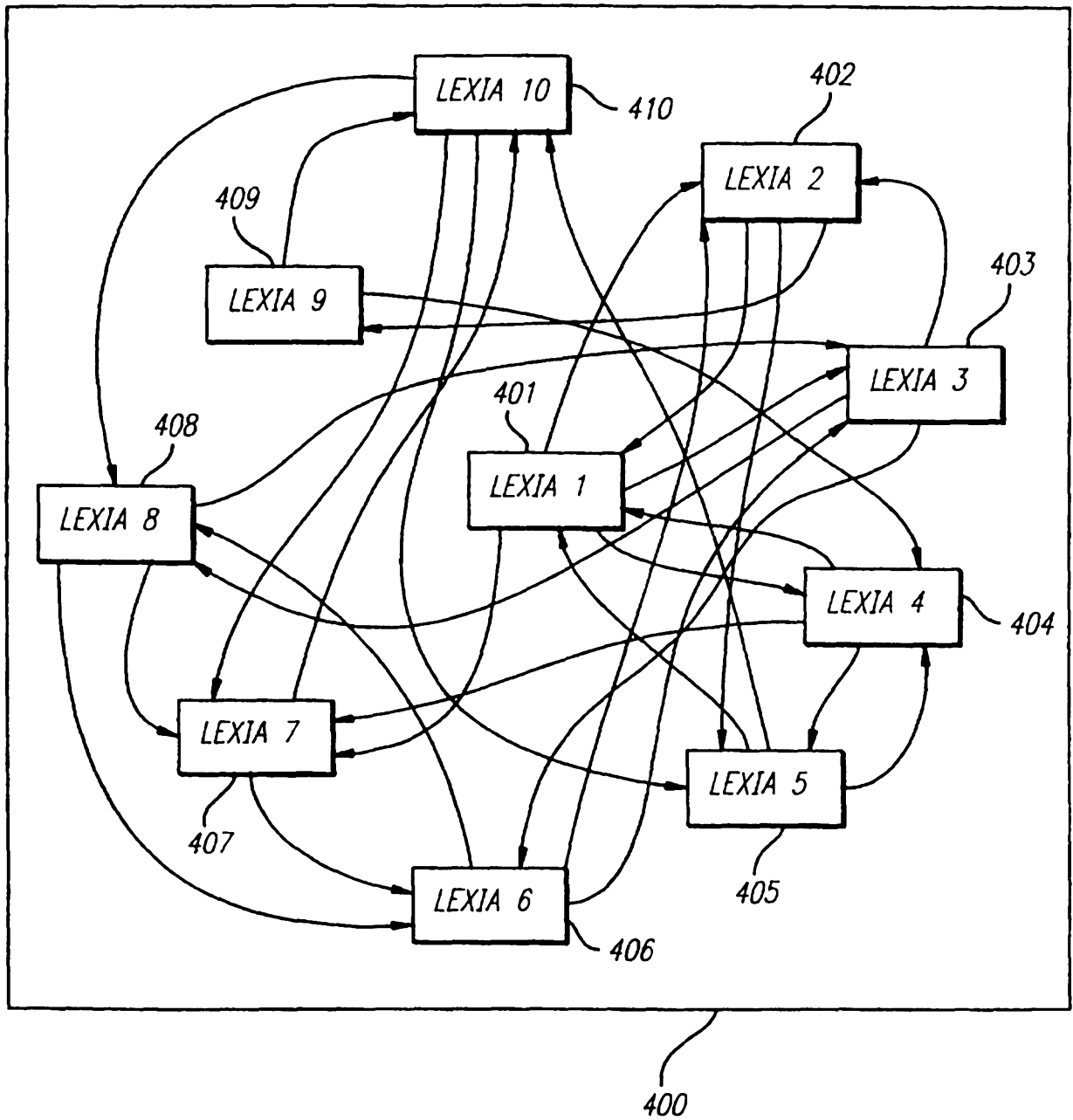
FIG. 3

PRIOR ART



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FIG. 4  
PRIOR ART



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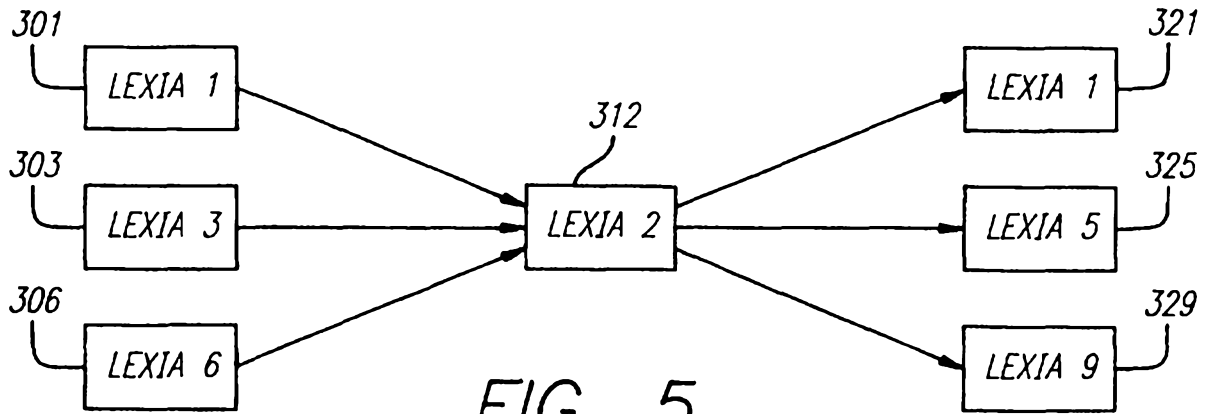
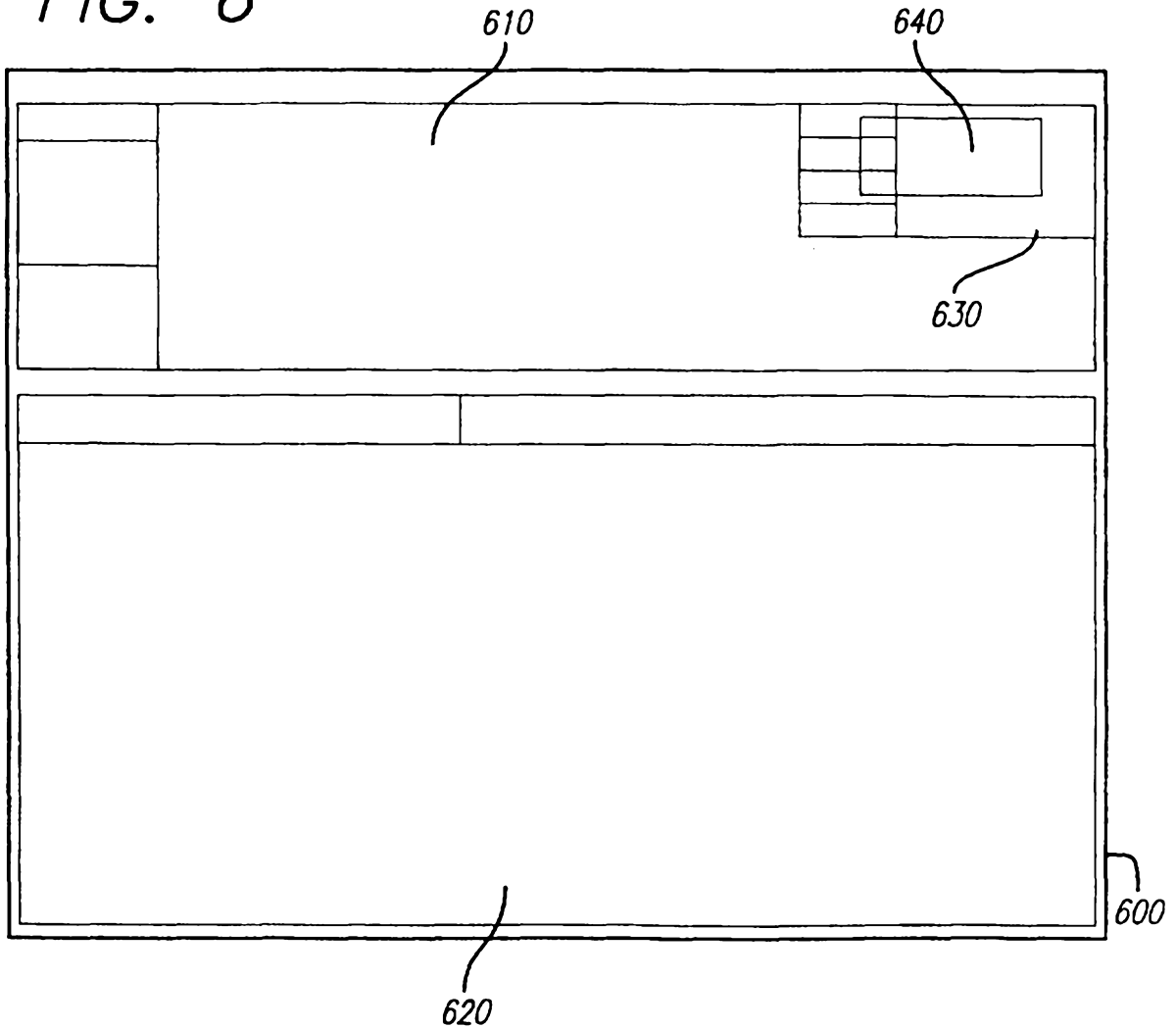


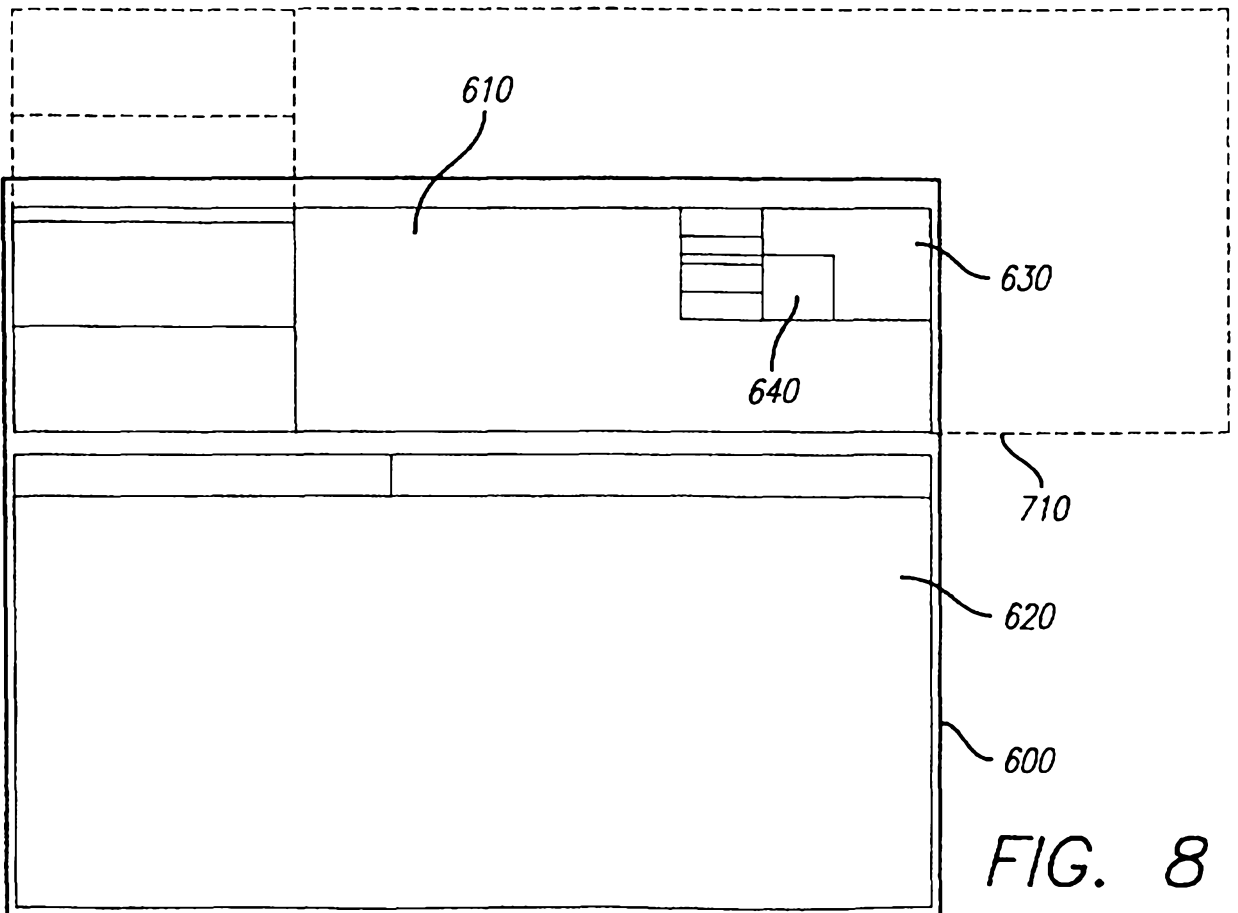
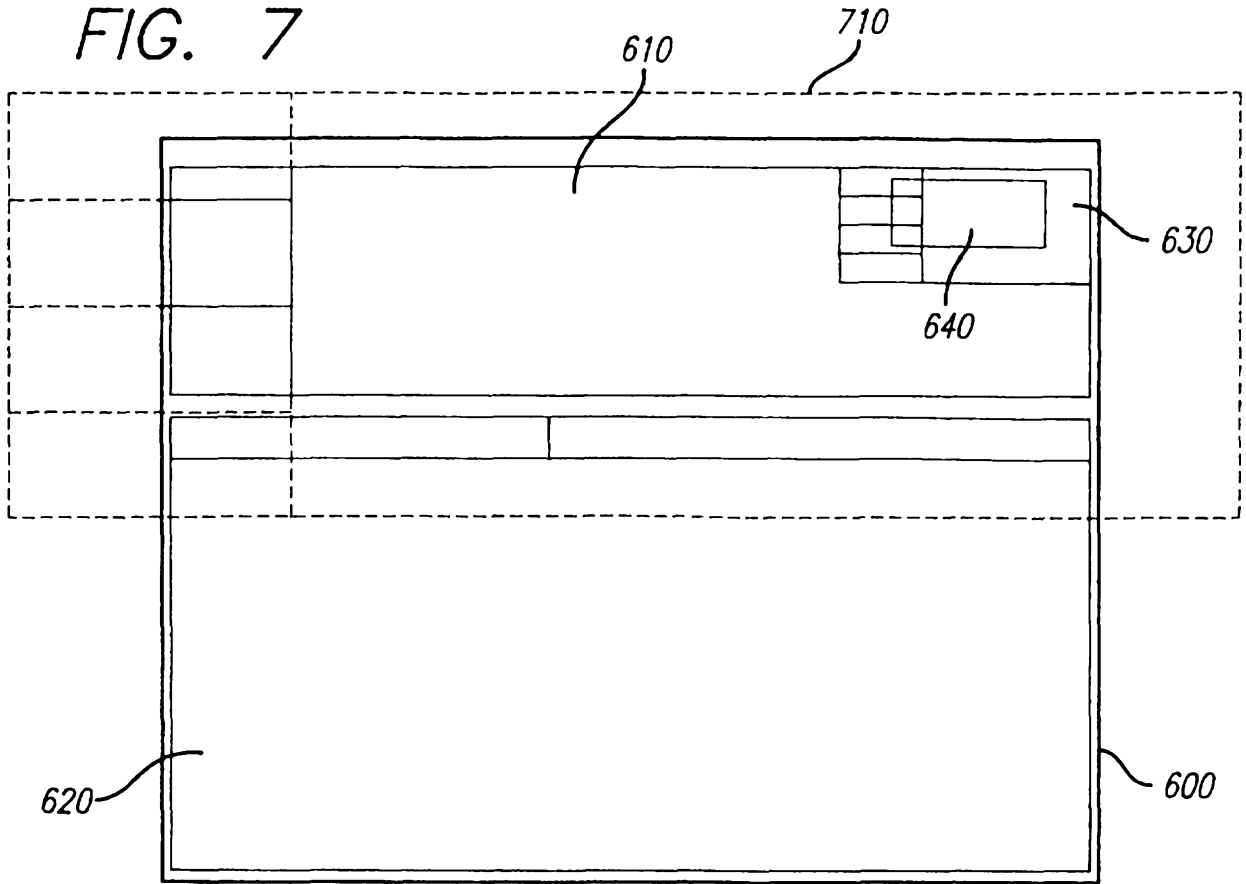
FIG. 5  
PRIOR ART

FIG. 6



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FIG. 7



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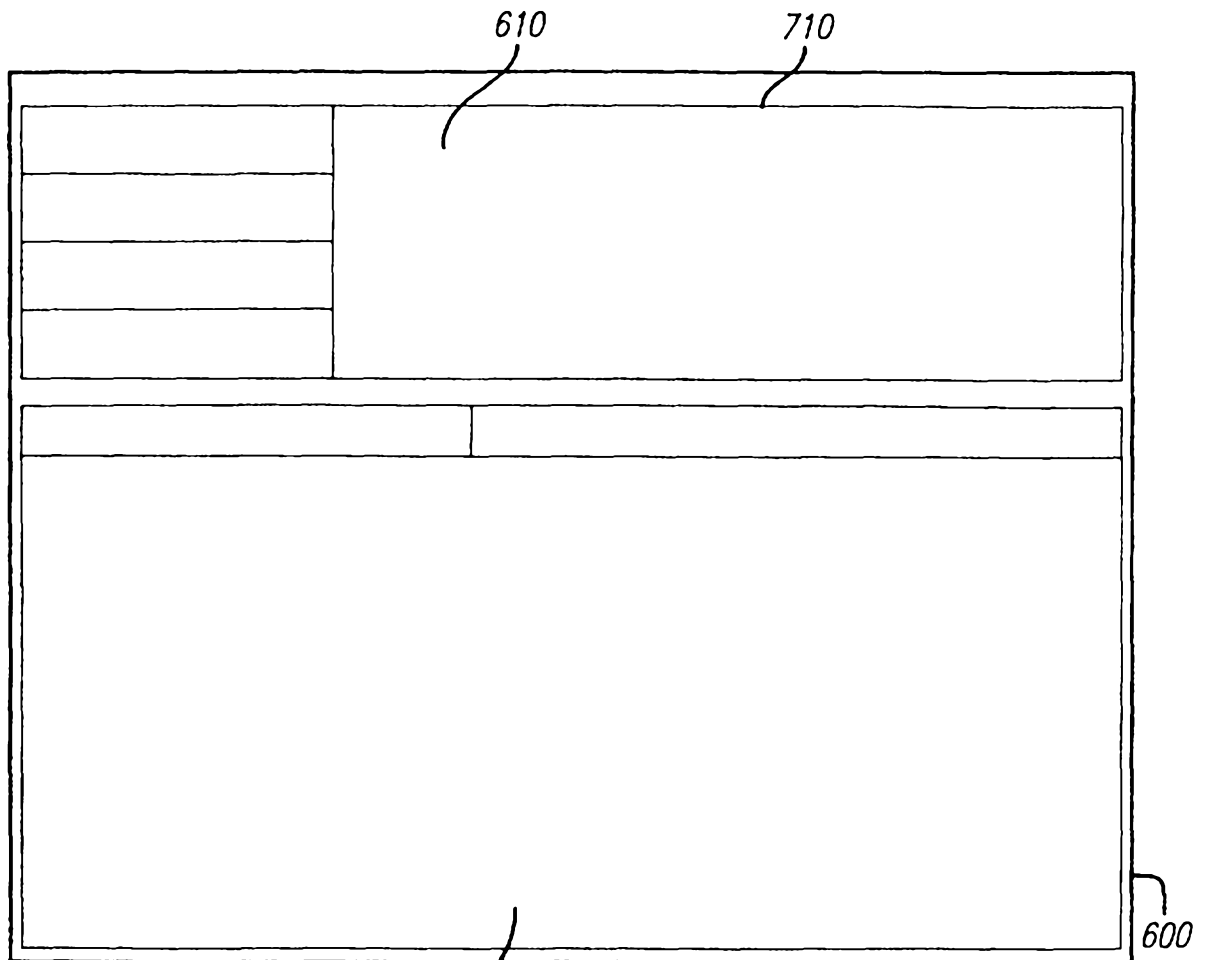


FIG. 9

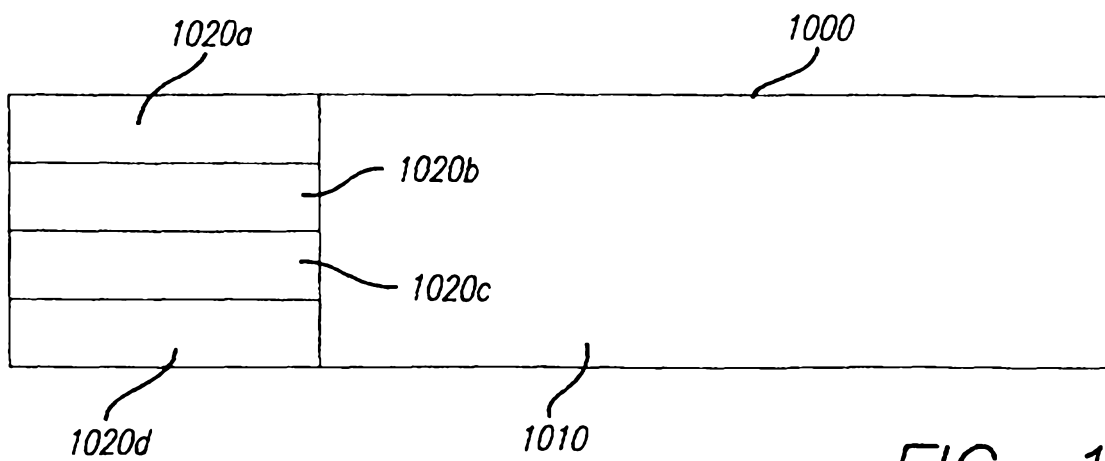


FIG. 10

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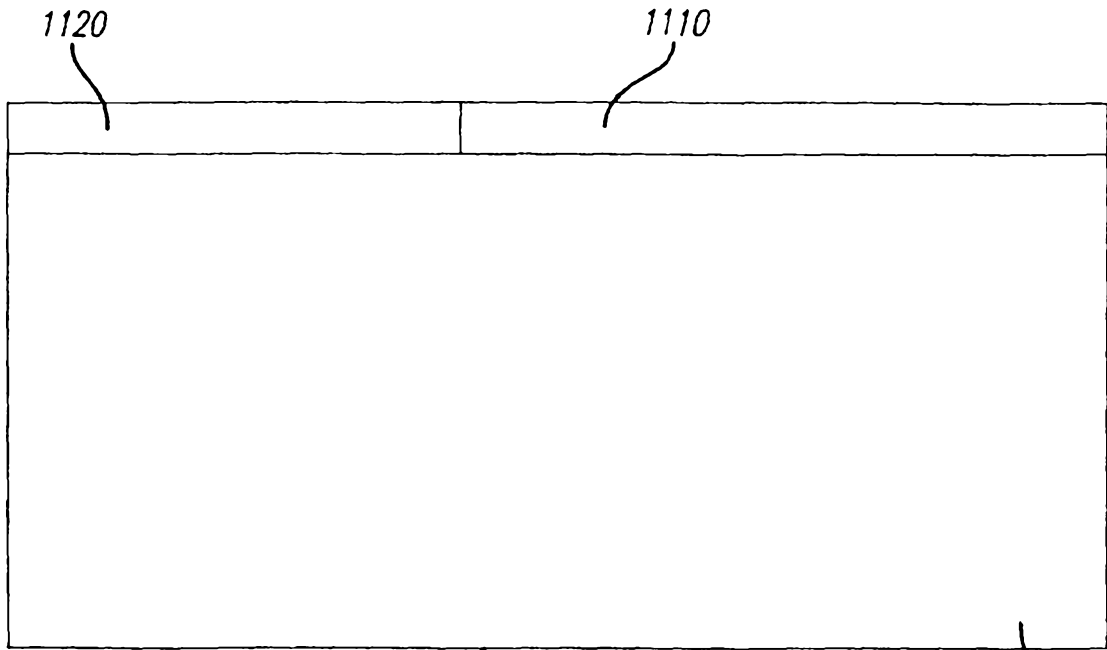


FIG. 11

1100

1130

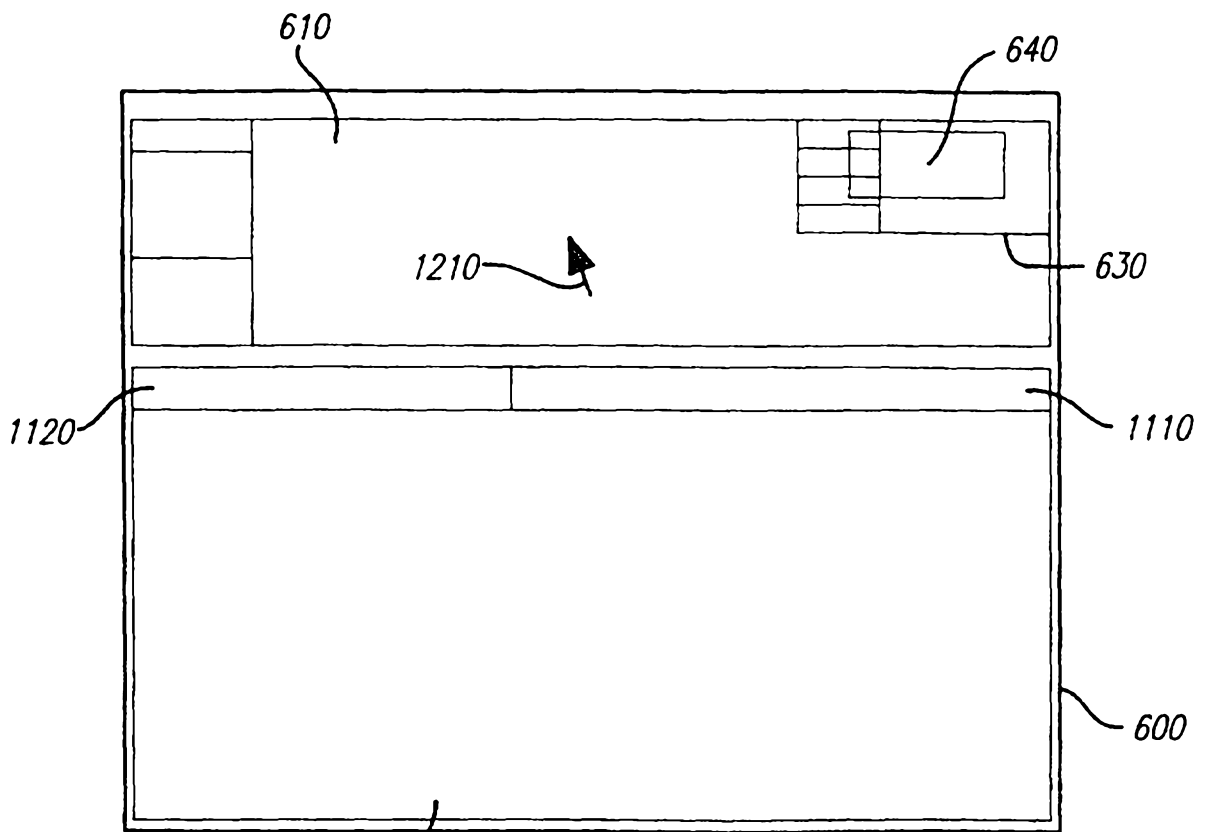


FIG. 12a

1130

600

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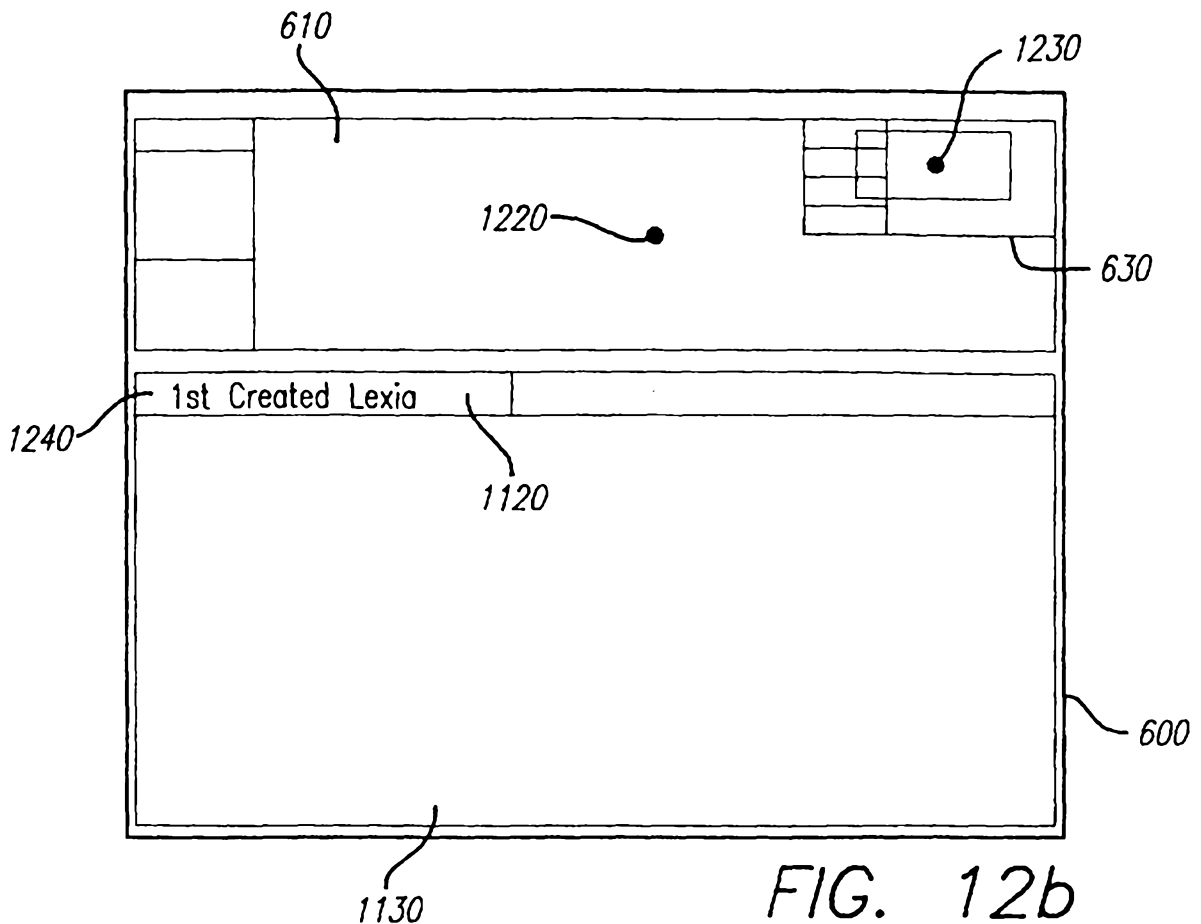


FIG. 12b

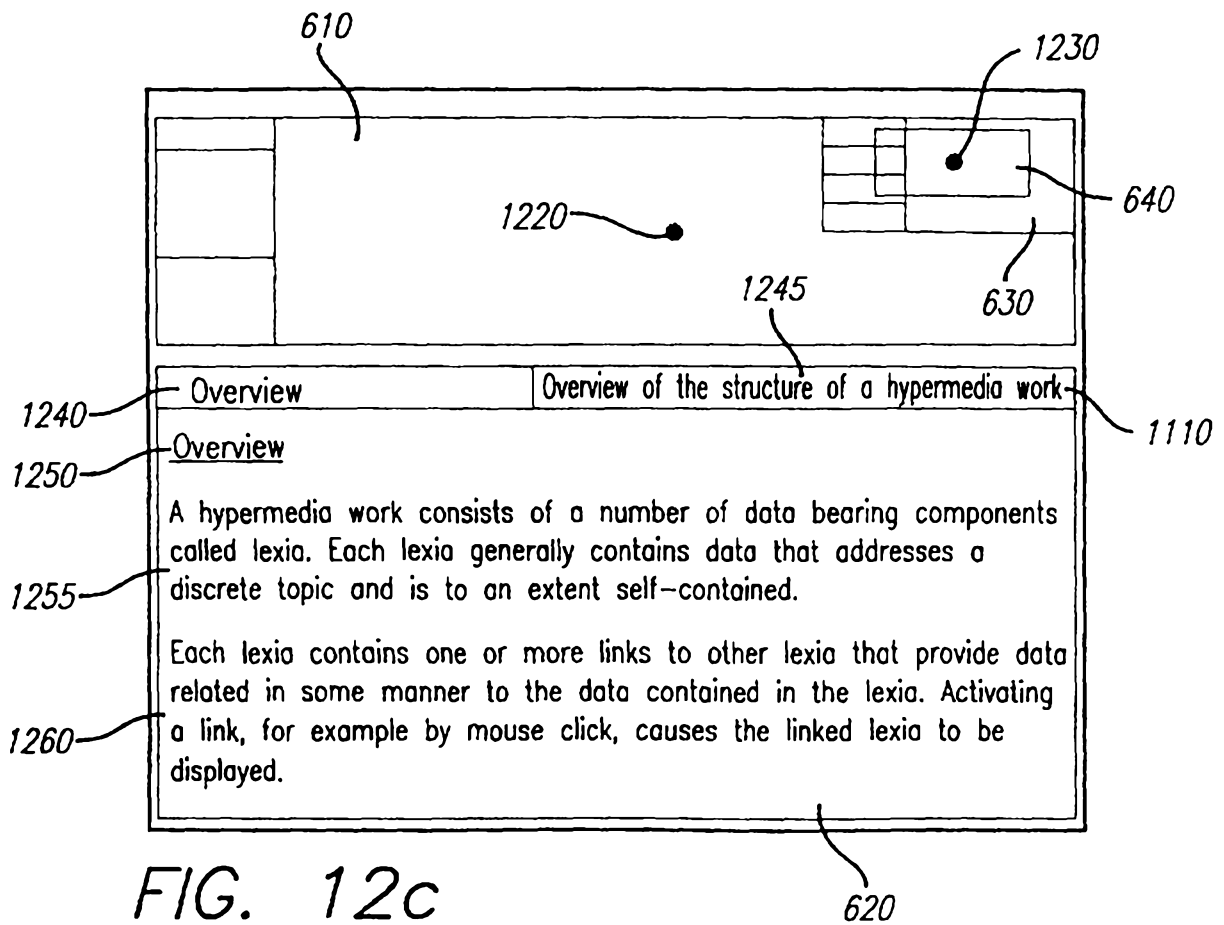


FIG. 12c

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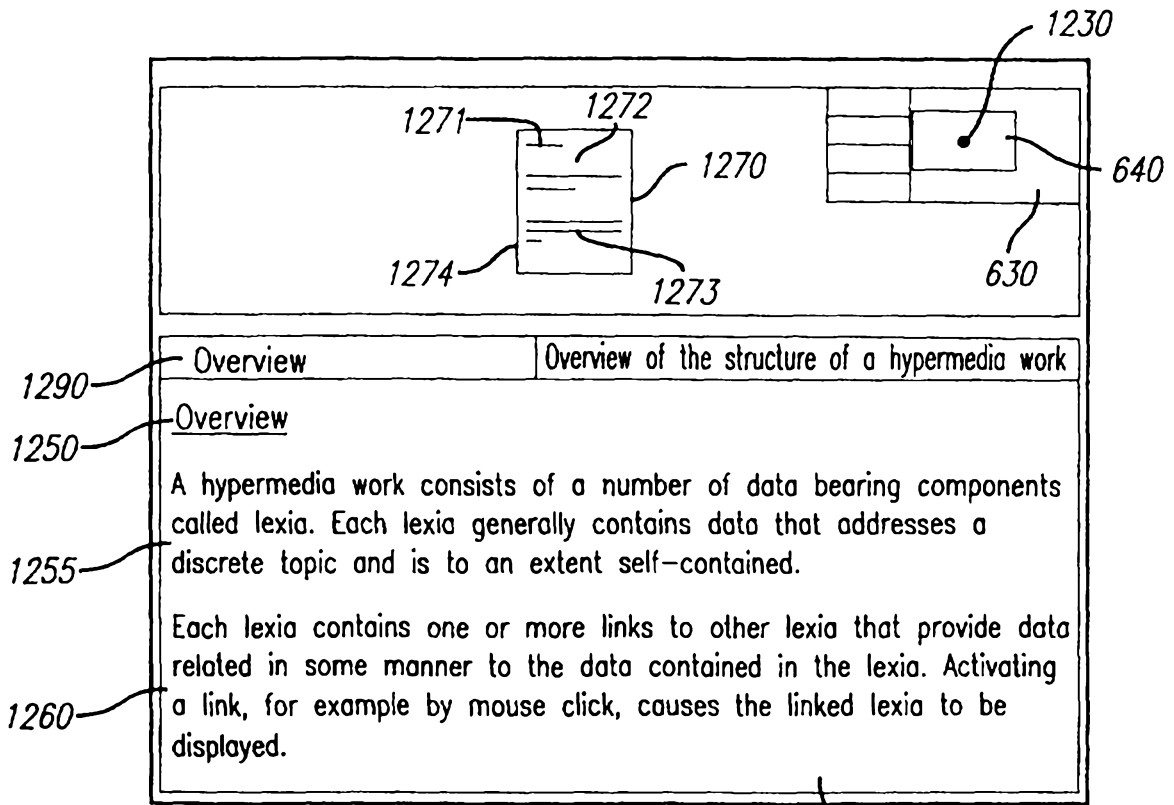


FIG. 12d

620

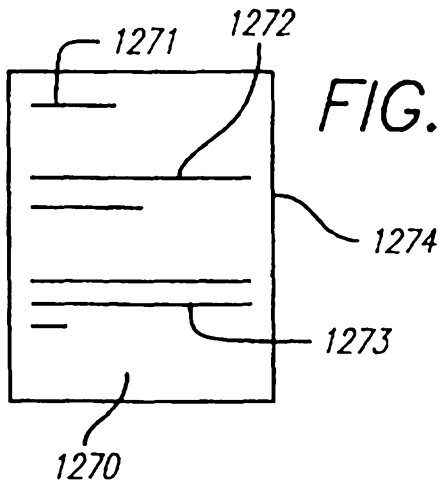


FIG. 13a

FIG. 13b

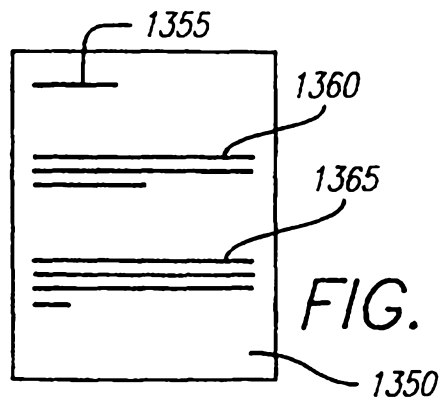
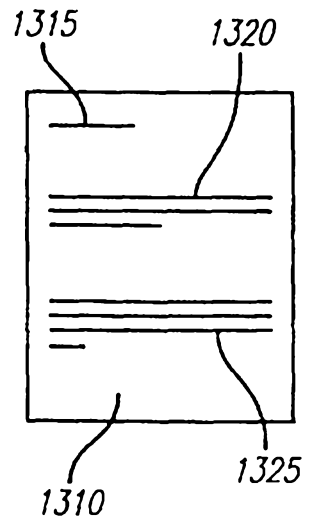


FIG. 13c

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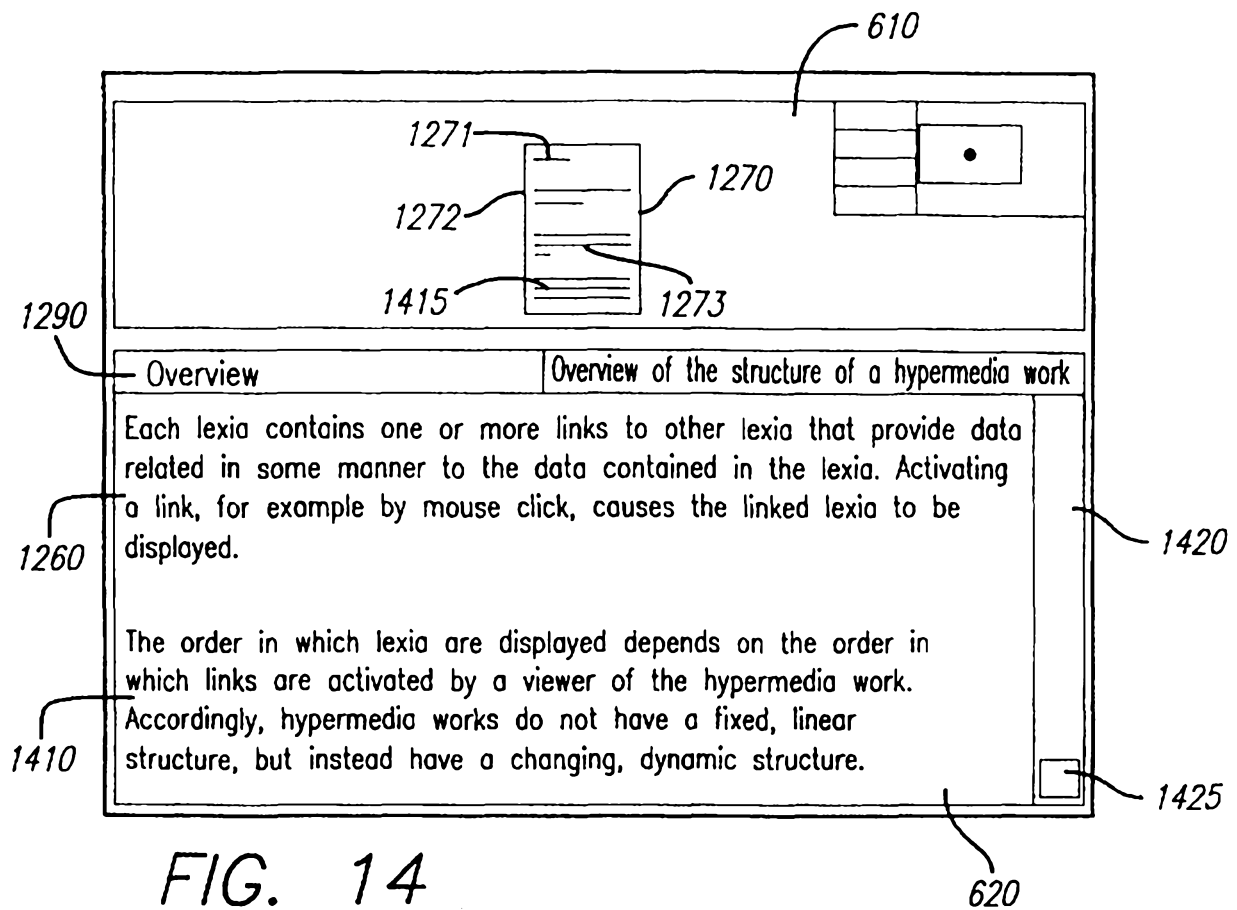


FIG. 14

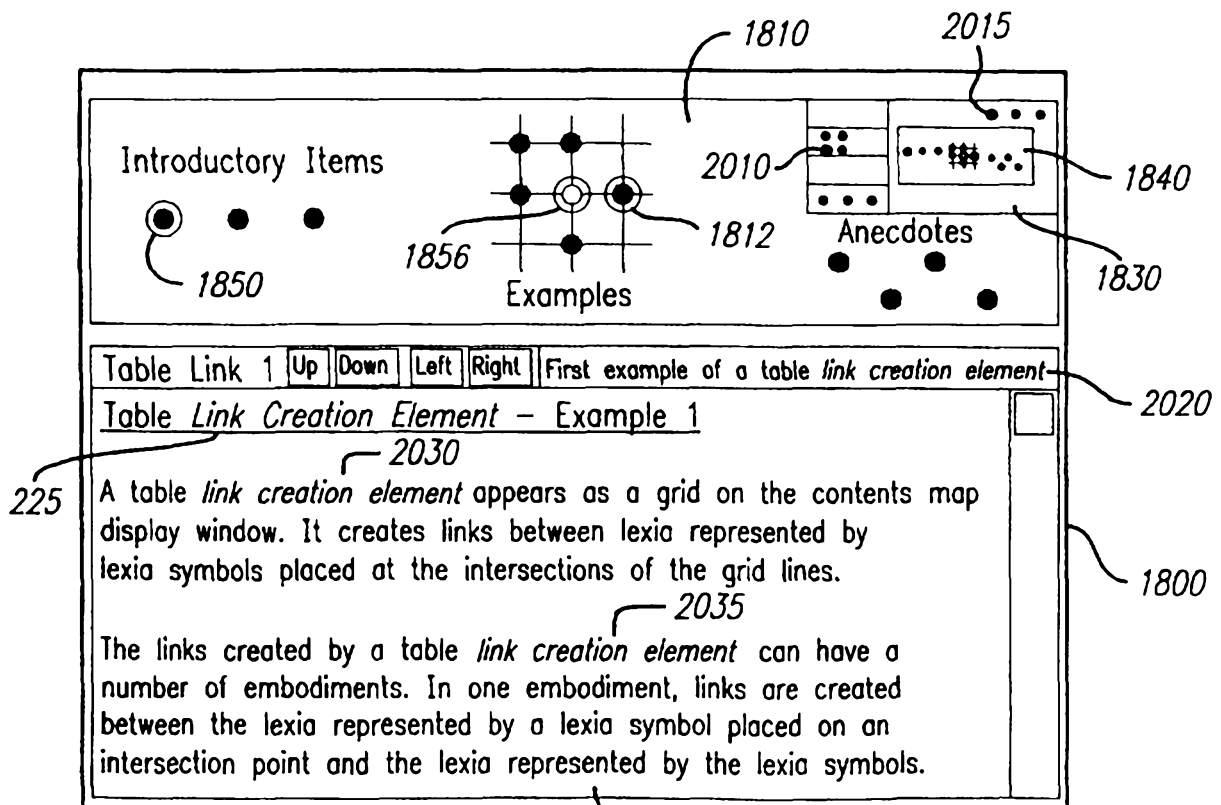


FIG. 20

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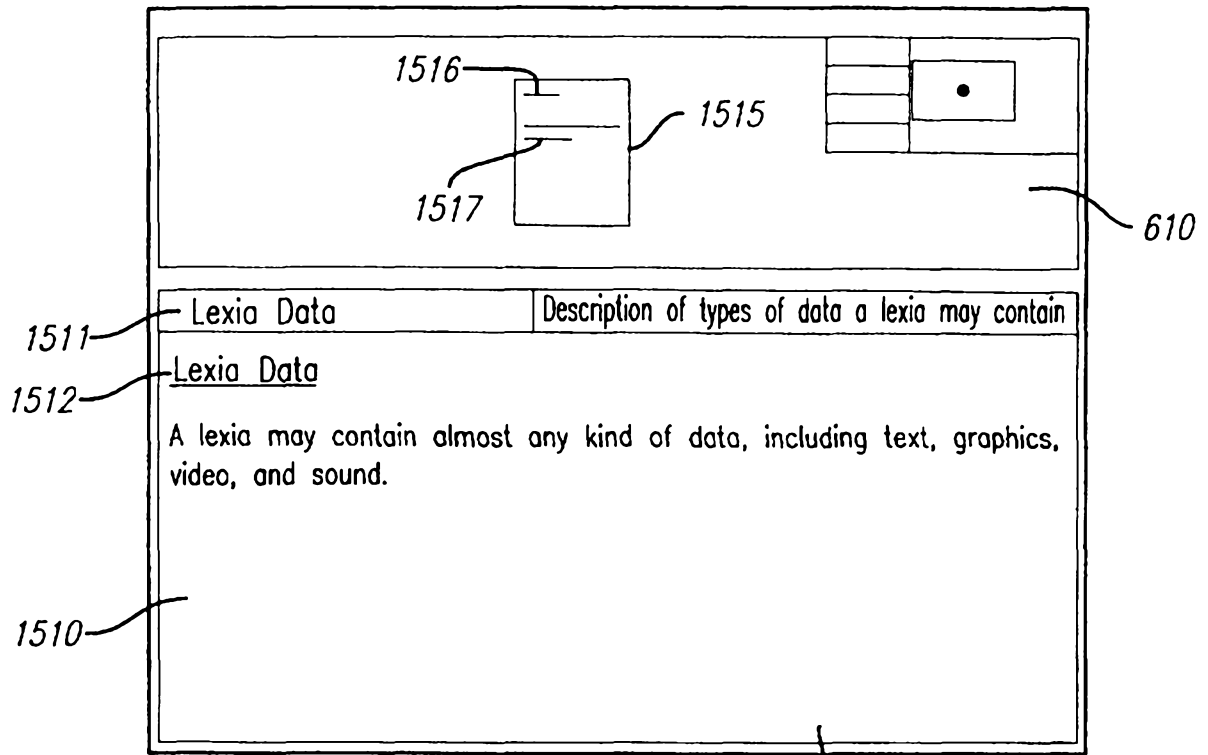


FIG. 15a

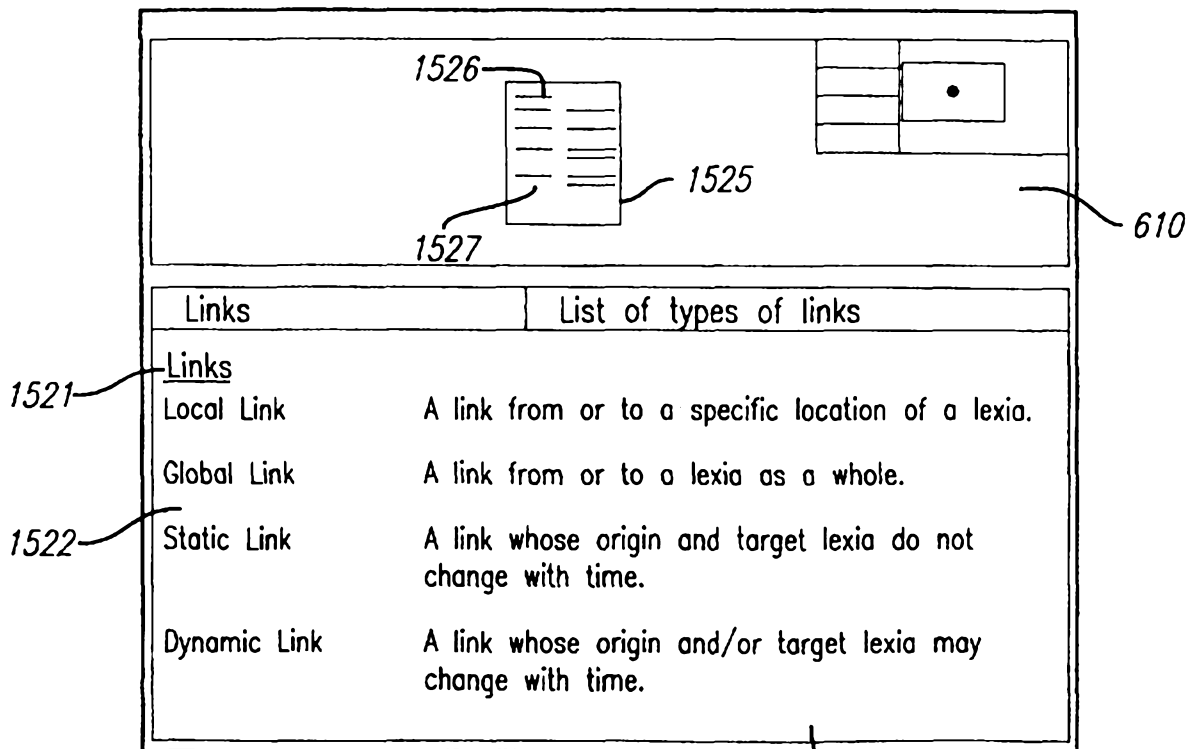


FIG. 15b

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FIG. 16a

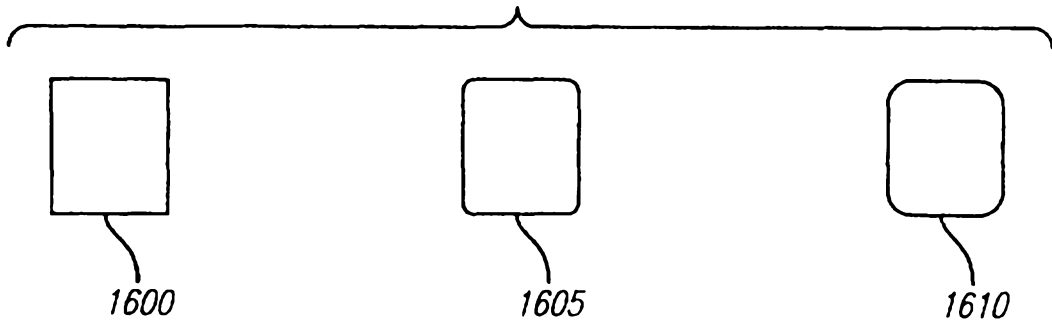


FIG. 16b

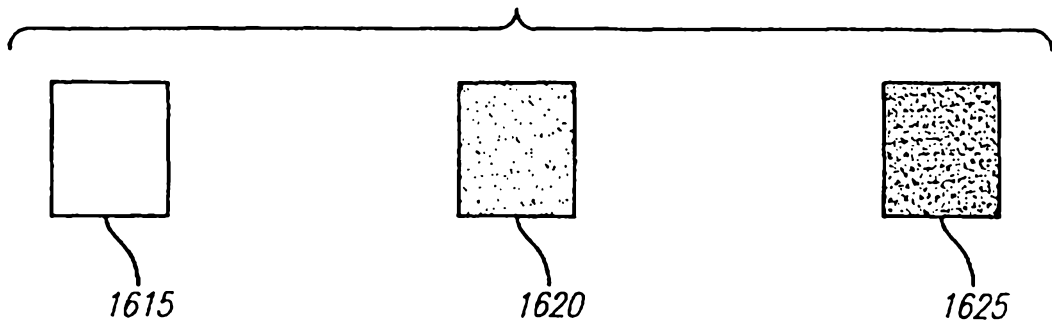


FIG. 16c

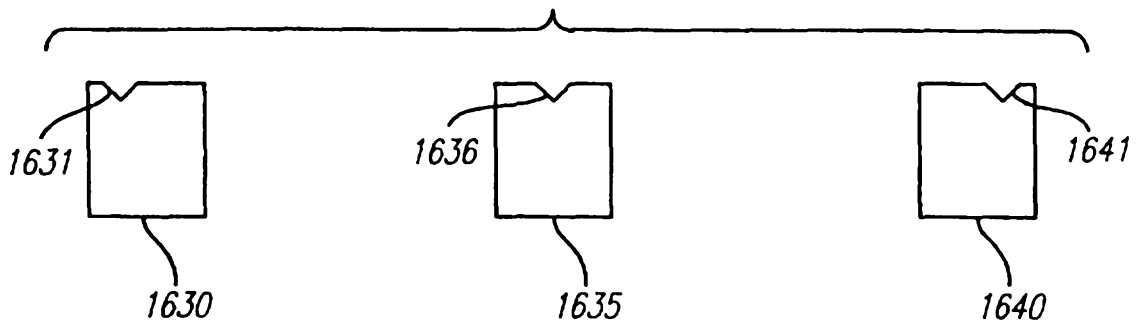
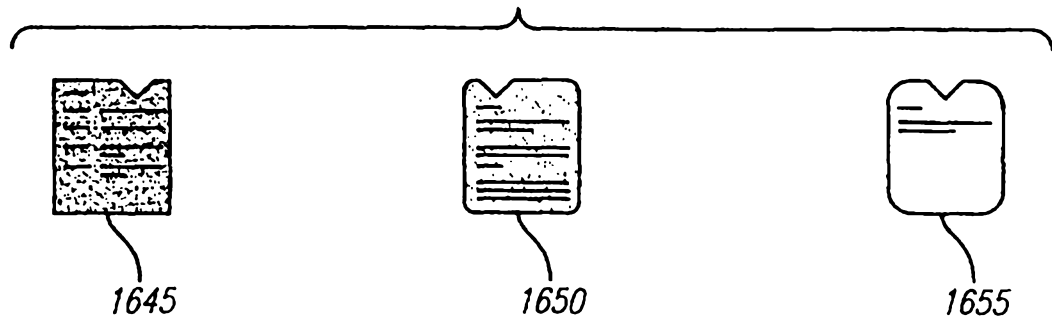


FIG. 16d



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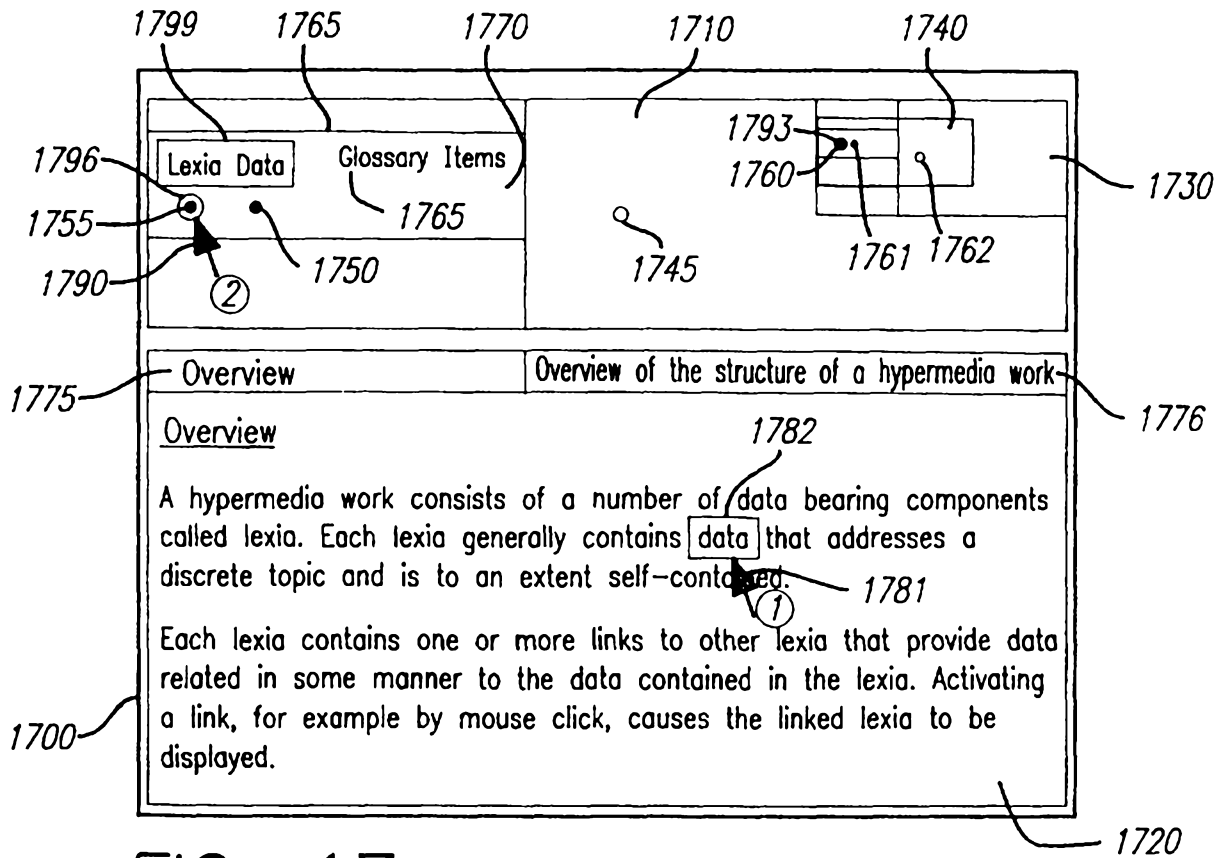


FIG. 17a

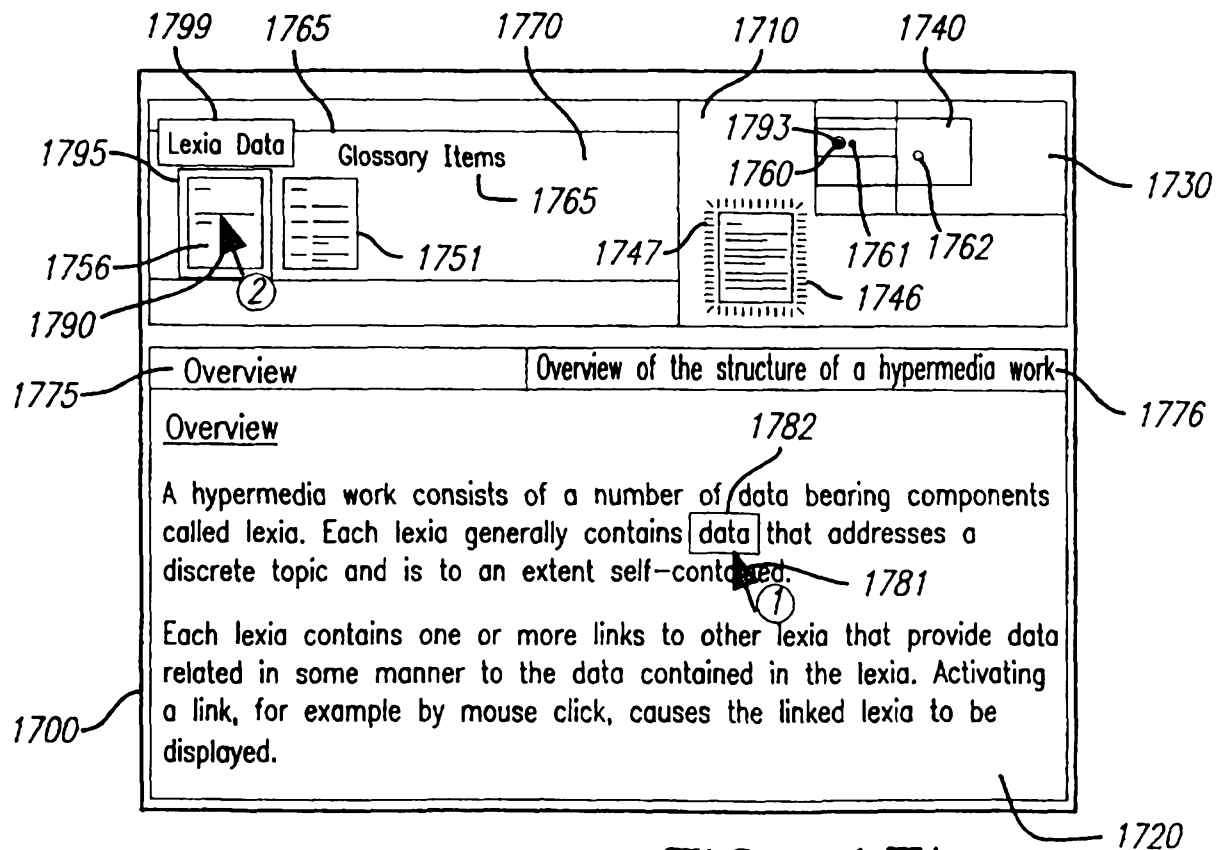


FIG. 17b

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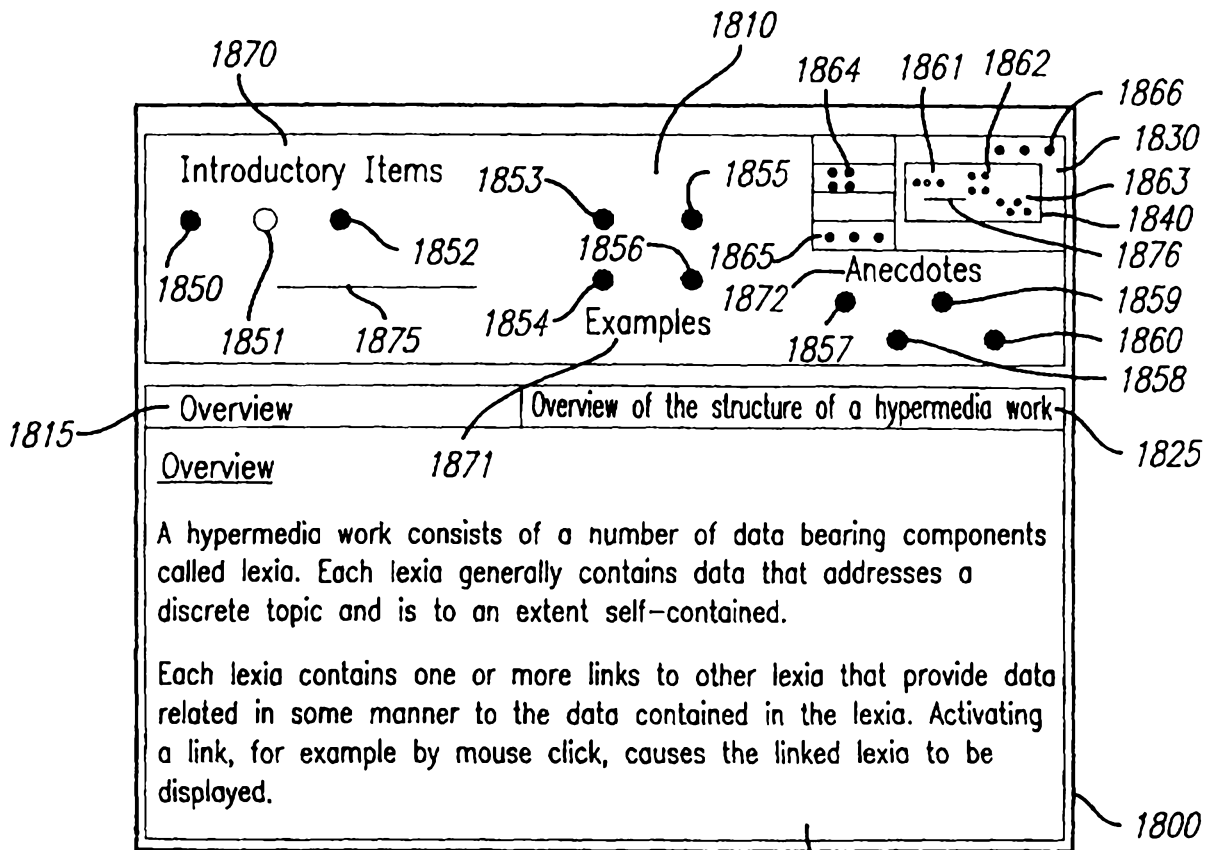


FIG. 18a

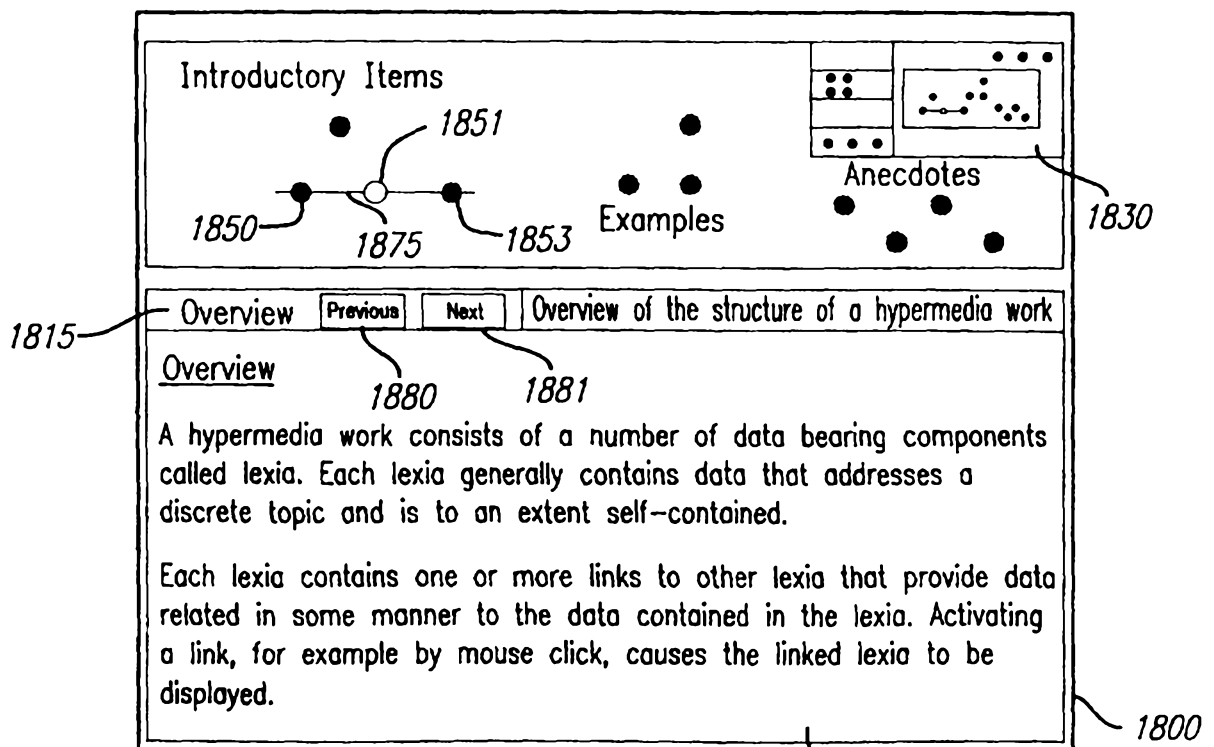


FIG. 18b

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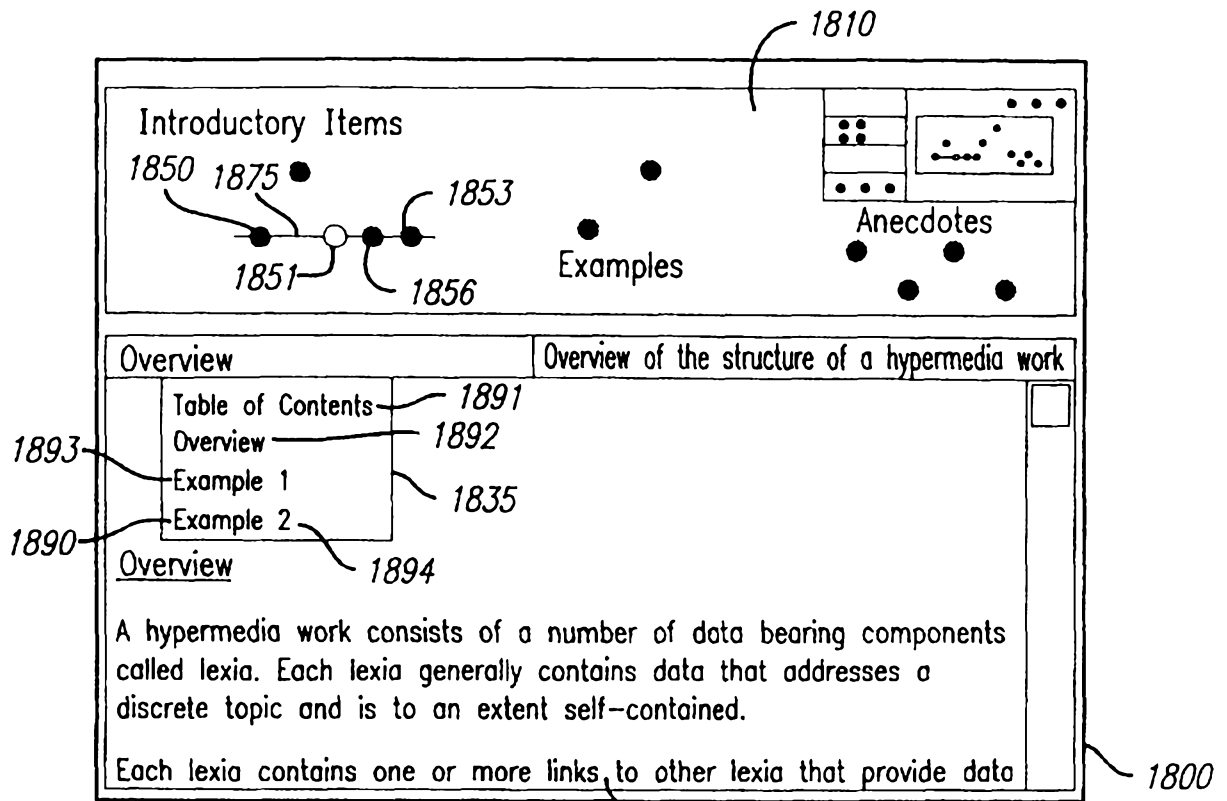


FIG. 18c

1820

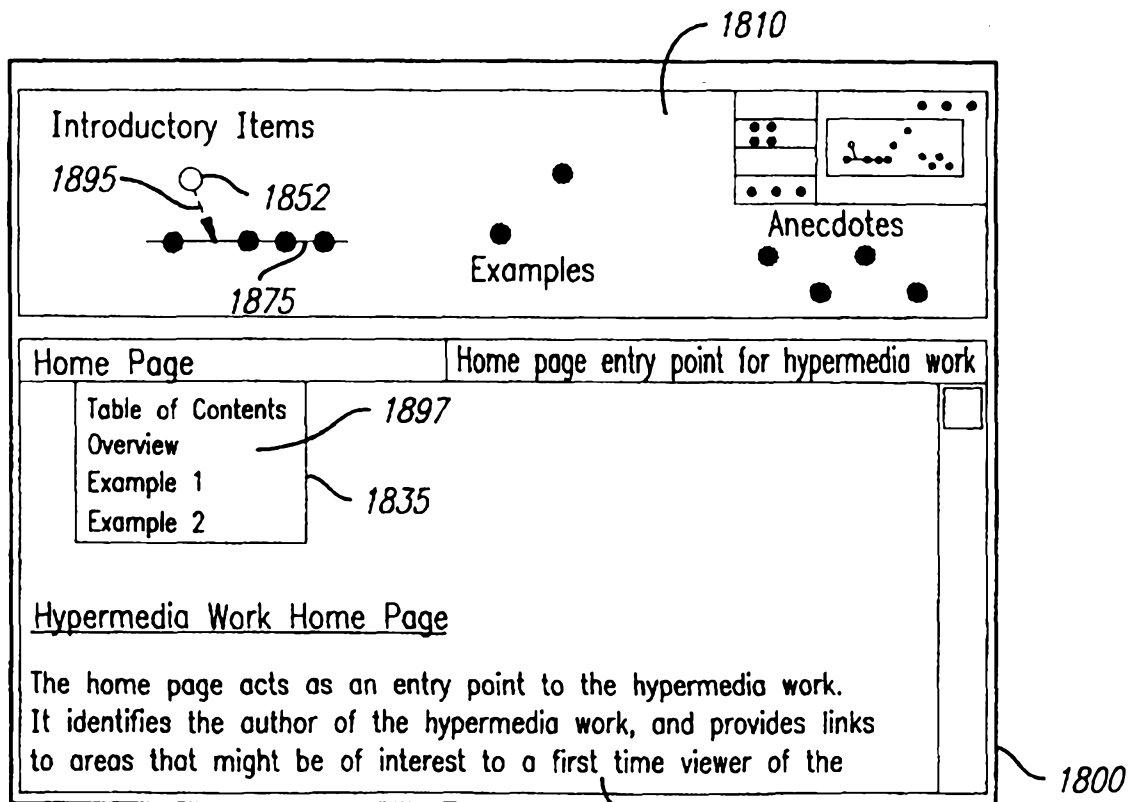


FIG. 18d

1820

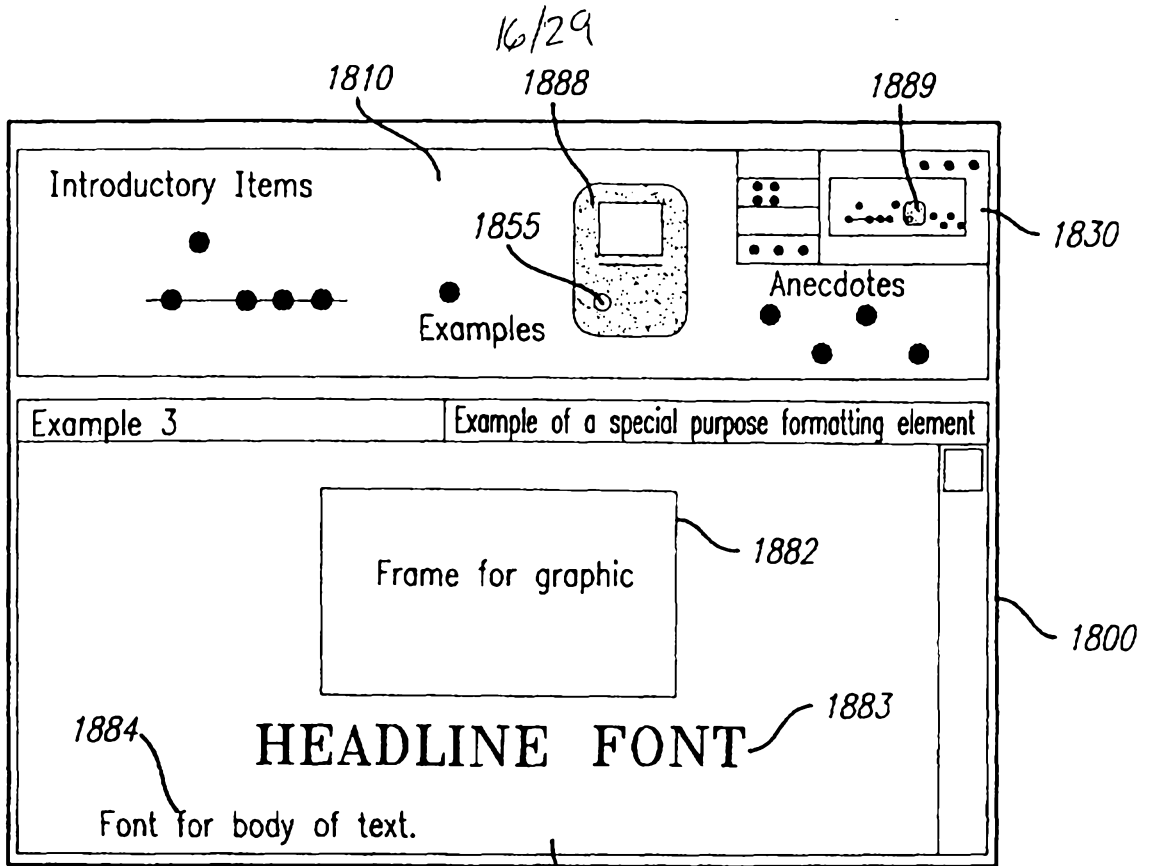


FIG. 18e

1820

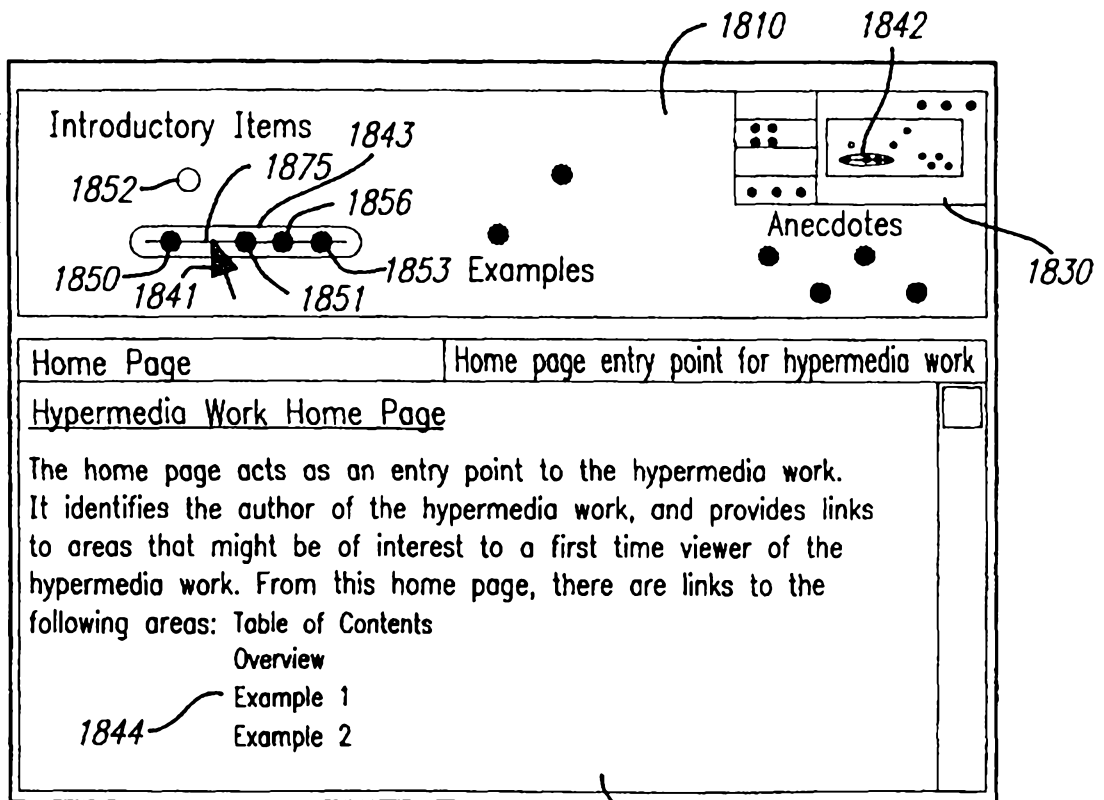


FIG. 18f

1820

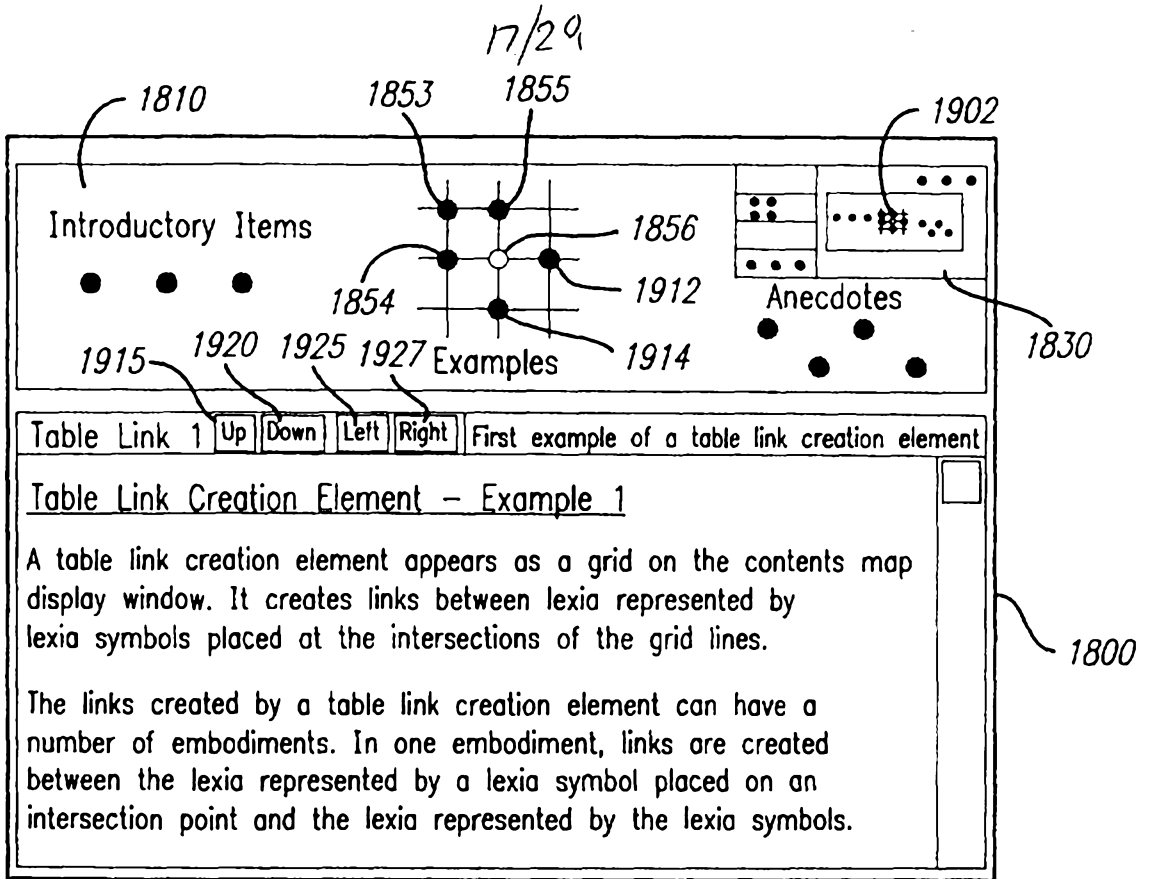


FIG. 19a

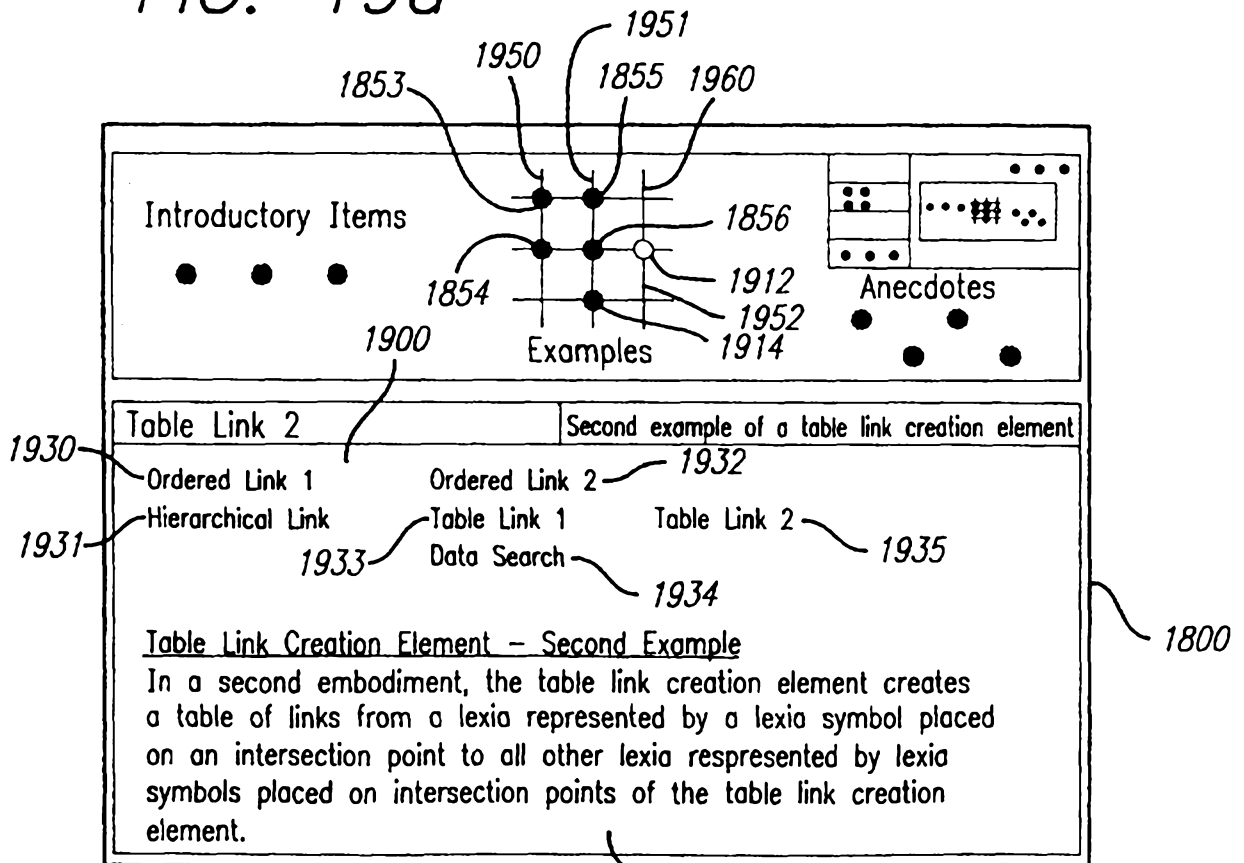


FIG. 19b

1820

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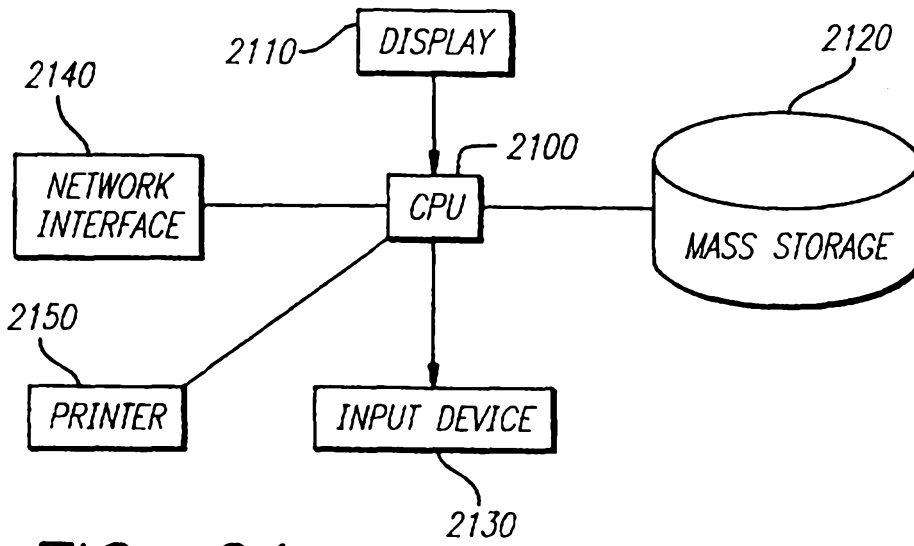


FIG. 21

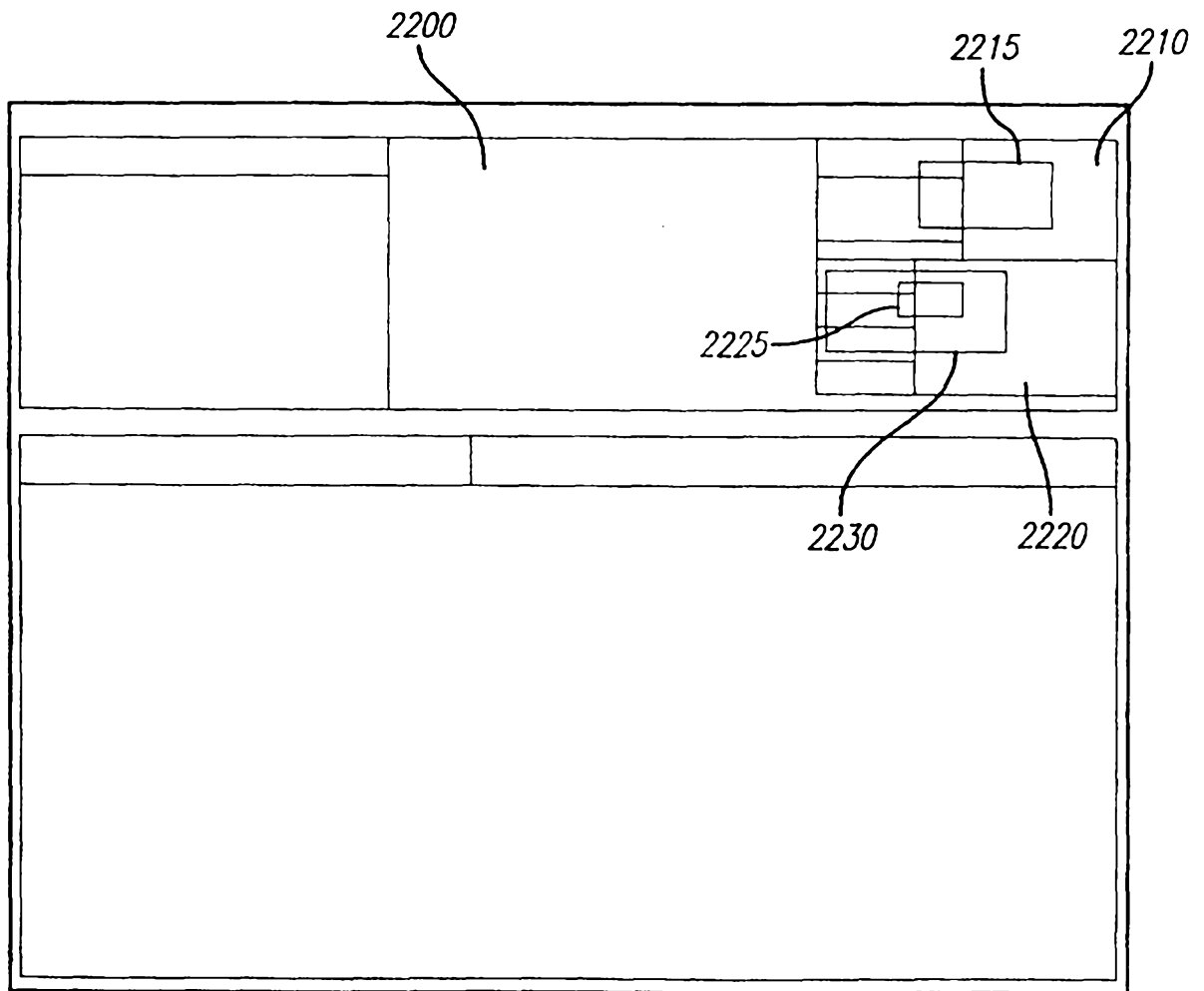


FIG. 22

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FIG. 23

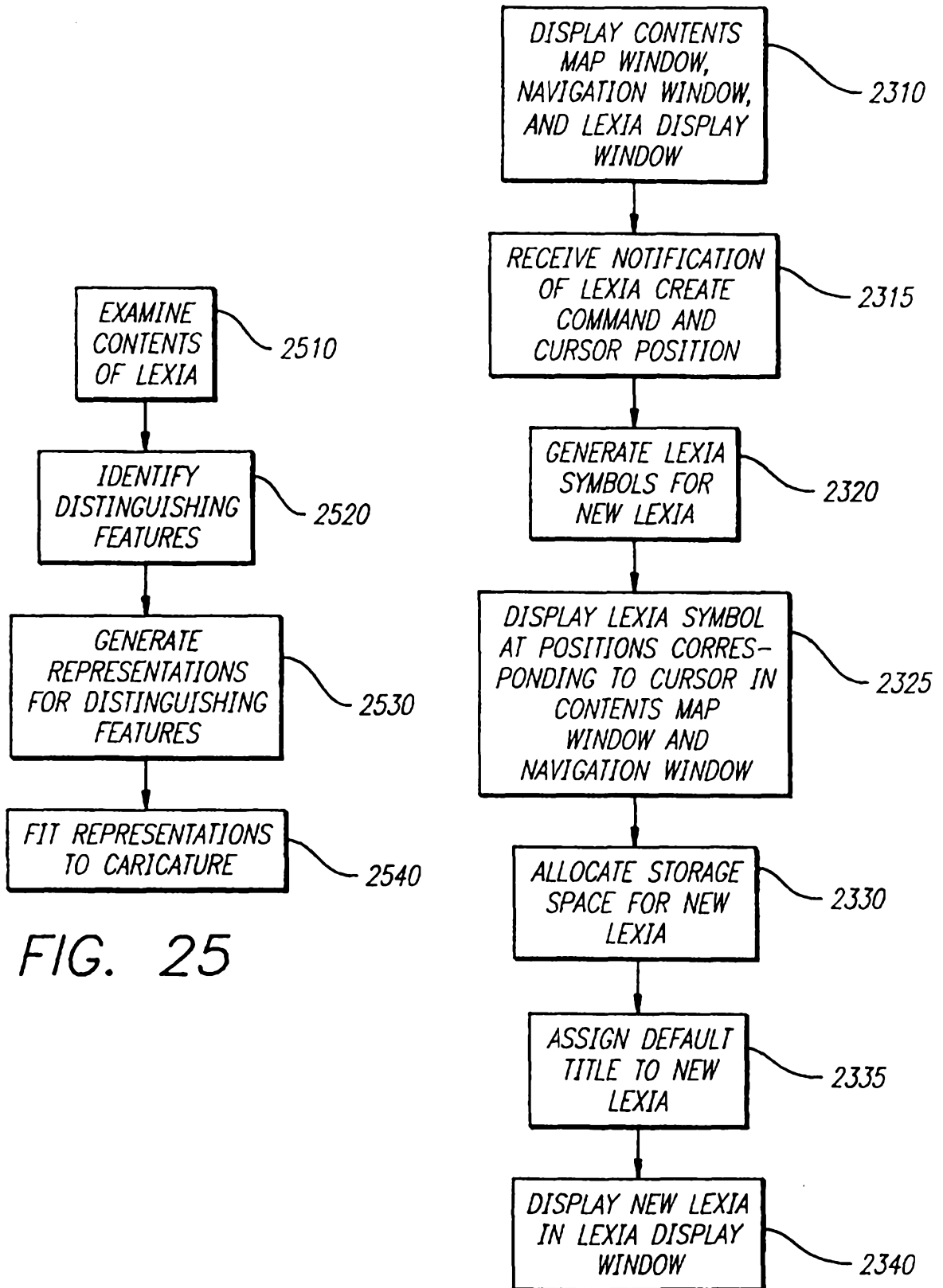


FIG. 25

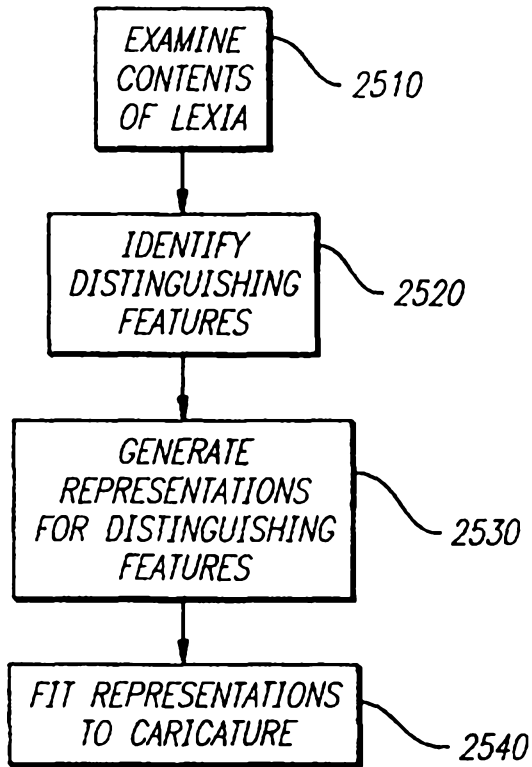
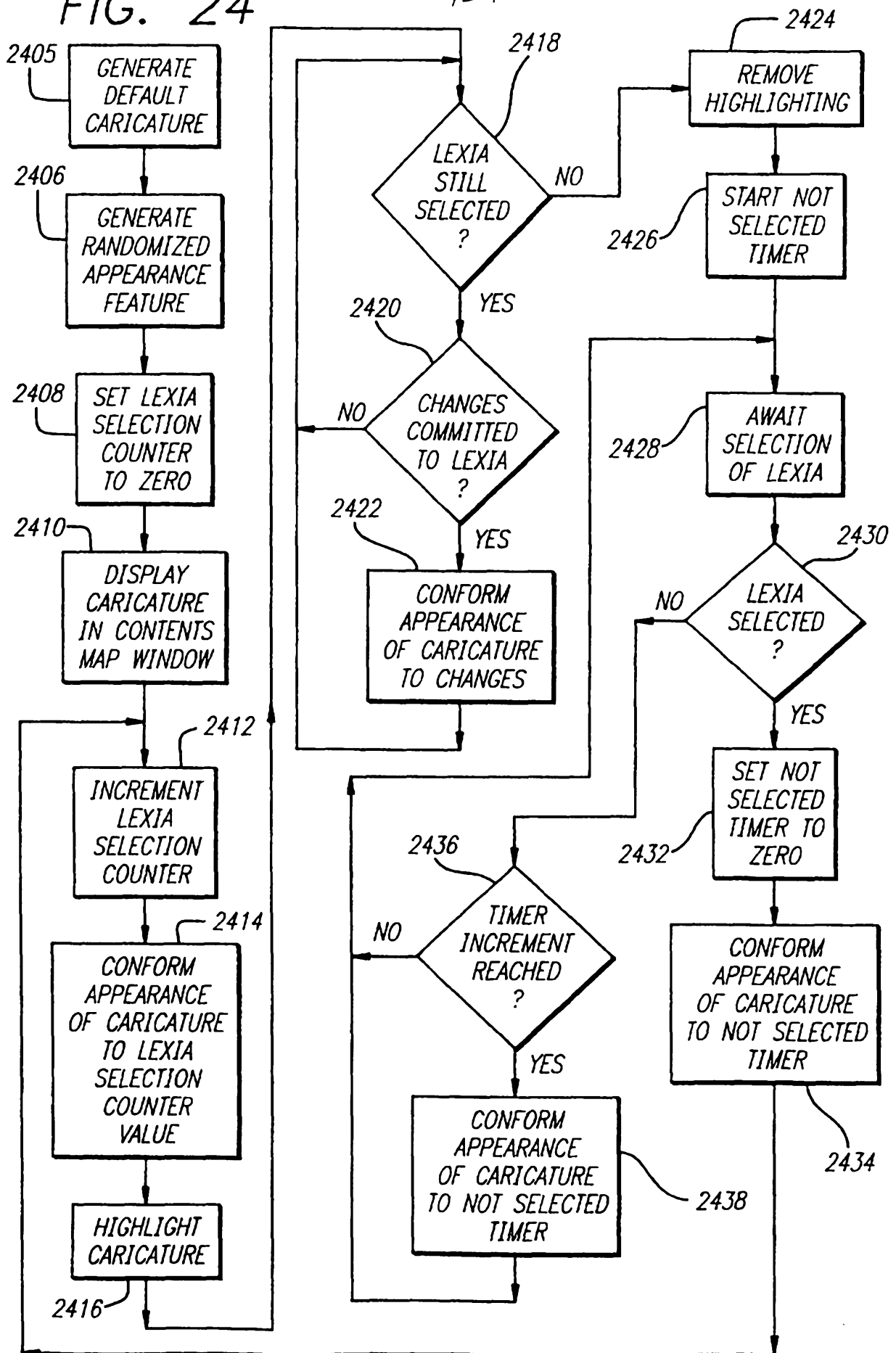


FIG. 24

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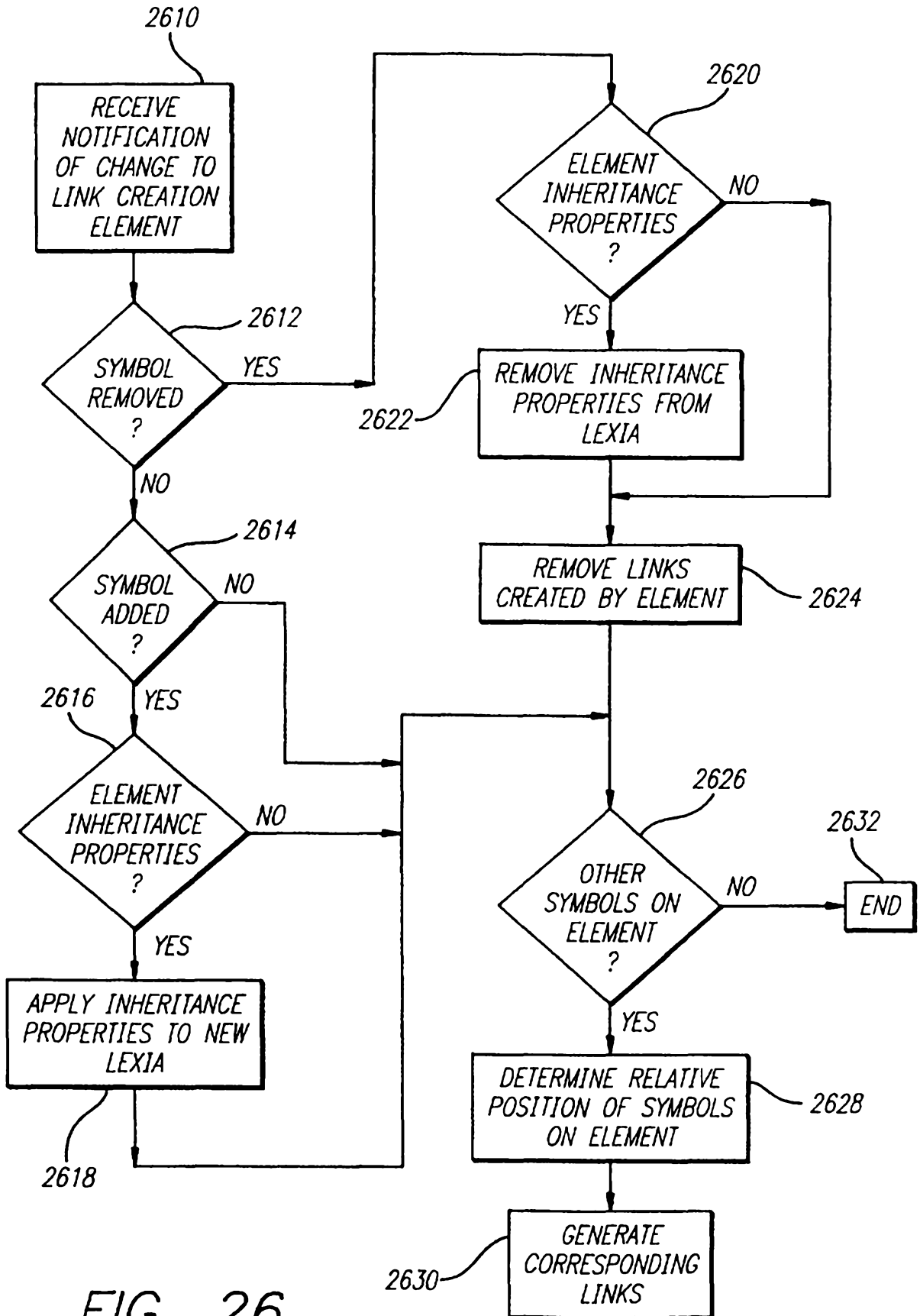


FIG. 26

FIG. 1 PRIOR ART

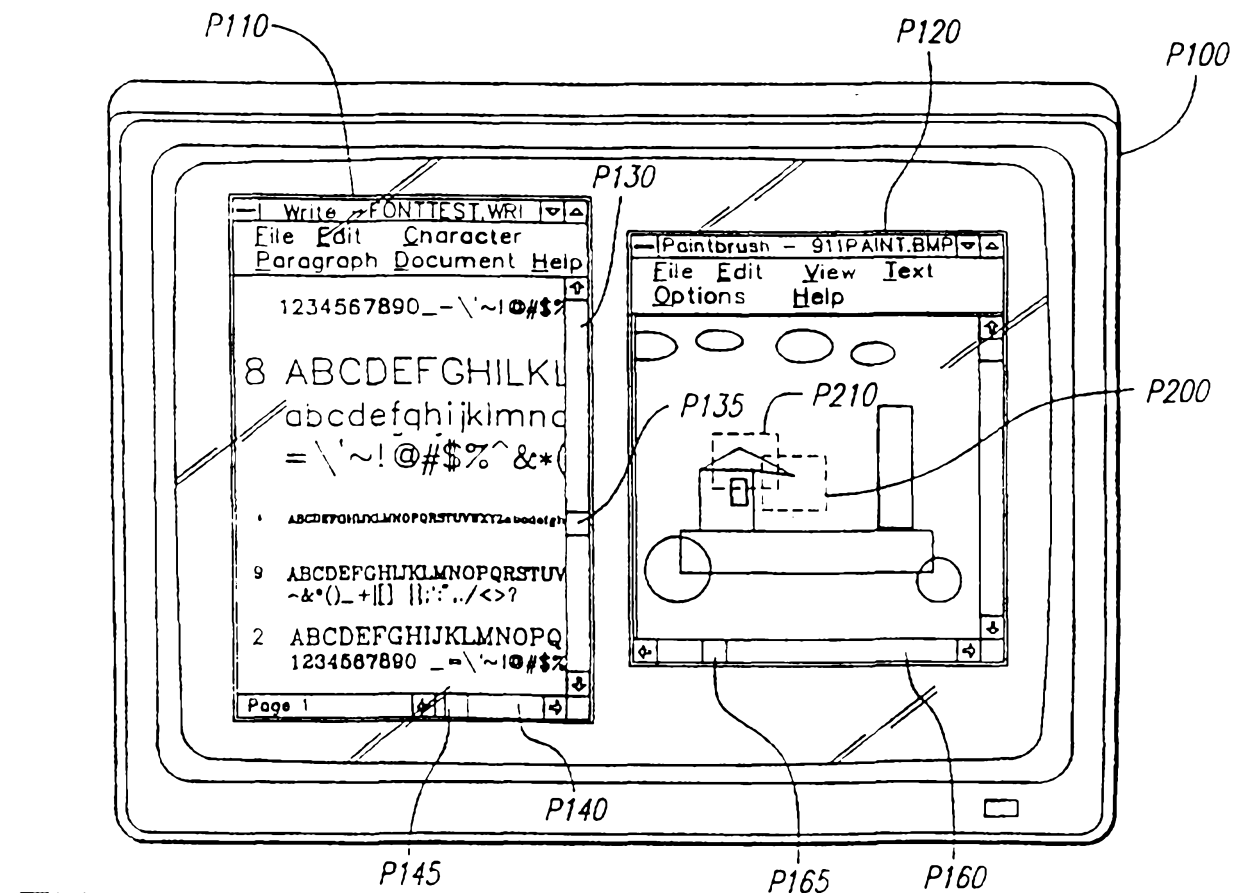
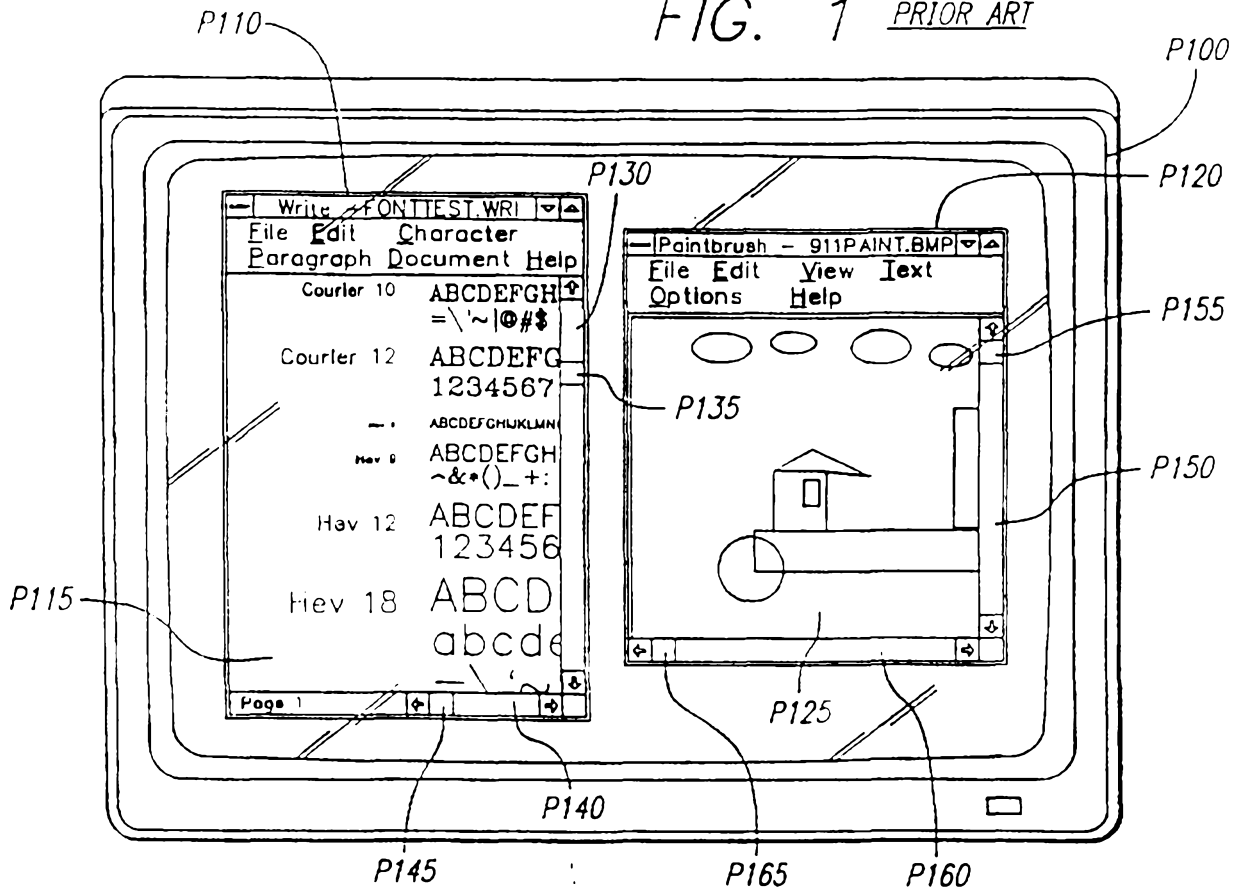


FIG. 2 PRIOR ART

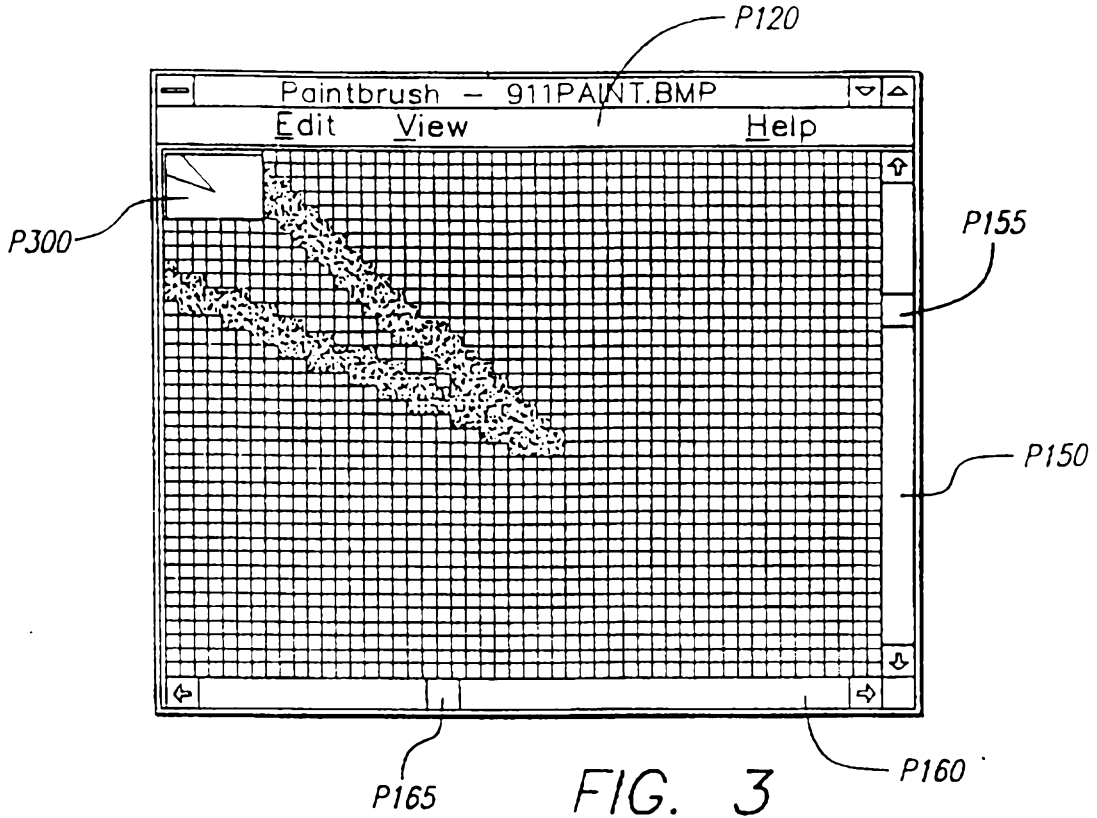


FIG. 3

PRIOR ART

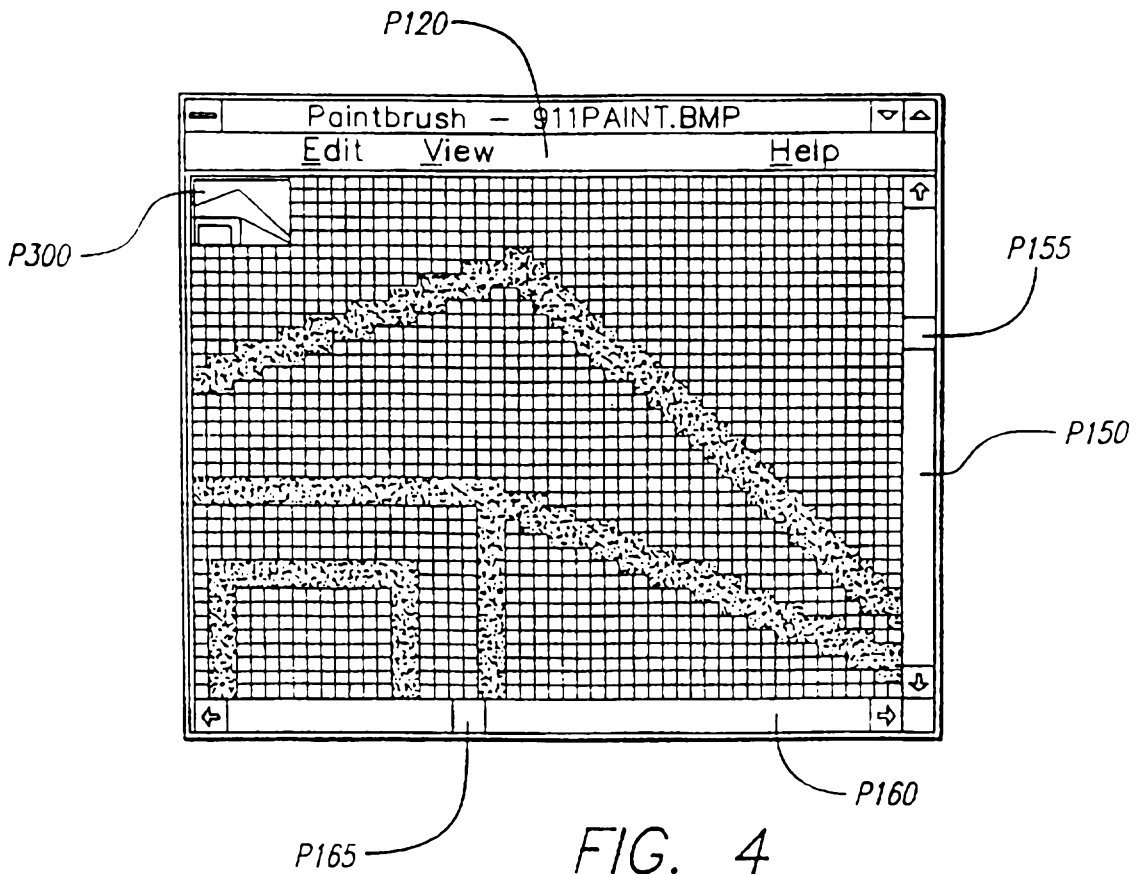


FIG. 4

PRIOR ART

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FIG. 5

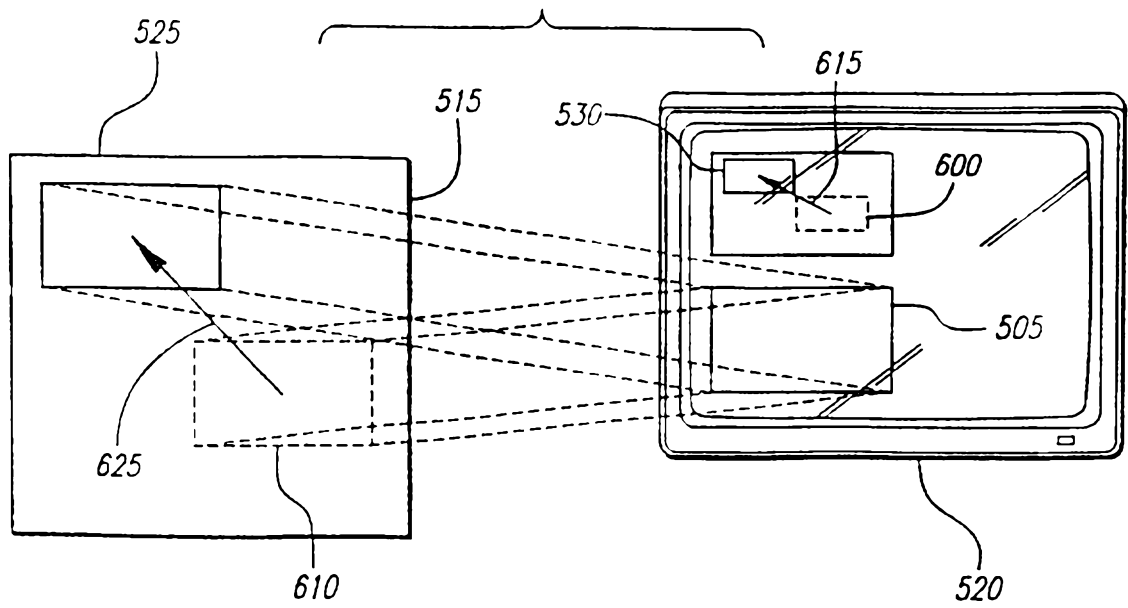
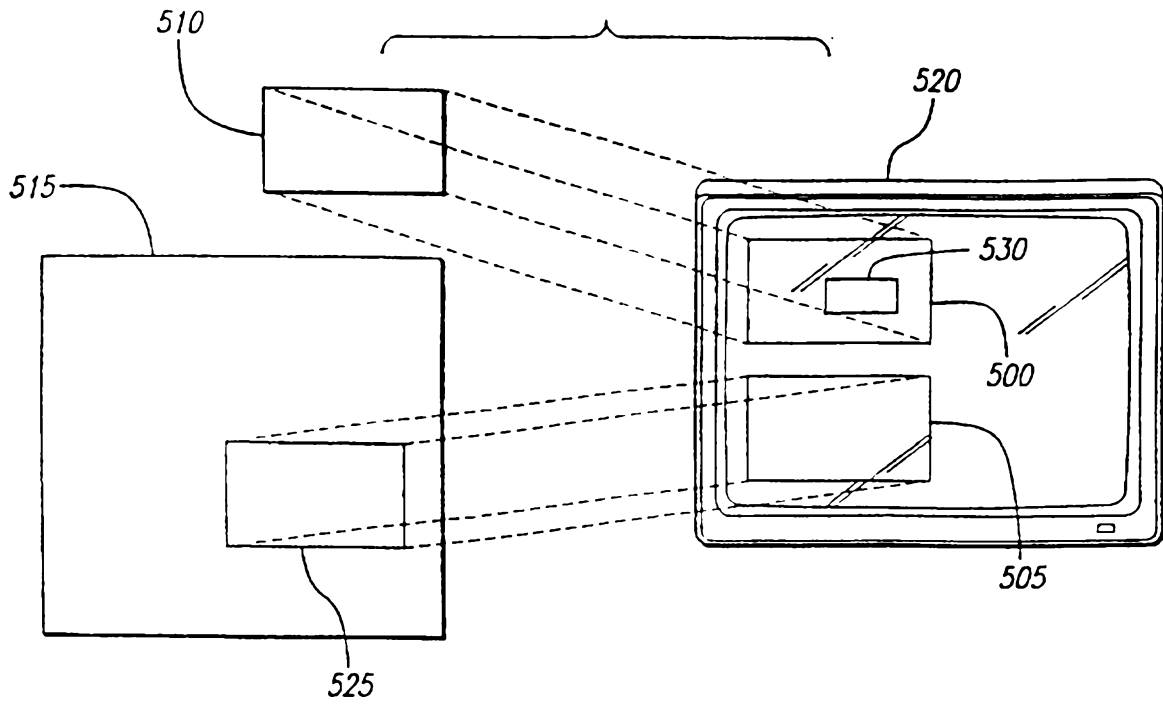


FIG. 6

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FIG. 7

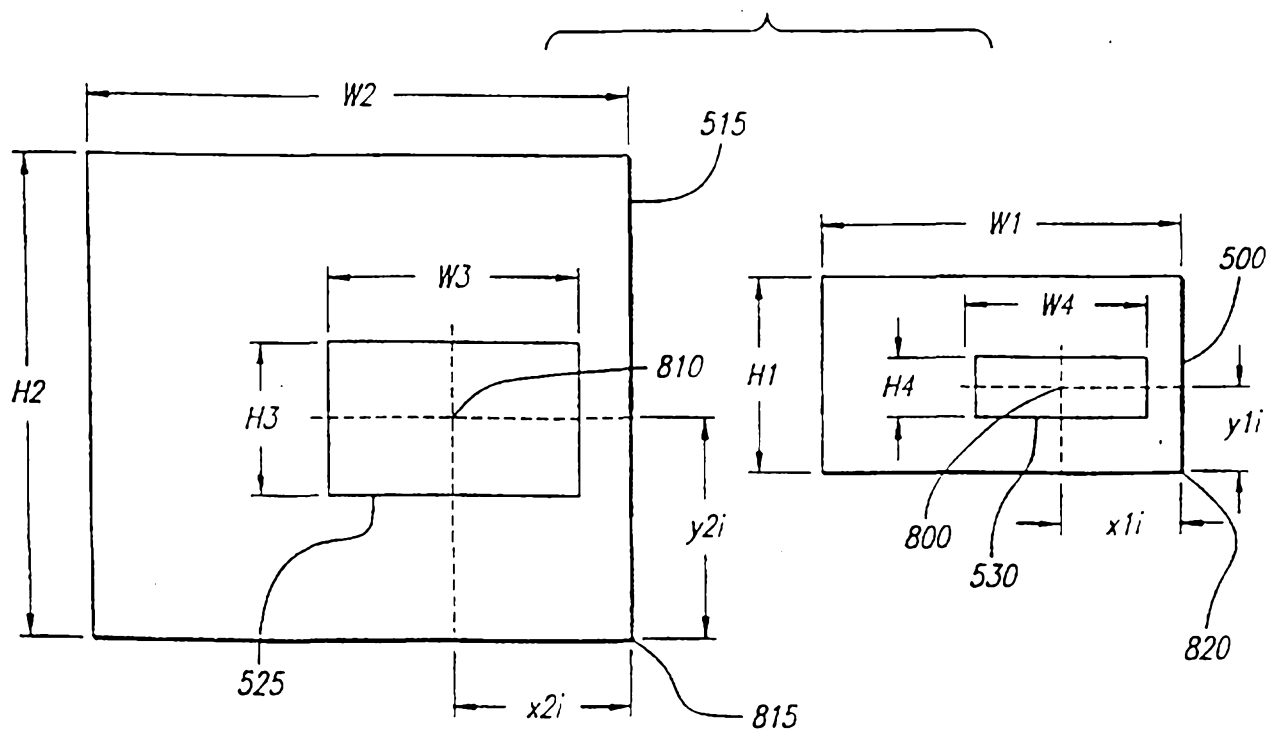
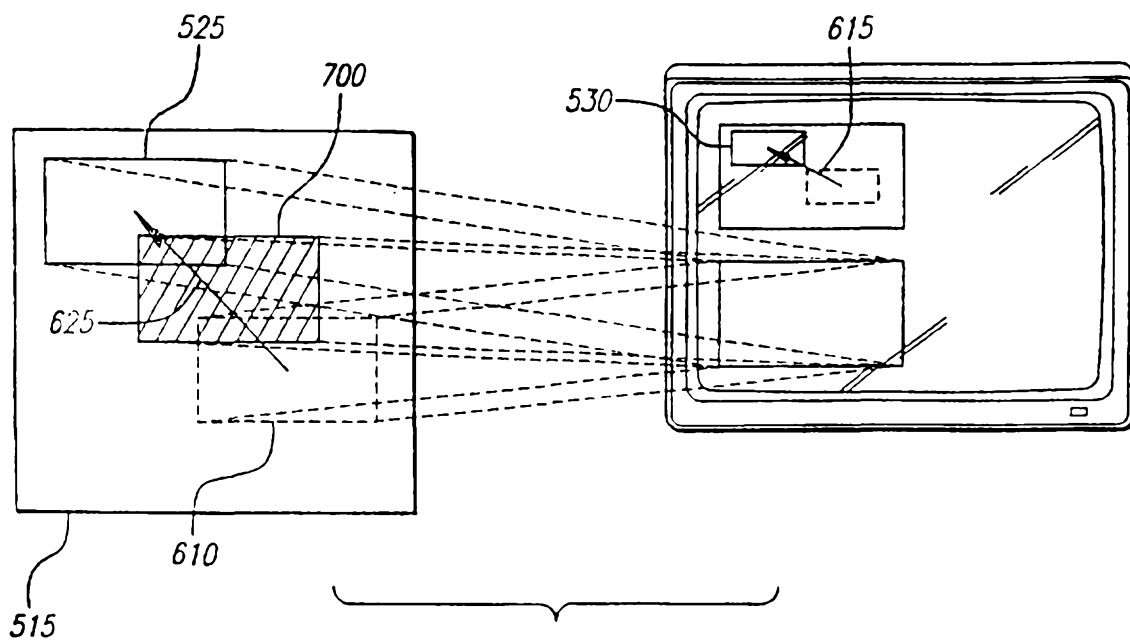


FIG. 8

FIG. 9

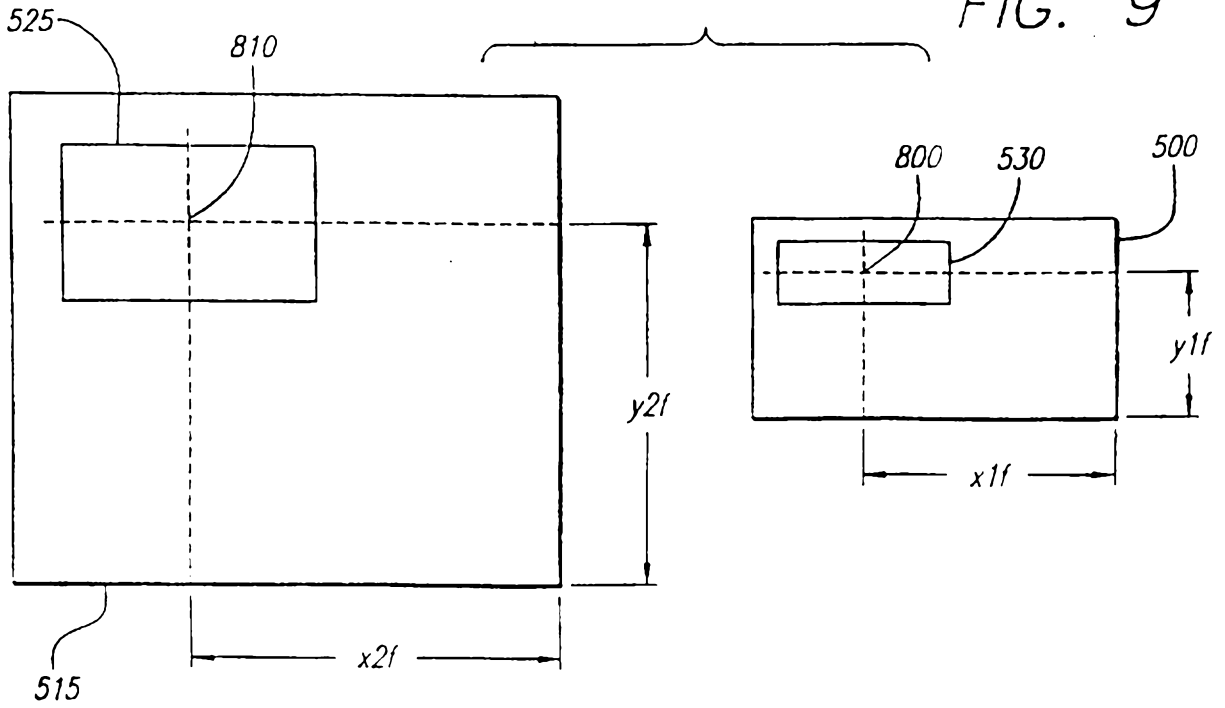


FIG. 10

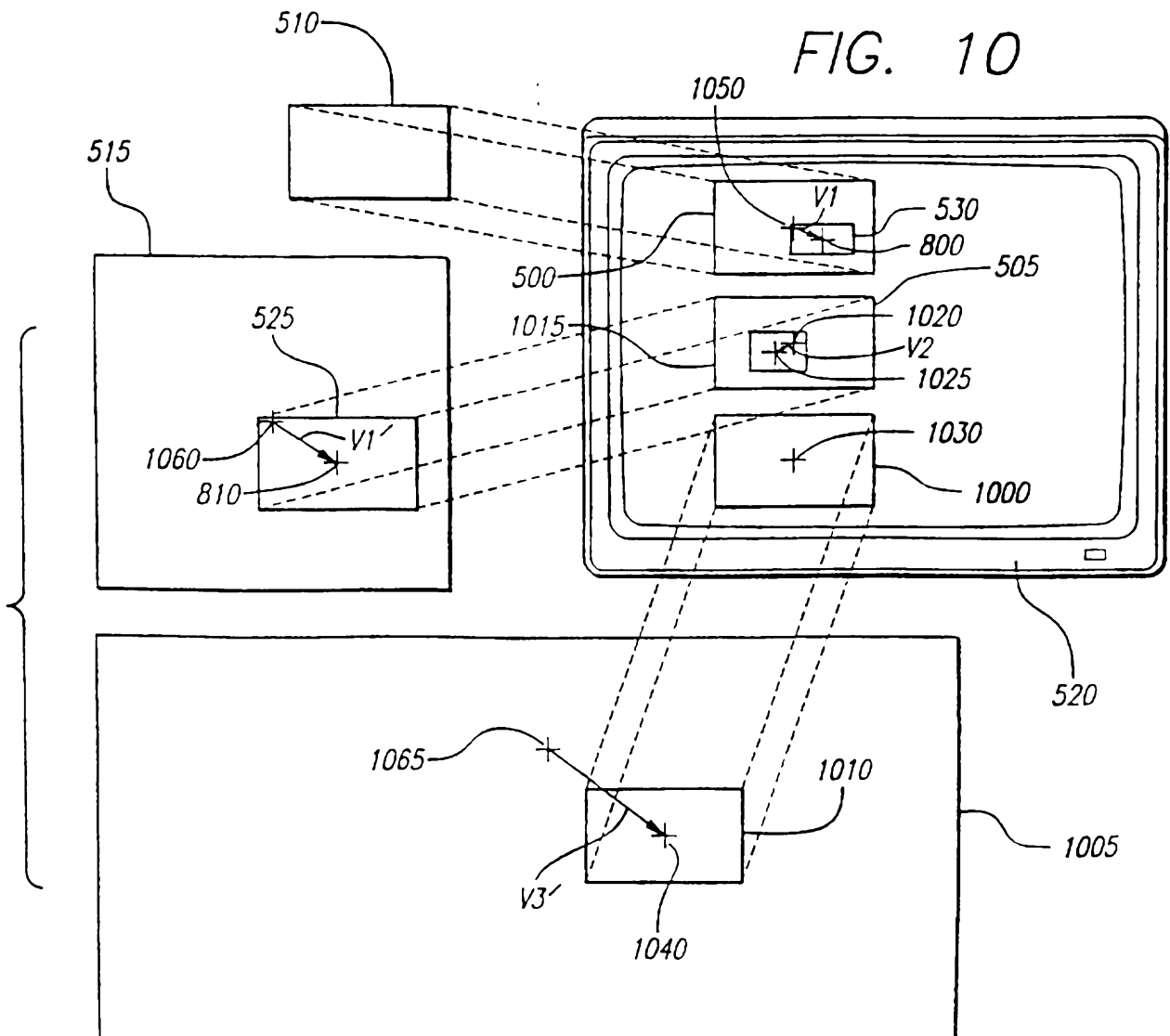
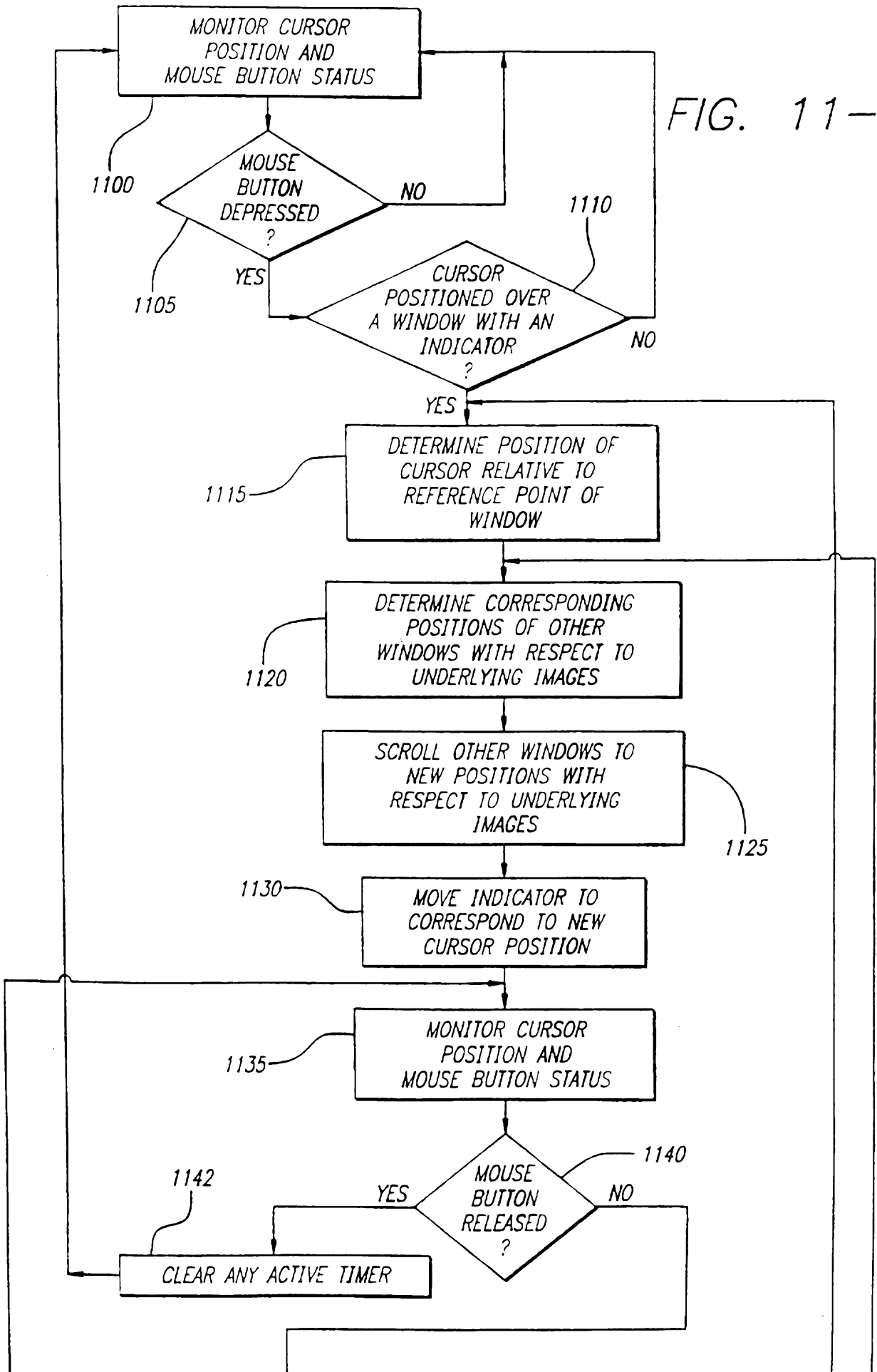


FIG. 11-1



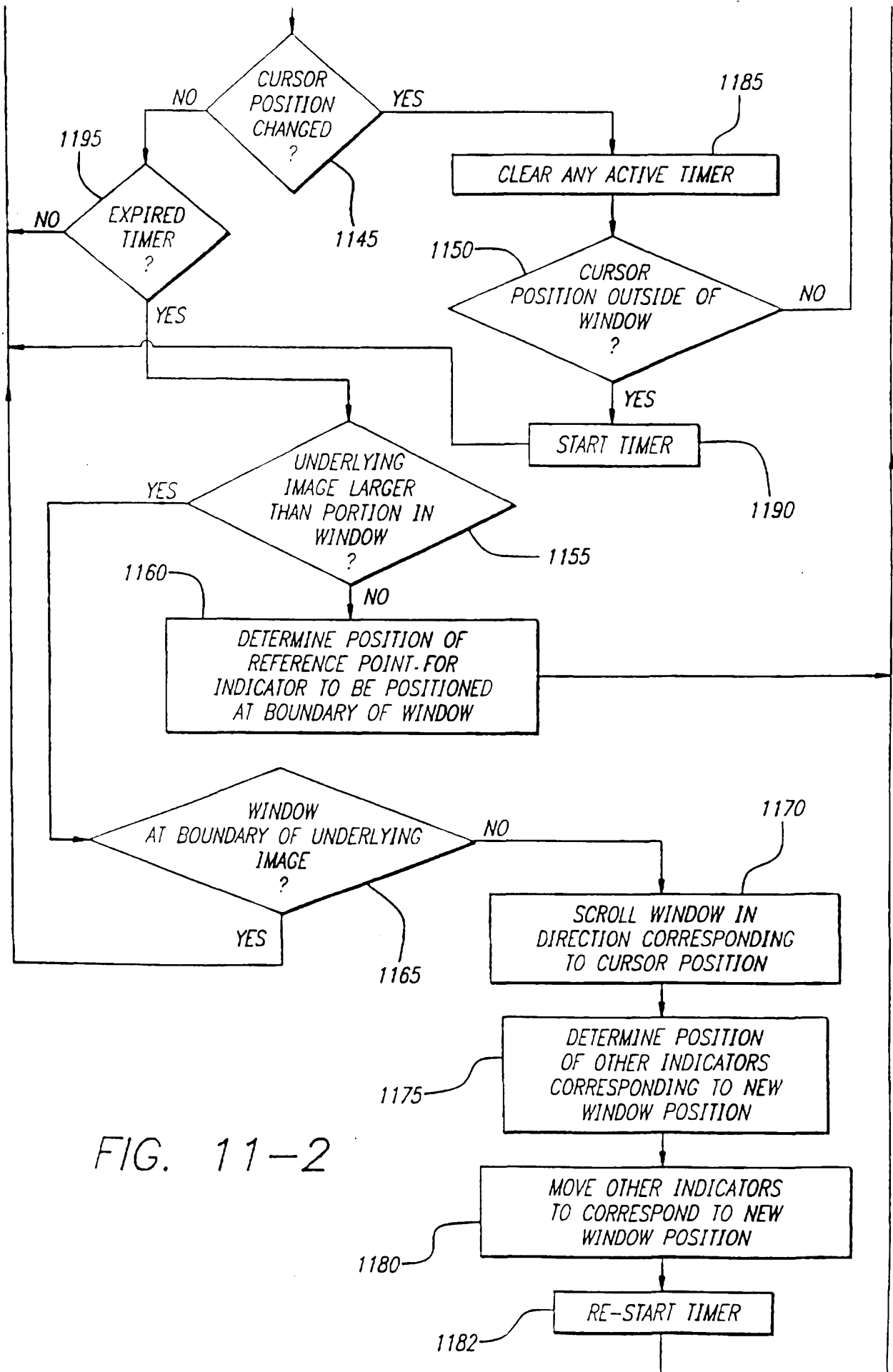


FIG. 11-2

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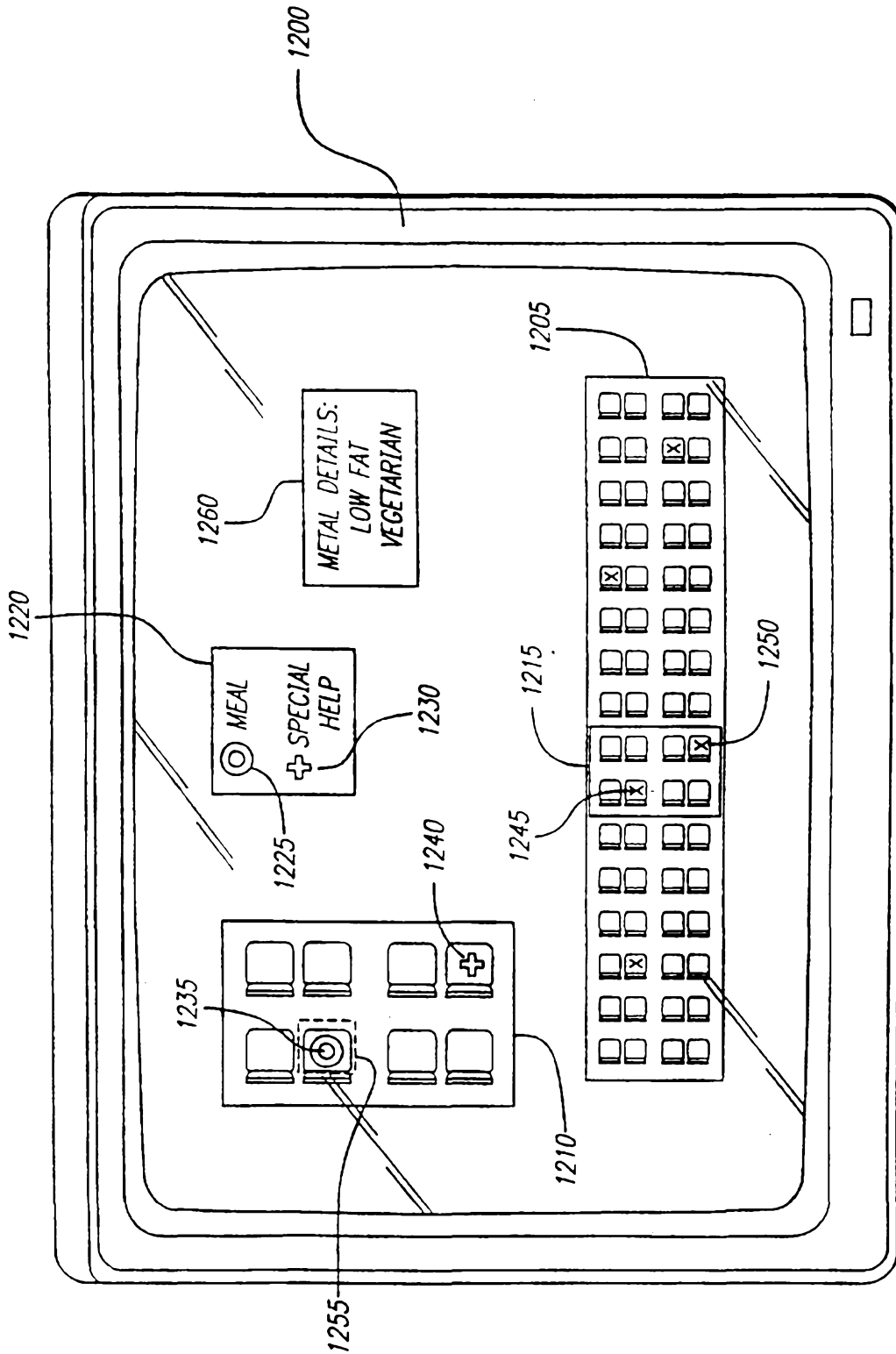


FIG. 12