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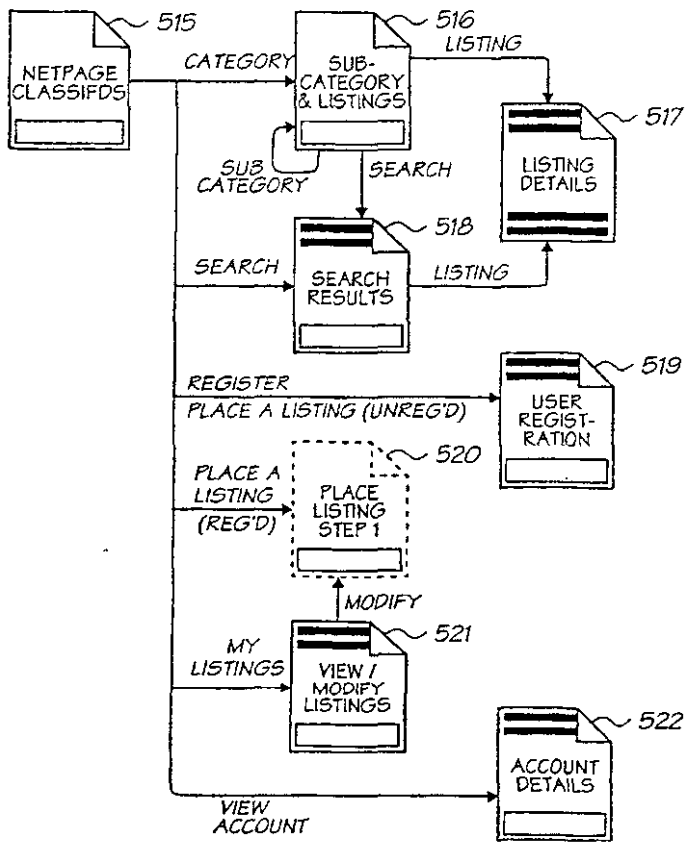
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(54) Title: METHOD AND SYSTEM FOR SEARCHING CLASSIFIED ADVERTISING



(57) Abstract: Methods and systems are disclosed which relate to listing classified advertising via interface surfaces printed with information and coded data. The coded data, encoded visibly or invisibly, may be queried by an appropriate sensing device. The sensing device communicates with a computer system. Together, the interface surfaces, sensing device and computer system are capable of effecting classified listing search transactions over a network.

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METHOD AND SYSTEM FOR SEARCHING CLASSIFIED ADVERTISING

FIELD OF INVENTION

The present invention relates generally to methods, systems and apparatus for interacting with computers. More particularly, the invention relates to enabling searching of classified advertising utilizing such methods, systems and apparatus.

The invention has been developed primarily to allow a large number of distributed users to interact with networked information via printed matter and optical sensors, thereby to obtain interactive printed matter on demand via high-speed networked color printers. Although the invention will largely be described herein with reference to this use, it will be appreciated that the invention is not limited to use in this field.

CO-PENDING APPLICATIONS

Various methods, systems and apparatus relating to the present invention are disclosed in the following co-pending applications filed by the applicant or assignee of the present invention simultaneously with the present application:

PCT/AU00/00762, PCT/AU00/00763, PCT/AU00/00761, PCT/AU00/00760, PCT/AU00/00759,
PCT/AU00/00758, PCT/AU00/00764, PCT/AU00/00765, PCT/AU00/00766, PCT/AU00/00767,
PCT/AU00/00768, PCT/AU00/00773, PCT/AU00/00774, PCT/AU00/00776, PCT/AU00/00777,
PCT/AU00/00770, PCT/AU00/00769, PCT/AU00/00771, PCT/AU00/00772, PCT/AU00/00754,
PCT/AU00/00755, PCT/AU00/00756, PCT/AU00/00757

The disclosures of these co-pending applications are incorporated herein by cross-reference.

Various methods, systems and apparatus relating to the present invention are disclosed in the following co-pending applications filed by the applicant or assignee of the present invention on 24 May 2000:

PCT/AU00/00518, PCT/AU00/00519, PCT/AU00/00520, PCT/AU00/00521, PCT/AU00/00523,
PCT/AU00/00524, PCT/AU00/00525, PCT/AU00/00526, PCT/AU00/00527, PCT/AU00/00528,
PCT/AU00/00529, PCT/AU00/00530, PCT/AU00/00531, PCT/AU00/00532, PCT/AU00/00533,
PCT/AU00/00534, PCT/AU00/00535, PCT/AU00/00536, PCT/AU00/00537, PCT/AU00/00538,
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PCT/AU00/00577, PCT/AU00/00578, PCT/AU00/00579, PCT/AU00/00581, PCT/AU00/00580,
PCT/AU00/00582, PCT/AU00/00587, PCT/AU00/00588, PCT/AU00/00589, PCT/AU00/00583,
PCT/AU00/00593, PCT/AU00/00590, PCT/AU00/00591, PCT/AU00/00592, PCT/AU00/00594,
PCT/AU00/00595, PCT/AU00/00596, PCT/AU00/00597, PCT/AU00/00598, PCT/AU00/00516,
PCT/AU00/00517 and PCT/AU00/00511

The disclosures of these co-pending applications are incorporated herein by cross-reference.

BACKGROUND

Classified advertising is well known, allowing sellers of goods or services to list advertisements offering those goods or services in newspapers, magazines, and other printed publications. Potential buyers can search these classified advertisements looking for items of interest. Classified advertising is increasingly being delivered over the Internet, offering such added facilities as online searching.

OBJECT

It is an object of the present invention to provide a new method and system for enabling searching of classified advertising.

SUMMARY OF INVENTION

According to a first aspect, the present invention provides a method of enabling searching of classified advertising, the method including the steps of:

providing a user with a form containing information relating to a listing search transaction, the form including coded data indicative of an identity of the form and of at least one reference point of the form;

receiving, in a computer system, indicating data from a sensing device regarding the identity of the form and a position of the sensing device relative to the form, the sensing device, when placed in an operative position relative to the form, sensing the indicating data using at least some of the coded data; and

identifying, in the computer system and from the indicating data, at least one parameter relating to the listing search transaction.

Preferably, the parameter relating to the listing search transaction is associated with at least one zone of the form and the method includes identifying, in the computer system and from the zone relative to which the sensing device is located, the parameter.

Preferably also, the method includes:

receiving, in the computer system, data regarding movement of the sensing device relative to the form, the sensing device sensing its movement relative to the form using at least some of the coded data; and

identifying, in the computer system and from said movement being at least partially within said at least one zone, said at least one parameter of the listing search transaction.

According to a second aspect, the invention provides a method of enabling searching of classified advertising, the method including the steps of:

providing a user with a form containing information relating to a listing search transaction, the form including coded data indicative of at least one parameter of the listing search transaction;

receiving, in a computer system, data from a sensing device regarding said at least one parameter and regarding movement of the sensing device relative to the form, the sensing device, when moved relative to the form, sensing the data regarding said at least one parameter using at least some of the coded data and generating the data regarding its own movement relative to the form; and

interpreting, in the computer system, said movement of the sensing device as it relates to said at least one parameter.

According to a third aspect, the invention provides a method of enabling searching of classified advertising,

the method including the steps of:

providing a user with a form including coded data indicative of an identity of the form;

receiving, in a computer system, data from a sensing device regarding an identity of the user and regarding the identity of the form, the sensing device containing the data regarding the identity of the user and sensing the data regarding the identity of the form using at least some of the coded data; and

identifying, in the computer system and from the data regarding the identity of the user and the identity of the form, a listing search transaction.

Preferably, the coded data is also indicative of at least one parameter of the listing search transaction, and the method includes receiving, in the computer system, indicating data from the sensing device regarding the at least one parameter of the listing search transaction, the sensing device sensing the indicating data using at least some of the coded data.

According to a fourth aspect, the invention provides a system for enabling searching of classified advertising, the system including:

a form containing information relating to a listing search transaction, the form including coded data indicative of an identity of the form and of at least one reference point of the form; and

a computer system for receiving indicating data from a sensing device for identifying at least one parameter relating to the listing search transaction, the indicating data being indicative of the identity of the form and a position of the sensing device relative to the form, the sensing device sensing the indicating data using at least some of the coded data.

Preferably, the parameter relating to the listing search transaction is associated with at least one zone of the form.

Preferably also, the system includes the sensing device, the sensing device sensing its movement relative to the form using at least some of the coded data.

According to a fifth aspect, the invention provides a system for enabling searching of classified advertising, the system including:

a form containing information relating to a listing search transaction, the form including coded data indicative of at least one parameter of the listing search transaction; and

a computer system for receiving data from a sensing device regarding said at least one parameter and regarding movement of the sensing device relative to the form, and for interpreting said movement of the sensing device as it relates to said at least one parameter, the sensing device, when moved relative to the form, sensing the data regarding said at least one parameter using at least some of the coded data and generating the data regarding its own movement relative to the form.

According to a sixth aspect, the invention provides a system for enabling searching of classified advertising, the system including:

a form including coded data indicative of an identity of the form; and

a computer system for receiving from a sensing device data regarding an identity of a user and the identity of the form, and for identifying, from said received data, a listing search transaction, the sensing device containing the data regarding the identity of the user and sensing the data regarding the identity of the form using at least some of the coded

data.

Preferably, the coded data is also indicative of at least one parameter of the listing search transaction, the computer system receiving indicating data from the sensing device regarding the at least one parameter, and the sensing device sensing the indicating data using at least some of the coded data.

Accordingly, the present invention provides a system and a method which utilizes one or more forms capable of interacting with a computer system. Whilst the novel method and system of the present invention may be used in conjunction with a single computer system, in a particularly preferred form it is designed to operate over a computer network, such as the Internet.

Physically, the form is disposed on a surface medium of any suitable structure. However, in a preferred arrangement, the form is disposed on sheet material such as paper or the like which has the coded data printed on it and which allows interaction with the computer system. The coded data is detectable preferably, but not exclusively, outside the visible spectrum, thereby enabling it to be machine-readable but substantially invisible to the human eye. The form may also include visible material which provides information to a user, such as the application or purpose of the form, and which visible information may be registered or correlate in position with the relevant hidden coded data.

The system also includes a sensing device to convey data from the form to the computer system, and in some instances, to contribute additional data. Again, the sensing device may take a variety of forms but is preferably compact and easily portable. In a particularly preferred arrangement, the sensing device is configured as a pen which is designed to be able to physically mark the form as well as to selectively enable the coded data from the form to be read and transmitted to the computer system. The coded data then provides control information, configured such that designation thereof by a user causes instructions to be applied to the software running on the computer system or network.

The nature of the interaction between the form and the sensing device and the data that each contributes to the computer system may vary. In one arrangement, the coded data on the form is indicative of the identity of the form and of at least one reference point on that form. In another embodiment, the form includes coded data which is indicative of a parameter of the form, whereas the sensing device is operative to provide data regarding its own movement relative to that form to the computer system together with coded data from the form. In yet another arrangement, the form includes the coded data which at least identifies the form, and the sensing device is designed to provide, to the computer system, data based on the form coded data, and also on data which identifies the user of the device.

In a preferred arrangement, the system and method also employs specially designed printers to print the form. Further these printers constitute or form part of the computer system and are designed to receive data from the sensing device. As indicated above, the system and method of the invention is ideally suited to operate over a network. In this arrangement, the printers are fully integrated into the network and allow for printing of the forms on demand and also for distributing of the forms using a mixture of multicast and pointcast communication protocols.

Accordingly, in a preferred form, the present invention provides methods and systems which use a paper and pen based interface for a computer system. This provides many significant benefits over traditional computer systems. The advantage of paper is that it is widely used to display and record information. Further, printed information is easier to read than information displayed on a computer screen. Moreover, paper does not run on batteries, can be read in bright light, or robustly accepts coffee spills or the like and is portable and disposable. Furthermore, the system allows for hand-drawing and handwriting to be captured which affords greater richness of expression than input via a computer keyboard and mouse.

The present invention therefore provides a novel method and system for enabling searching of classified

advertising making use of novel interactive surface media.

BRIEF DESCRIPTION OF DRAWINGS

Preferred and other embodiments of the invention will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Figure 1 is a schematic of a the relationship between a sample printed netpage and its online page description;

Figure 2 is a schematic view of a interaction between a netpage pen, a netpage printer, a netpage page server, and a netpage application server;

Figure 3 illustrates a collection of netpage servers and printers interconnected via a network;

Figure 4 is a schematic view of a high-level structure of a printed netpage and its online page description;

Figure 5 is a plan view showing a structure of a netpage tag;

Figure 6 is a plan view showing a relationship between a set of the tags shown in Figure 5 and a field of view of a netpage sensing device in the form of a netpage pen;

Figure 7 is a flowchart of a tag image processing and decoding algorithm;

Figure 8 is a perspective view of a netpage pen and its associated tag-sensing field-of-view cone;

Figure 9 is a perspective exploded view of the netpage pen shown in Figure 8;

Figure 10 is a schematic block diagram of a pen controller for the netpage pen shown in Figures 8 and 9;

Figure 11 is a perspective view of a wall-mounted netpage printer;

Figure 12 is a section through the length of the netpage printer of Figure 11;

Figure 12a is an enlarged portion of Figure 12 showing a section of the duplexed print engines and glue wheel assembly;

Figure 13 is a detailed view of the ink cartridge, ink, air and glue paths, and print engines of the netpage printer of Figures 11 and 12;

Figure 14 is a schematic block diagram of a printer controller for the netpage printer shown in Figures 11 and 12;

Figure 15 is a schematic block diagram of duplexed print engine controllers and Memjet™ printheads associated with the printer controller shown in Figure 14;

Figure 16 is a schematic block diagram of the print engine controller shown in Figures 14 and 15;

Figure 17 is a perspective view of a single Memjet™ printing element, as used in, for example, the netpage printer of Figures 10 to 12;

Figure 18 is a perspective view of a small part of an array of Memjet™ printing elements;

Figure 19 is a series of perspective views illustrating the operating cycle of the Memjet™ printing element shown in Figure 13;

Figure 20 is a perspective view of a short segment of a pagewidth Memjet™ printhead;

Figure 21 is a schematic view of a user class diagram;

Figure 22 is a schematic view of a printer class diagram;

Figure 23 is a schematic view of a pen class diagram;

Figure 24 is a schematic view of an application class diagram;

Figure 25 is a schematic view of a document and page description class diagram;

Figure 26 is a schematic view of a document and page ownership class diagram;

Figure 27 is a schematic view of a terminal element specialization class diagram;

Figure 28 is a schematic view of a static element specialization class diagram;

Figure 29 is a schematic view of a hyperlink element class diagram;

Figure 30 is a schematic view of a hyperlink element specialization class diagram;

Figure 31 is a schematic view of a hyperlinked group class diagram;

Figure 32 is a schematic view of a form class diagram;

Figure 33 is a schematic view of a digital ink class diagram;

Figure 34 is a schematic view of a field element specialization class diagram;

Figure 35 is a schematic view of a checkbox field class diagram;

Figure 36 is a schematic view of a text field class diagram;

Figure 37 is a schematic view of a signature field class diagram;

Figure 38 is a flowchart of an input processing algorithm;

Figure 38a is a detailed flowchart of one step of the flowchart of Figure 38;

Figure 39 is a schematic view of a page server command element class diagram;

Figure 40 is a schematic view of a subscription delivery protocol;

Figure 41 is a schematic view of a hyperlink request class diagram;

Figure 42 is a schematic view of a hyperlink activation protocol;

Figure 43 is a schematic view of a form submission protocol;

Figure 44 is a schematic view of a set of user interface flow document icons;

Figure 45 is a schematic view of a set of user interface page layout element icons;

Figure 46 is a schematic view of a classifieds class diagram;

Figure 47 is a schematic view of a payment class diagram;

Figure 48 is a schematic view of a classifieds user interface flow;

Figure 49 is a schematic view of a place classifieds listing user interface flow;

Figure 50 is a schematic view of a classifieds main page;

Figure 51 is a schematic view of a classifieds subcategory and listings page;

Figure 52 is a schematic view of a search results page;

Figure 53 is a schematic view of a place a listing - step 1 form;

Figure 54 is a schematic view of a place a listing - step 2 form;

Figure 55 is a schematic view a place a listing - step 3 form; and

Figure 56 is a schematic view of a listing confirmation page.

DETAILED DESCRIPTION OF PREFERRED AND OTHER EMBODIMENTS

Note: Memjet™ is a trade mark of Silverbrook Research Pty Ltd, Australia.

In the preferred embodiment, the invention is configured to work with the netpage networked computer system, a detailed overview of which follows. It will be appreciated that not every implementation will necessarily embody all or even most of the specific details and extensions discussed below in relation to the basic system. However, the system is described in its most complete form to reduce the need for external reference when attempting to understand the context in which the preferred embodiments and aspects of the present invention operate.

In brief summary, the preferred form of the netpage system employs a computer interface in the form of a mapped surface, that is, a physical surface which contains references to a map of the surface maintained in a computer system. The map references can be queried by an appropriate sensing device. Depending upon the specific implementation, the map references may be encoded visibly or invisibly, and defined in such a way that a local query on the mapped surface yields an unambiguous map reference both within the map and among different maps. The computer system can contain information about features on the mapped surface, and such information can be retrieved based on map references supplied by a sensing device used with the mapped surface. The information thus retrieved can take the form of actions which are initiated by the computer system on behalf of the operator in response to the operator's interaction with the surface features.

In its preferred form, the netpage system relies on the production of, and human interaction with, netpages. These are pages of text, graphics and images printed on ordinary paper, but which work like interactive web pages. Information is encoded on each page using ink which is substantially invisible to the unaided human eye. The ink, however, and thereby the coded data, can be sensed by an optically imaging pen and transmitted to the netpage system.

In the preferred form, active buttons and hyperlinks on each page can be clicked with the pen to request information from the network or to signal preferences to a network server. In one embodiment, text written by hand on a netpage is automatically recognized and converted to computer text in the netpage system, allowing forms to be filled in. In other embodiments, signatures recorded on a netpage are automatically verified, allowing e-commerce transactions to be securely authorized.

As illustrated in Figure 1, a printed netpage 1 can represent a interactive form which can be filled in by the user both physically, on the printed page, and "electronically", via communication between the pen and the netpage system. The example shows a "Request" form containing name and address fields and a submit button. The netpage consists of graphic data 2 printed using visible ink, and coded data 3 printed as a collection of tags 4 using invisible ink. The corresponding page description 5, stored on the netpage network, describes the individual elements of the netpage. In particular it describes the type and spatial extent (zone) of each interactive element (i.e. text field or button in the example), to allow the netpage system to correctly interpret input via the netpage. The submit button 6, for example, has a zone 7 which corresponds to the spatial extent of the corresponding graphic 8.

As illustrated in Figure 2, the netpage pen 101, a preferred form of which is shown in Figures 8 and 9 and described in more detail below, works in conjunction with a netpage printer 601, an Internet-connected printing appliance for home, office or mobile use. The pen is wireless and communicates securely with the netpage printer via a short-range

radio link 9.

The netpage printer 601, a preferred form of which is shown in Figures 11 to 13 and described in more detail below, is able to deliver, periodically or on demand, personalized newspapers, magazines, catalogs, brochures and other publications, all printed at high quality as interactive netpages. Unlike a personal computer, the netpage printer is an appliance which can be, for example, wall-mounted adjacent to an area where the morning news is first consumed, such as in a user's kitchen, near a breakfast table, or near the household's point of departure for the day. It also comes in tabletop, desktop, portable and miniature versions.

Netpages printed at their point of consumption combine the ease-of-use of paper with the timeliness and interactivity of an interactive medium.

As shown in Figure 2, the netpage pen 101 interacts with the coded data on a printed netpage 1 and communicates, via a short-range radio link 9, the interaction to a netpage printer. The printer 601 sends the interaction to the relevant netpage page server 10 for interpretation. In appropriate circumstances, the page server sends a corresponding message to application computer software running on a netpage application server 13. The application server may in turn send a response which is printed on the originating printer.

The netpage system is made considerably more convenient in the preferred embodiment by being used in conjunction with high-speed microelectromechanical system (MEMS) based inkjet (Memjet™) printers. In the preferred form of this technology, relatively high-speed and high-quality printing is made more affordable to consumers. In its preferred form, a netpage publication has the physical characteristics of a traditional newsmagazine, such as a set of letter-size glossy pages printed in full color on both sides, bound together for easy navigation and comfortable handling.

The netpage printer exploits the growing availability of broadband Internet access. Cable service is available to 95% of households in the United States, and cable modem service offering broadband Internet access is already available to 20% of these. The netpage printer can also operate with slower connections, but with longer delivery times and lower image quality. Indeed, the netpage system can be enabled using existing consumer inkjet and laser printers, although the system will operate more slowly and will therefore be less acceptable from a consumer's point of view. In other embodiments, the netpage system is hosted on a private intranet. In still other embodiments, the netpage system is hosted on a single computer or computer-enabled device, such as a printer.

Netpage publication servers 14 on the netpage network are configured to deliver print-quality publications to netpage printers. Periodical publications are delivered automatically to subscribing netpage printers via pointcasting and multicasting Internet protocols. Personalized publications are filtered and formatted according to individual user profiles.

A netpage printer can be configured to support any number of pens, and a pen can work with any number of netpage printers. In the preferred implementation, each netpage pen has a unique identifier. A household may have a collection of colored netpage pens, one assigned to each member of the family. This allows each user to maintain a distinct profile with respect to a netpage publication server or application server.

A netpage pen can also be registered with a netpage registration server 11 and linked to one or more payment card accounts. This allows e-commerce payments to be securely authorized using the netpage pen. The netpage registration server compares the signature captured by the netpage pen with a previously registered signature, allowing it to authenticate the user's identity to an e-commerce server. Other biometrics can also be used to verify identity. A version of the netpage pen includes fingerprint scanning, verified in a similar way by the netpage registration server.

Although a netpage printer may deliver periodicals such as the morning newspaper without user intervention, it can be configured never to deliver unsolicited junk mail. In its preferred form, it only delivers periodicals from

subscribed or otherwise authorized sources. In this respect, the netpage printer is unlike a fax machine or e-mail account which is visible to any junk mailer who knows the telephone number or email address.

1 NETPAGE SYSTEM ARCHITECTURE

Each object model in the system is described using a Unified Modeling Language (UML) class diagram. A class diagram consists of a set of object classes connected by relationships, and two kinds of relationships are of interest here: associations and generalizations. An association represents some kind of relationship between objects, i.e. between instances of classes. A generalization relates actual classes, and can be understood in the following way: if a class is thought of as the set of all objects of that class, and class A is a generalization of class B, then B is simply a subset of A. The UML does not directly support second-order modelling - i.e. classes of classes.

Each class is drawn as a rectangle labelled with the name of the class. It contains a list of the attributes of the class, separated from the name by a horizontal line, and a list of the operations of the class, separated from the attribute list by a horizontal line. In the class diagrams which follow, however, operations are never modelled.

An association is drawn as a line joining two classes, optionally labelled at either end with the multiplicity of the association. The default multiplicity is one. An asterisk (*) indicates a multiplicity of "many", i.e. zero or more. Each association is optionally labelled with its name, and is also optionally labelled at either end with the role of the corresponding class. An open diamond indicates an aggregation association ("is-part-of"), and is drawn at the aggregator end of the association line.

A generalization relationship ("is-a") is drawn as a solid line joining two classes, with an arrow (in the form of an open triangle) at the generalization end.

When a class diagram is broken up into multiple diagrams, any class which is duplicated is shown with a dashed outline in all but the main diagram which defines it. It is shown with attributes only where it is defined.

1.1 NETPAGES

Netpages are the foundation on which a netpage network is built. They provide a paper-based user interface to published information and interactive services.

A netpage consists of a printed page (or other surface region) invisibly tagged with references to an online description of the page. The online page description is maintained persistently by a netpage page server. The page description describes the visible layout and content of the page, including text, graphics and images. It also describes the input elements on the page, including buttons, hyperlinks, and input fields. A netpage allows markings made with a netpage pen on its surface to be simultaneously captured and processed by the netpage system.

Multiple netpages can share the same page description. However, to allow input through otherwise identical pages to be distinguished, each netpage is assigned a unique page identifier. This page ID has sufficient precision to distinguish between a very large number of netpages.

Each reference to the page description is encoded in a printed tag. The tag identifies the unique page on which it appears, and thereby indirectly identifies the page description. The tag also identifies its own position on the page. Characteristics of the tags are described in more detail below.

Tags are printed in infrared-absorptive ink on any substrate which is infrared-reflective, such as ordinary paper. Near-infrared wavelengths are invisible to the human eye but are easily sensed by a solid-state image sensor with an appropriate filter.

A tag is sensed by an area image sensor in the netpage pen, and the tag data is transmitted to the netpage system via the nearest netpage printer. The pen is wireless and communicates with the netpage printer via a short-range radio link. Tags are sufficiently small and densely arranged that the pen can reliably image at least one tag even on a single click on the page. It is important that the pen recognize the page ID and position on every interaction with the page, since the interaction is stateless. Tags are error-correctably encoded to make them partially tolerant to surface damage.

The netpage page server maintains a unique page instance for each printed netpage, allowing it to maintain a distinct set of user-supplied values for input fields in the page description for each printed netpage.

The relationship between the page description, the page instance, and the printed netpage is shown in Figure 4. The printed netpage may be part of a printed netpage document 45. The page instance is associated with both the netpage printer which printed it and, if known, the netpage user who requested it.

1.2 NETPAGE TAGS

1.2.1 Tag Data Content

In a preferred form, each tag identifies the region in which it appears, and the location of that tag within the region. A tag may also contain flags which relate to the region as a whole or to the tag. One or more flag bits may, for example, signal a tag sensing device to provide feedback indicative of a function associated with the immediate area of the tag, without the sensing device having to refer to a description of the region. A netpage pen may, for example, illuminate an "active area" LED when in the zone of a hyperlink.

As will be more clearly explained below, in a preferred embodiment, each tag contains an easily recognized invariant structure which aids initial detection, and which assists in minimizing the effect of any warp induced by the surface or by the sensing process. The tags preferably tile the entire page, and are sufficiently small and densely arranged that the pen can reliably image at least one tag even on a single click on the page. It is important that the pen recognize the page ID and position on every interaction with the page, since the interaction is stateless.

In a preferred embodiment, the region to which a tag refers coincides with an entire page, and the region ID encoded in the tag is therefore synonymous with the page ID of the page on which the tag appears. In other embodiments, the region to which a tag refers can be an arbitrary subregion of a page or other surface. For example, it can coincide with the zone of an interactive element, in which case the region ID can directly identify the interactive element.

Table 1 - Tag data

Field	Precision (bits)
Region ID	100
Tag ID	16
Flags	4
Total	120

Each tag contains 120 bits of information, typically allocated as shown in Table 1. Assuming a maximum tag density of 64 per square inch, a 16-bit tag ID supports a region size of up to 1024 square inches. Larger regions can be mapped continuously without increasing the tag ID precision simply by using abutting regions and maps. The 100-bit region ID allows 2^{100} ($\sim 10^{30}$ or a million trillion trillion) different regions to be uniquely identified.

1.2.2 Tag Data Encoding

The 120 bits of tag data are redundantly encoded using a (15, 5) Reed-Solomon code. This yields 360

encoded bits consisting of 6 codewords of 15 4-bit symbols each. The (15, 5) code allows up to 5 symbol errors to be corrected per codeword, i.e. it is tolerant of a symbol error rate of up to 33% per codeword.

Each 4-bit symbol is represented in a spatially coherent way in the tag, and the symbols of the six codewords are interleaved spatially within the tag. This ensures that a burst error (an error affecting multiple spatially adjacent bits) damages a minimum number of symbols overall and a minimum number of symbols in any one codeword, thus maximising the likelihood that the burst error can be fully corrected.

1.2.3 Physical Tag Structure

The physical representation of the tag, shown in Figure 5, includes fixed target structures 15, 16, 17 and variable data areas 18. The fixed target structures allow a sensing device such as the netpage pen to detect the tag and infer its three-dimensional orientation relative to the sensor. The data areas contain representations of the individual bits of the encoded tag data.

To achieve proper tag reproduction, the tag is rendered at a resolution of 256×256 dots. When printed at 1600 dots per inch this yields a tag with a diameter of about 4 mm. At this resolution the tag is designed to be surrounded by a "quiet area" of radius 16 dots. Since the quiet area is also contributed by adjacent tags, it only adds 16 dots to the effective diameter of the tag.

The tag includes six target structures. A detection ring 15 allows the sensing device to initially detect the tag. The ring is easy to detect because it is rotationally invariant and because a simple correction of its aspect ratio removes most of the effects of perspective distortion. An orientation axis 16 allows the sensing device to determine the approximate planar orientation of the tag due to the yaw of the sensor. The orientation axis is skewed to yield a unique orientation. Four perspective targets 17 allow the sensing device to infer an accurate two-dimensional perspective transform of the tag and hence an accurate three-dimensional position and orientation of the tag relative to the sensor.

All target structures are redundantly large to improve their immunity to noise.

The overall tag shape is circular. This supports, amongst other things, optimal tag packing on an irregular triangular grid. In combination with the circular detection ring, this makes a circular arrangement of data bits within the tag optimal. To maximise its size, each data bit is represented by a radial wedge in the form of an area bounded by two radial lines and two concentric circular arcs. Each wedge has a minimum dimension of 8 dots at 1600 dpi and is designed so that its base (its inner arc), is at least equal to this minimum dimension. The height of the wedge in the radial direction is always equal to the minimum dimension. Each 4-bit data symbol is represented by an array of 2×2 wedges.

The 15 4-bit data symbols of each of the six codewords are allocated to the four concentric symbol rings 18a to 18d in interleaved fashion. Symbols are allocated alternately in circular progression around the tag.

The interleaving is designed to maximise the average spatial distance between any two symbols of the same codeword.

In order to support "single-click" interaction with a tagged region via a sensing device, the sensing device must be able to see at least one entire tag in its field of view no matter where in the region or at what orientation it is positioned. The required diameter of the field of view of the sensing device is therefore a function of the size and spacing of the tags.

Assuming a circular tag shape, the minimum diameter of the sensor field of view is obtained when the tags are tiled on a equilateral triangular grid, as shown in Figure 6.

1.2.4 Tag Image Processing and Decoding

The tag image processing and decoding performed by a sensing device such as the netpage pen is shown in Figure 7. While a captured image is being acquired from the image sensor, the dynamic range of the image is determined (at 20). The center of the range is then chosen as the binary threshold for the image 21. The image is then thresholded and segmented into connected pixel regions (i.e. shapes 23) (at 22). Shapes which are too small to represent tag target structures are discarded. The size and centroid of each shape is also computed.

Binary shape moments 25 are then computed (at 24) for each shape, and these provide the basis for subsequently locating target structures. Central shape moments are by their nature invariant of position, and can be easily made invariant of scale, aspect ratio and rotation.

The ring target structure 15 is the first to be located (at 26). A ring has the advantage of being very well behaved when perspective-distorted. Matching proceeds by aspect-normalizing and rotation-normalizing each shape's moments. Once its second-order moments are normalized the ring is easy to recognize even if the perspective distortion was significant. The ring's original aspect and rotation 27 together provide a useful approximation of the perspective transform.

The axis target structure 16 is the next to be located (at 28). Matching proceeds by applying the ring's normalizations to each shape's moments, and rotation-normalizing the resulting moments. Once its second-order moments are normalized the axis target is easily recognized. Note that one third order moment is required to disambiguate the two possible orientations of the axis. The shape is deliberately skewed to one side to make this possible. Note also that it is only possible to rotation-normalize the axis target after it has had the ring's normalizations applied, since the perspective distortion can hide the axis target's axis. The axis target's original rotation provides a useful approximation of the tag's rotation due to pen yaw 29.

The four perspective target structures 17 are the last to be located (at 30). Good estimates of their positions are computed based on their known spatial relationships to the ring and axis targets, the aspect and rotation of the ring, and the rotation of the axis. Matching proceeds by applying the ring's normalizations to each shape's moments. Once their second-order moments are normalized the circular perspective targets are easy to recognize, and the target closest to each estimated position is taken as a match. The original centroids of the four perspective targets are then taken to be the perspective-distorted corners 31 of a square of known size in tag space, and an eight-degree-of-freedom perspective transform 33 is inferred (at 32) based on solving the well-understood equations relating the four tag-space and image-space point pairs (see Heckbert, P., Fundamentals of Texture Mapping and Image Warping, Masters Thesis, Dept. of EECS, U. of California at Berkeley, Technical Report No. UCB/CSD 89/516, June 1989, the contents of which are herein incorporated by cross-reference).

The inferred tag-space to image-space perspective transform is used to project (at 36) each known data bit position in tag space into image space where the real-valued position is used to bilinearly interpolate (at 36) the four relevant adjacent pixels in the input image. The previously computed image threshold 21 is used to threshold the result to produce the final bit value 37.

Once all 360 data bits 37 have been obtained in this way, each of the six 60-bit Reed-Solomon codewords is decoded (at 38) to yield 20 decoded bits 39, or 120 decoded bits in total. Note that the codeword symbols are sampled in codeword order, so that codewords are implicitly de-interleaved during the sampling process.

The ring target 15 is only sought in a subarea of the image whose relationship to the image guarantees that the ring, if found, is part of a complete tag. If a complete tag is not found and successfully decoded, then no pen position is recorded for the current frame. Given adequate processing power and ideally a non-minimal field of view 193, an

alternative strategy involves seeking another tag in the current image.

The obtained tag data indicates the identity of the region containing the tag and the position of the tag within the region. An accurate position 35 of the pen nib in the region, as well as the overall orientation 35 of the pen, is then inferred (at 34) from the perspective transform 33 observed on the tag and the known spatial relationship between the pen's physical axis and the pen's optical axis.

1.2.5 Tag Map

Decoding a tag results in a region ID, a tag ID, and a tag-relative pen transform. Before the tag ID and the tag-relative pen location can be translated into an absolute location within the tagged region, the location of the tag within the region must be known. This is given by a tag map, a function which maps each tag ID in a tagged region to a corresponding location. The tag map class diagram is shown in Figure 22, as part of the netpage printer class diagram.

A tag map reflects the scheme used to tile the surface region with tags, and this can vary according to surface type. When multiple tagged regions share the same tiling scheme and the same tag numbering scheme, they can also share the same tag map.

The tag map for a region must be retrievable via the region ID. Thus, given a region ID, a tag ID and a pen transform, the tag map can be retrieved, the tag ID can be translated into an absolute tag location within the region, and the tag-relative pen location can be added to the tag location to yield an absolute pen location within the region.

1.2.6 Tagging Schemes

Two distinct surface coding schemes are of interest, both of which use the tag structure described earlier in this section. The preferred coding scheme uses "location-indicating" tags as already discussed. An alternative coding scheme uses object-indicating tags.

A location-indicating tag contains a tag ID which, when translated through the tag map associated with the tagged region, yields a unique tag location within the region. The tag-relative location of the pen is added to this tag location to yield the location of the pen within the region. This in turn is used to determine the location of the pen relative to a user interface element in the page description associated with the region. Not only is the user interface element itself identified, but a location relative to the user interface element is identified. Location-indicating tags therefore trivially support the capture of an absolute pen path in the zone of a particular user interface element.

An object-indicating tag contains a tag ID which directly identifies a user interface element in the page description associated with the region. All the tags in the zone of the user interface element identify the user interface element, making them all identical and therefore indistinguishable. Object-indicating tags do not, therefore, support the capture of an absolute pen path. They do, however, support the capture of a relative pen path. So long as the position sampling frequency exceeds twice the encountered tag frequency, the displacement from one sampled pen position to the next within a stroke can be unambiguously determined.

With either tagging scheme, the tags function in cooperation with associated visual elements on the netpage as user interactive elements in that a user can interact with the printed page using an appropriate sensing device in order for tag data to be read by the sensing device and for an appropriate response to be generated in the netpage system.

1.3 Document and Page Descriptions

A preferred embodiment of a document and page description class diagram is shown in Figures 25 and 26.

In the netpage system a document is described at three levels. At the most abstract level the document 836

has a hierarchical structure whose terminal elements 839 are associated with content objects 840 such as text objects, text style objects, image objects, etc. Once the document is printed on a printer with a particular page size and according to a particular user's scale factor preference, the document is paginated and otherwise formatted. Formatted terminal elements 835 will in some cases be associated with content objects which are different from those associated with their corresponding terminal elements, particularly where the content objects are style-related. Each printed instance of a document and page is also described separately, to allow input captured through a particular page instance 830 to be recorded separately from input captured through other instances of the same page description.

The presence of the most abstract document description on the page server allows a user to request a copy of a document without being forced to accept the source document's specific format. The user may be requesting a copy through a printer with a different page size, for example. Conversely, the presence of the formatted document description on the page server allows the page server to efficiently interpret user actions on a particular printed page.

A formatted document 834 consists of a set of formatted page descriptions 5, each of which consists of a set of formatted terminal elements 835. Each formatted element has a spatial extent or zone 58 on the page. This defines the active area of input elements such as hyperlinks and input fields.

A document instance 831 corresponds to a formatted document 834. It consists of a set of page instances 830, each of which corresponds to a page description 5 of the formatted document. Each page instance 830 describes a single unique printed netpage 1, and records the page ID 50 of the netpage. A page instance is not part of a document instance if it represents a copy of a page requested in isolation.

A page instance consists of a set of terminal element instances 832. An element instance only exists if it records instance-specific information. Thus, a hyperlink instance exists for a hyperlink element because it records a transaction ID 55 which is specific to the page instance, and a field instance exists for a field element because it records input specific to the page instance. An element instance does not exist, however, for static elements such as textflows.

A terminal element can be a static element 843, a hyperlink element 844, a field element 845 or a page server command element 846, as shown in Figure 27. A static element 843 can be a style element 847 with an associated style object 854, a textflow element 848 with an associated styled text object 855, an image element 849 with an associated image element 856, a graphic element 850 with an associated graphic object 857, a video clip element 851 with an associated video clip object 858, an audio clip element 852 with an associated audio clip object 859, or a script element 853 with an associated script object 860, as shown in Figure 28.

A page instance has a background field 833 which is used to record any digital ink captured on the page which does not apply to a specific input element.

In the preferred form of the invention, a tag map 811 is associated with each page instance to allow tags on the page to be translated into locations on the page.

1.4 THE NETPAGE NETWORK

In a preferred embodiment, a netpage network consists of a distributed set of netpage page servers 10, netpage registration servers 11, netpage ID servers 12, netpage application servers 13, netpage publication servers 14, and netpage printers 601 connected via a network 19 such as the Internet, as shown in Figure 3.

The netpage registration server 11 is a server which records relationships between users, pens, printers, applications and publications, and thereby authorizes various network activities. It authenticates users and acts as a signing proxy on behalf of authenticated users in application transactions. It also provides handwriting recognition

services. As described above, a netpage page server 10 maintains persistent information about page descriptions and page instances. The netpage network includes any number of page servers, each handling a subset of page instances. Since a page server also maintains user input values for each page instance, clients such as netpage printers send netpage input directly to the appropriate page server. The page server interprets any such input relative to the description of the corresponding page.

A netpage ID server 12 allocates document IDs 51 on demand, and provides load-balancing of page servers via its ID allocation scheme.

A netpage printer uses the Internet Distributed Name System (DNS), or similar, to resolve a netpage page ID 50 into the network address of the netpage page server handling the corresponding page instance.

A netpage application server 13 is a server which hosts interactive netpage applications. A netpage publication server 14 is an application server which publishes netpage documents to netpage printers. They are described in detail in Section 2.

Netpage servers can be hosted on a variety of network server platforms from manufacturers such as IBM, Hewlett-Packard, and Sun. Multiple netpage servers can run concurrently on a single host, and a single server can be distributed over a number of hosts. Some or all of the functionality provided by netpage servers, and in particular the functionality provided by the ID server and the page server, can also be provided directly in a netpage appliance such as a netpage printer, in a computer workstation, or on a local network.

1.5 THE NETPAGE PRINTER

The netpage printer 601 is an appliance which is registered with the netpage system and prints netpage documents on demand and via subscription. Each printer has a unique printer ID 62, and is connected to the netpage network via a network such as the Internet, ideally via a broadband connection.

Apart from identity and security settings in non-volatile memory, the netpage printer contains no persistent storage. As far as a user is concerned, "the network is the computer". Netpages function interactively across space and time with the help of the distributed netpage page servers 10, independently of particular netpage printers.

The netpage printer receives subscribed netpage documents from netpage publication servers 14. Each document is distributed in two parts: the page layouts, and the actual text and image objects which populate the pages. Because of personalization, page layouts are typically specific to a particular subscriber and so are pointcast to the subscriber's printer via the appropriate page server. Text and image objects, on the other hand, are typically shared with other subscribers, and so are multicast to all subscribers' printers and the appropriate page servers.

The netpage publication server optimizes the segmentation of document content into pointcasts and multicasts. After receiving the pointcast of a document's page layouts, the printer knows which multicasts, if any, to listen to.

Once the printer has received the complete page layouts and objects that define the document to be printed, it can print the document.

The printer rasterizes and prints odd and even pages simultaneously on both sides of the sheet. It contains duplexed print engine controllers 760 and print engines utilizing Memjet™ printheads 350 for this purpose.

The printing process consists of two decoupled stages: rasterization of page descriptions, and expansion and printing of page images. The raster image processor (RIP) consists of one or more standard DSPs 757 running in parallel.

The duplexed print engine controllers consist of custom processors which expand, dither and print page images in real time, synchronized with the operation of the printheads in the print engines.

Printers not enabled for IR printing have the option to print tags using IR-absorptive black ink, although this restricts tags to otherwise empty areas of the page. Although such pages have more limited functionality than IR-printed pages, they are still classed as netpages.

A normal netpage printer prints netpages on sheets of paper. More specialised netpage printers may print onto more specialised surfaces, such as globes. Each printer supports at least one surface type, and supports at least one tag tiling scheme, and hence tag map, for each surface type. The tag map 811 which describes the tag tiling scheme actually used to print a document becomes associated with that document so that the document's tags can be correctly interpreted.

Figure 2 shows the netpage printer class diagram, reflecting printer-related information maintained by a registration server 11 on the netpage network.

A preferred embodiment of the netpage printer is described in greater detail in Section 6 below, with reference to Figures 11 to 16.

1.5.1 Memjet™ Printheads

The netpage system can operate using printers made with a wide range of digital printing technologies, including thermal inkjet, piezoelectric inkjet, laser electrophotographic, and others. However, for wide consumer acceptance, it is desirable that a netpage printer have the following characteristics:

- photographic quality color printing
- high quality text printing
- high reliability
- low printer cost
- low ink cost
- low paper cost
- simple operation
- nearly silent printing
- high printing speed
- simultaneous double sided printing
- compact form factor
- low power consumption

No commercially available printing technology has all of these characteristics.

To enable to production of printers with these characteristics, the present applicant has invented a new print technology, referred to as Memjet™ technology. Memjet™ is a drop-on-demand inkjet technology that incorporates pagewidth printheads fabricated using microelectromechanical systems (MEMS) technology. Figure 17 shows a single printing element 300 of a Memjet™ printhead. The netpage wallprinter incorporates 168960 printing elements 300 to form a 1600 dpi pagewidth duplex printer. This printer simultaneously prints cyan, magenta, yellow, black, and infrared

inks as well as paper conditioner and ink fixative.

The printing element 300 is approximately 110 microns long by 32 microns wide. Arrays of these printing elements are formed on a silicon substrate 301 that incorporates CMOS logic, data transfer, timing, and drive circuits (not shown).

Major elements of the printing element 300 are the nozzle 302, the nozzle rim 303, the nozzle chamber 304, the fluidic seal 305, the ink channel rim 306, the lever arm 307, the active actuator beam pair 308, the passive actuator beam pair 309, the active actuator anchor 310, the passive actuator anchor 311, and the ink inlet 312.

The active actuator beam pair 308 is mechanically joined to the passive actuator beam pair 309 at the join 319. Both beams pairs are anchored at their respective anchor points 310 and 311. The combination of elements 308, 309, 310, 311, and 319 form a cantilevered electrothermal bend actuator 320.

Figure 18 shows a small part of an array of printing elements 300, including a cross section 315 of a printing element 300. The cross section 315 is shown without ink, to clearly show the ink inlet 312 that passes through the silicon wafer 301.

Figures 19(a), 19(b) and 19(c) show the operating cycle of a Memjet™ printing element 300.

Figure 19(a) shows the quiescent position of the ink meniscus 316 prior to printing an ink droplet. Ink is retained in the nozzle chamber by surface tension at the ink meniscus 316 and at the fluidic seal 305 formed between the nozzle chamber 304 and the ink channel rim 306.

While printing, the printhead CMOS circuitry distributes data from the print engine controller to the correct printing element, latches the data, and buffers the data to drive the electrodes 318 of the active actuator beam pair 308. This causes an electrical current to pass through the beam pair 308 for about one microsecond, resulting in Joule heating. The temperature increase resulting from Joule heating causes the beam pair 308 to expand. As the passive actuator beam pair 309 is not heated, it does not expand, resulting in a stress difference between the two beam pairs. This stress difference is partially resolved by the cantilevered end of the electrothermal bend actuator 320 bending towards the substrate 301. The lever arm 307 transmits this movement to the nozzle chamber 304. The nozzle chamber 304 moves about two microns to the position shown in Figure 19(b). This increases the ink pressure, forcing ink 321 out of the nozzle 302, and causing the ink meniscus 316 to bulge. The nozzle rim 303 prevents the ink meniscus 316 from spreading across the surface of the nozzle chamber 304.

As the temperature of the beam pairs 308 and 309 equalizes, the actuator 320 returns to its original position. This aids in the break-off of the ink droplet 317 from the ink 321 in the nozzle chamber, as shown in Figure 19(c). The nozzle chamber is refilled by the action of the surface tension at the meniscus 316.

Figure 20 shows a segment of a printhead 350. In a netpage printer, the length of the printhead is the full width of the paper (typically 210 mm) in the direction 351. The segment shown is 0.4 mm long (about 0.2% of a complete printhead). When printing, the paper is moved past the fixed printhead in the direction 352. The printhead has 6 rows of interdigitated printing elements 300, printing the six colors or types of ink supplied by the ink inlets 312.

To protect the fragile surface of the printhead during operation, a nozzle guard wafer 330 is attached to the printhead substrate 301. For each nozzle 302 there is a corresponding nozzle guard hole 331 through which the ink droplets are fired. To prevent the nozzle guard holes 331 from becoming blocked by paper fibers or other debris, filtered air is pumped through the air inlets 332 and out of the nozzle guard holes during printing. To prevent ink 321 from drying, the nozzle guard is sealed while the printer is idle.

1.6 The Netpage Pen

The active sensing device of the netpage system is typically a pen 101, which, using its embedded controller 134, is able to capture and decode IR position tags from a page via an image sensor. The image sensor is a solid-state device provided with an appropriate filter to permit sensing at only near-infrared wavelengths. As described in more detail below, the system is able to sense when the nib is in contact with the surface, and the pen is able to sense tags at a sufficient rate to capture human handwriting (i.e. at 200 dpi or greater and 100 Hz or faster). Information captured by the pen is encrypted and wirelessly transmitted to the printer (or base station), the printer or base station interpreting the data with respect to the (known) page structure.

The preferred embodiment of the netpage pen operates both as a normal marking ink pen and as a non-marking stylus. The marking aspect, however, is not necessary for using the netpage system as a browsing system, such as when it is used as an Internet interface. Each netpage pen is registered with the netpage system and has a unique pen ID 61. Figure 23 shows the netpage pen class diagram, reflecting pen-related information maintained by a registration server 11 on the netpage network.

When either nib is in contact with a netpage, the pen determines its position and orientation relative to the page. The nib is attached to a force sensor, and the force on the nib is interpreted relative to a threshold to indicate whether the pen is "up" or "down". This allows a interactive element on the page to be 'clicked' by pressing with the pen nib, in order to request, say, information from a network. Furthermore, the force is captured as a continuous value to allow, say, the full dynamics of a signature to be verified.

The pen determines the position and orientation of its nib on the netpage by imaging, in the infrared spectrum, an area 193 of the page in the vicinity of the nib. It decodes the nearest tag and computes the position of the nib relative to the tag from the observed perspective distortion on the imaged tag and the known geometry of the pen optics. Although the position resolution of the tag may be low, because the tag density on the page is inversely proportional to the tag size, the adjusted position resolution is quite high, exceeding the minimum resolution required for accurate handwriting recognition.

Pen actions relative to a netpage are captured as a series of strokes. A stroke consists of a sequence of time-stamped pen positions on the page, initiated by a pen-down event and completed by the subsequent pen-up event. A stroke is also tagged with the page ID 50 of the netpage whenever the page ID changes, which, under normal circumstances, is at the commencement of the stroke.

Each netpage pen has a current selection 826 associated with it, allowing the user to perform copy and paste operations etc. The selection is timestamped to allow the system to discard it after a defined time period. The current selection describes a region of a page instance. It consists of the most recent digital ink stroke captured through the pen relative to the background area of the page. It is interpreted in an application-specific manner once it is submitted to an application via a selection hyperlink activation.

Each pen has a current nib 824. This is the nib last notified by the pen to the system. In the case of the default netpage pen described above, either the marking black ink nib or the non-marking stylus nib is current. Each pen also has a current nib style 825. This is the nib style last associated with the pen by an application, e.g. in response to the user selecting a color from a palette. The default nib style is the nib style associated with the current nib. Strokes captured through a pen are tagged with the current nib style. When the strokes are subsequently reproduced, they are reproduced in the nib style with which they are tagged.

Whenever the pen is within range of a printer with which it can communicate, the pen slowly flashes its "online" LED. When the pen fails to decode a stroke relative to the page, it momentarily activates its "error" LED. When

the pen succeeds in decoding a stroke relative to the page, it momentarily activates its "ok" LED.

A sequence of captured strokes is referred to as digital ink. Digital ink forms the basis for the digital exchange of drawings and handwriting, for online recognition of handwriting, and for online verification of signatures.

The pen is wireless and transmits digital ink to the netpage printer via a short-range radio link. The transmitted digital ink is encrypted for privacy and security and packetized for efficient transmission, but is always flushed on a pen-up event to ensure timely handling in the printer.

When the pen is out-of-range of a printer it buffers digital ink in internal memory, which has a capacity of over ten minutes of continuous handwriting. When the pen is once again within range of a printer, it transfers any buffered digital ink.

A pen can be registered with any number of printers, but because all state data resides in netpages both on paper and on the network, it is largely immaterial which printer a pen is communicating with at any particular time.

A preferred embodiment of the pen is described in greater detail in Section 6 below, with reference to Figures 8 to 10.

1.7 NETPAGE INTERACTION

The netpage printer 601 receives data relating to a stroke from the pen 101 when the pen is used to interact with a netpage 1. The coded data 3 of the tags 4 is read by the pen when it is used to execute a movement, such as a stroke. The data allows the identity of the particular page and associated interactive element to be determined and an indication of the relative positioning of the pen relative to the page to be obtained. The indicating data is transmitted to the printer, where it resolves, via the DNS, the page ID 50 of the stroke into the network address of the netpage page server 10 which maintains the corresponding page instance 830. It then transmits the stroke to the page server. If the page was recently identified in an earlier stroke, then the printer may already have the address of the relevant page server in its cache. Each netpage consists of a compact page layout maintained persistently by a netpage page server (see below). The page layout refers to objects such as images, fonts and pieces of text, typically stored elsewhere on the netpage network.

When the page server receives the stroke from the pen, it retrieves the page description to which the stroke applies, and determines which element of the page description the stroke intersects. It is then able to interpret the stroke in the context of the type of the relevant element.

A "click" is a stroke where the distance and time between the pen down position and the subsequent pen up position are both less than some small maximum. An object which is activated by a click typically requires a click to be activated, and accordingly, a longer stroke is ignored. The failure of a pen action, such as a "sloppy" click, to register is indicated by the lack of response from the pen's "ok" LED.

There are two kinds of input elements in a netpage page description: hyperlinks and form fields. Input through a form field can also trigger the activation of an associated hyperlink.

1.7.1 Hyperlinks

A hyperlink is a means of sending a message to a remote application, and typically elicits a printed response in the netpage system.

A hyperlink element 844 identifies the application 71 which handles activation of the hyperlink, a link ID 54 which identifies the hyperlink to the application, an "alias required" flag which asks the system to include the user's application alias ID 65 in the hyperlink activation, and a description which is used when the hyperlink is recorded as a

favorite or appears in the user's history. The hyperlink element class diagram is shown in Figure 29.

When a hyperlink is activated, the page server sends a request to an application somewhere on the network. The application is identified by an application ID 64, and the application ID is resolved in the normal way via the DNS. There are three types of hyperlinks: general hyperlinks 863, form hyperlinks 865, and selection hyperlinks 864, as shown in Figure 30. A general hyperlink can implement a request for a linked document, or may simply signal a preference to a server. A form hyperlink submits the corresponding form to the application. A selection hyperlink submits the current selection to the application. If the current selection contains a single-word piece of text, for example, the application may return a single-page document giving the word's meaning within the context in which it appears, or a translation into a different language. Each hyperlink type is characterized by what information is submitted to the application.

The corresponding hyperlink instance 862 records a transaction ID 55 which can be specific to the page instance on which the hyperlink instance appears. The transaction ID can identify user-specific data to the application, for example a "shopping cart" of pending purchases maintained by a purchasing application on behalf of the user.

The system includes the pen's current selection 826 in a selection hyperlink activation. The system includes the content of the associated form instance 868 in a form hyperlink activation, although if the hyperlink has its "submit delta" attribute set, only input since the last form submission is included. The system includes an effective return path in all hyperlink activations.

A hyperlinked group 866 is a group element 838 which has an associated hyperlink, as shown in Figure 31. When input occurs through any field element in the group, the hyperlink 844 associated with the group is activated. A hyperlinked group can be used to associate hyperlink behavior with a field such as a checkbox. It can also be used, in conjunction with the "submit delta" attribute of a form hyperlink, to provide continuous input to an application. It can therefore be used to support a "blackboard" interaction model, i.e. where input is captured and therefore shared as soon as it occurs.

1.7.2 Forms

A form defines a collection of related input fields used to capture a related set of inputs through a printed netpage. A form allows a user to submit one or more parameters to an application software program running on a server.

A form 867 is a group element 838 in the document hierarchy. It ultimately contains a set of terminal field elements 839. A form instance 868 represents a printed instance of a form. It consists of a set of field instances 870 which correspond to the field elements 845 of the form. Each field instance has an associated value 871, whose type depends on the type of the corresponding field element. Each field value records input through a particular printed form instance, i.e. through one or more printed netpages. The form class diagram is shown in Figure 32.

Each form instance has a status 872 which indicates whether the form is active, frozen, submitted, void or expired. A form is active when first printed. A form becomes frozen once it is signed or once its freeze time is reached. A form becomes submitted once one of its submission hyperlinks has been activated, unless the hyperlink has its "submit delta" attribute set. A form becomes void when the user invokes a void form, reset form or duplicate form page command. A form expires when its specified expiry time is reached, i.e. when the time the form has been active exceeds the form's specified lifetime. While the form is active, form input is allowed. Input through a form which is not active is instead captured in the background field 833 of the relevant page instance. When the form is active or frozen, form submission is allowed. Any attempt to submit a form when the form is not active or frozen is rejected, and instead elicits an form status report.

Each form instance is associated (at 59) with any form instances derived from it, thus providing a version

history. This allows all but the latest version of a form in a particular time period to be excluded from a search.

All input is captured as digital ink. Digital ink 873 consists of a set of timestamped stroke groups 874, each of which consists of a set of styled strokes 875. Each stroke consists of a set of timestamped pen positions 876, each of which also includes pen orientation and nib force. The digital ink class diagram is shown in Figure 33.

A field element 845 can be a checkbox field 877, a text field 878, a drawing field 879, or a signature field 880. The field element class diagram is shown in Figure 34. Any digital ink captured in a field's zone 58 is assigned to the field.

A checkbox field has an associated boolean value 881, as shown in Figure 35. Any mark (a tick, a cross, a stroke, a fill zigzag, etc.) captured in a checkbox field's zone causes a true value to be assigned to the field's value.

A text-field has an associated text value 882, as shown in Figure 36. Any digital ink captured in a text field's zone is automatically converted to text via online handwriting recognition, and the text is assigned to the field's value. Online handwriting recognition is well-understood (see, for example, Tappert, C., C.Y. Suen and T. Wakahara, "The State of the Art in On-Line Handwriting Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence, Vol.12, No.8, August 1990, the contents of which are herein incorporated by cross-reference).

A signature field has an associated digital signature value 883, as shown in Figure 37. Any digital ink captured in a signature field's zone is automatically verified with respect to the identity of the owner of the pen, and a digital signature of the content of the form of which the field is part is generated and assigned to the field's value. The digital signature is generated using the pen user's private signature key specific to the application which owns the form. Online signature verification is well-understood (see, for example, Plamondon, R. and G. Lorette, "Automatic Signature Verification and Writer Identification – The State of the Art", Pattern Recognition, Vol.22, No.2, 1989, the contents of which are herein incorporated by cross-reference).

A field element is hidden if its "hidden" attribute is set. A hidden field element does not have an input zone on a page and does not accept input. It can have an associated field value which is included in the form data when the form containing the field is submitted.

"Editing" commands, such as strike-throughs indicating deletion, can also be recognized in form fields.

Because the handwriting recognition algorithm works "online" (i.e. with access to the dynamics of the pen movement), rather than "offline" (i.e. with access only to a bitmap of pen markings), it can recognize run-on discretely-written characters with relatively high accuracy, without a writer-dependent training phase. A writer-dependent model of handwriting is automatically generated over time, however, and can be generated up-front if necessary,

Digital ink, as already stated, consists of a sequence of strokes. Any stroke which starts in a particular element's zone is appended to that element's digital ink stream, ready for interpretation. Any stroke not appended to an object's digital ink stream is appended to the background field's digital ink stream.

Digital ink captured in the background field is interpreted as a selection gesture. Circumscription of one or more objects is generally interpreted as a selection of the circumscribed objects, although the actual interpretation is application-specific.

Table 2 summarises these various pen interactions with a netpage.

Table 2 - Summary of pen interactions with a netpage

Object	Type	Pen input	Action
Hyperlink	General	Click	Submit action to application
	Form	Click	Submit form to application
	Selection	Click	Submit selection to application
Form field	Checkbox	Any mark	Assign true to field
	Text	Handwriting	Convert digital ink to text; assign text to field
	Drawing	Digital ink	Assign digital ink to field
	Signature	Signature	Verify digital ink signature; generate digital signature of form; assign digital signature to field
None	-	Circumscription	Assign digital ink to current selection

The system maintains a current selection for each pen. The selection consists simply of the most recent stroke captured in the background field. The selection is cleared after an inactivity timeout to ensure predictable behavior.

The raw digital ink captured in every field is retained on the netpage page server and is optionally transmitted with the form data when the form is submitted to the application. This allows the application to interrogate the raw digital ink should it suspect the original conversion, such as the conversion of handwritten text. This can, for example, involve human intervention at the application level for forms which fail certain application-specific consistency checks. As an extension to this, the entire background area of a form can be designated as a drawing field. The application can then decide, on the basis of the presence of digital ink outside the explicit fields of the form, to route the form to a human operator, on the assumption that the user may have indicated amendments to the filled-in fields outside of those fields.

Figure 38 shows a flowchart of the process of handling pen input relative to a netpage. The process consists of receiving (at 884) a stroke from the pen; identifying (at 885) the page instance 830 to which the page ID 50 in the stroke refers; retrieving (at 886) the page description 5; identifying (at 887) a formatted element 839 whose zone 58 the stroke intersects; determining (at 888) whether the formatted element corresponds to a field element, and if so appending (at 892) the received stroke to the digital ink of the field value 871, interpreting (at 893) the accumulated digital ink of the field, and determining (at 894) whether the field is part of a hyperlinked group 866 and if so activating (at 895) the associated hyperlink; alternatively determining (at 889) whether the formatted element corresponds to a hyperlink element and if so activating (at 895) the corresponding hyperlink; alternatively, in the absence of an input field or hyperlink, appending (at 890) the received stroke to the digital ink of the background field 833; and copying (at 891) the received stroke to the current selection 826 of the current pen, as maintained by the registration server.

Figure 38a shows a detailed flowchart of step 893 in the process shown in Figure 38, where the accumulated digital ink of a field is interpreted according to the type of the field. The process consists of determining (at 896) whether the field is a checkbox and (at 897) whether the digital ink represents a checkmark, and if so assigning (at 898) a true value to the field value; alternatively determining (at 899) whether the field is a text field and if so converting (at 900) the digital ink to computer text, with the help of the appropriate registration server, and assigning (at 901) the converted computer text to the field value; alternatively determining (at 902) whether the field is a signature field and if so verifying (at 903) the digital ink as the signature of the pen's owner, with the help of the appropriate registration server, creating (at 904) a digital signature of the contents of the corresponding form, also with the help of the registration server and using the pen owner's private signature key relating to the corresponding application, and assigning (at 905) the digital signature to the field value.

1.7.3 Page Server Commands

A page server command is a command which is handled locally by the page server. It operates directly on form, page and document instances.

A page server command 907 can be a void form command 908, a duplicate form command 909, a reset form command 910, a get form status command 911, a duplicate page command 912, a reset page command 913, a get page status command 914, a duplicate document command 915, a reset document command 916, or a get document status command 917, as shown in Figure 39.

A void form command voids the corresponding form instance. A duplicate form command voids the corresponding form instance and then produces an active printed copy of the current form instance with field values preserved. The copy contains the same hyperlink transaction IDs as the original, and so is indistinguishable from the original to an application. A reset form command voids the corresponding form instance and then produces an active printed copy of the form instance with field values discarded. A get form status command produces a printed report on the status of the corresponding form instance, including who published it, when it was printed, for whom it was printed, and the form status of the form instance.

Since a form hyperlink instance contains a transaction ID, the application has to be involved in producing a new form instance. A button requesting a new form instance is therefore typically implemented as a hyperlink.

A duplicate page command produces a printed copy of the corresponding page instance with the background field value preserved. If the page contains a form or is part of a form, then the duplicate page command is interpreted as a duplicate form command. A reset page command produces a printed copy of the corresponding page instance with the background field value discarded. If the page contains a form or is part of a form, then the reset page command is interpreted as a reset form command. A get page status command produces a printed report on the status of the corresponding page instance, including who published it, when it was printed, for whom it was printed, and the status of any forms it contains or is part of.

The netpage logo which appears on every netpage is usually associated with a duplicate page element.

When a page instance is duplicated with field values preserved, field values are printed in their native form, i.e. a checkmark appears as a standard checkmark graphic, and text appears as typeset text. Only drawings and signatures appear in their original form, with a signature accompanied by a standard graphic indicating successful signature verification.

A duplicate document command produces a printed copy of the corresponding document instance with background field values preserved. If the document contains any forms, then the duplicate document command duplicates the forms in the same way a duplicate form command does. A reset document command produces a printed copy of the corresponding document instance with background field values discarded. If the document contains any forms, then the reset document command resets the forms in the same way a reset form command does. A get document status command produces a printed report on the status of the corresponding document instance, including who published it, when it was printed, for whom it was printed, and the status of any forms it contains.

If the page server command's "on selected" attribute is set, then the command operates on the page identified by the pen's current selection rather than on the page containing the command. This allows a menu of page server commands to be printed. If the target page doesn't contain a page server command element for the designated page server command, then the command is ignored.

An application can provide application-specific handling by embedding the relevant page server command element in a hyperlinked group. The page server activates the hyperlink associated with the hyperlinked group rather than executing the page server command.

A page server command element is hidden if its "hidden" attribute is set. A hidden command element does

not have an input zone on a page and so cannot be activated directly by a user. It can, however, be activated via a page server command embedded in a different page, if that page server command has its "on selected" attribute set.

1.8 STANDARD FEATURES OF NETPAGES

In the preferred form, each netpage is printed with the netpage logo at the bottom to indicate that it is a netpage and therefore has interactive properties. The logo also acts as a copy button. In most cases pressing the logo produces a copy of the page. In the case of a form, the button produces a copy of the entire form. And in the case of a secure document, such as a ticket or coupon, the button elicits an explanatory note or advertising page.

The default single-page copy function is handled directly by the relevant netpage page server. Special copy functions are handled by linking the logo button to an application.

1.9 USER HELP SYSTEM

In a preferred embodiment, the netpage printer has a single button labelled "Help". When pressed it elicits a single help page 46 of information, including:

- status of printer connection
- status of printer consumables
- top-level help menu
- document function menu
- top-level netpage network directory

The help menu provides a hierarchical manual on how to use the netpage system.

The document function menu includes the following functions:

- print a copy of a document
- print a clean copy of a form
- print the status of a document

A document function is initiated by selecting the document and then pressing the button. The status of a document indicates who published it and when, to whom it was delivered, and to whom and when it was subsequently submitted as a form.

The help page is obviously unavailable if the printer is unable to print. In this case the "error" light is lit and the user can request remote diagnosis over the network.

2 PERSONALIZED PUBLICATION MODEL

In the following description, news is used as a canonical publication example to illustrate personalization mechanisms in the netpage system. Although news is often used in the limited sense of newspaper and newsmagazine news, the intended scope in the present context is wider.

In the netpage system, the editorial content and the advertising content of a news publication are personalized using different mechanisms. The editorial content is personalized according to the reader's explicitly stated and implicitly captured interest profile. The advertising content is personalized according to the reader's locality and demographic.

2.1 EDITORIAL PERSONALIZATION

A subscriber can draw on two kinds of news sources: those that deliver news publications, and those that deliver news streams. While news publications are aggregated and edited by the publisher, news streams are aggregated either by a news publisher or by a specialized news aggregator. News publications typically correspond to traditional newspapers and newsmagazines, while news streams can be many and varied: a "raw" news feed from a news service, a cartoon strip, a freelance writer's column, a friend's bulletin board, or the reader's own e-mail.

The netpage publication server supports the publication of edited news publications as well as the aggregation of multiple news streams. By handling the aggregation and hence the formatting of news streams selected directly by the reader, the server is able to place advertising on pages over which it otherwise has no editorial control.

The subscriber builds a daily newspaper by selecting one or more contributing news publications, and creating a personalized version of each. The resulting daily editions are printed and bound together into a single newspaper. The various members of a household typically express their different interests and tastes by selecting different daily publications and then customizing them.

For each publication, the reader optionally selects specific sections. Some sections appear daily, while others appear weekly. The daily sections available from The New York Times online, for example, include "Page One Plus", "National", "International", "Opinion", "Business", "Arts/Living", "Technology", and "Sports". The set of available sections is specific to a publication, as is the default subset.

The reader can extend the daily newspaper by creating custom sections, each one drawing on any number of news streams. Custom sections might be created for e-mail and friends' announcements ("Personal"), or for monitoring news feeds for specific topics ("Alerts" or "Clippings").

For each section, the reader optionally specifies its size, either qualitatively (e.g. short, medium, or long), or numerically (i.e. as a limit on its number of pages), and the desired proportion of advertising, either qualitatively (e.g. high, normal, low, none), or numerically (i.e. as a percentage).

The reader also optionally expresses a preference for a large number of shorter articles or a small number of longer articles. Each article is ideally written (or edited) in both short and long forms to support this preference.

An article may also be written (or edited) in different versions to match the expected sophistication of the reader, for example to provide children's and adults' versions. The appropriate version is selected according to the reader's age. The reader can specify a "reading age" which takes precedence over their biological age.

The articles which make up each section are selected and prioritized by the editors, and each is assigned a useful lifetime. By default they are delivered to all relevant subscribers, in priority order, subject to space constraints in the subscribers' editions.

In sections where it is appropriate, the reader may optionally enable collaborative filtering. This is then applied to articles which have a sufficiently long lifetime. Each article which qualifies for collaborative filtering is printed with rating buttons at the end of the article. The buttons can provide an easy choice (e.g. "liked" and "disliked"), making it more likely that readers will bother to rate the article.

Articles with high priorities and short lifetimes are therefore effectively considered essential reading by the editors and are delivered to most relevant subscribers.

The reader optionally specifies a serendipity factor, either qualitatively (e.g. do or don't surprise me), or numerically. A high serendipity factor lowers the threshold used for matching during collaborative filtering. A high factor

makes it more likely that the corresponding section will be filled to the reader's specified capacity. A different serendipity factor can be specified for different days of the week.

The reader also optionally specifies topics of particular interest within a section, and this modifies the priorities assigned by the editors.

The speed of the reader's Internet connection affects the quality at which images can be delivered. The reader optionally specifies a preference for fewer images or smaller images or both. If the number or size of images is not reduced, then images may be delivered at lower quality (i.e. at lower resolution or with greater compression).

At a global level, the reader specifies how quantities, dates, times and monetary values are localized. This involves specifying whether units are imperial or metric, a local timezone and time format, and a local currency, and whether the localization consist of *in situ* translation or annotation. These preferences are derived from the reader's locality by default.

To reduce reading difficulties caused by poor eyesight, the reader optionally specifies a global preference for a larger presentation. Both text and images are scaled accordingly, and less information is accommodated on each page.

The language in which a news publication is published, and its corresponding text encoding, is a property of the publication and not a preference expressed by the user. However, the netpage system can be configured to provide automatic translation services in various guises.

2.2 Advertising Localization and Targeting

The personalization of the editorial content directly affects the advertising content, because advertising is typically placed to exploit the editorial context. Travel ads, for example, are more likely to appear in a travel section than elsewhere. The value of the editorial content to an advertiser (and therefore to the publisher) lies in its ability to attract large numbers of readers with the right demographics.

Effective advertising is placed on the basis of locality and demographics. Locality determines proximity to particular services, retailers etc., and particular interests and concerns associated with the local community and environment. Demographics determine general interests and preoccupations as well as likely spending patterns.

A news publisher's most profitable product is advertising "space", a multi-dimensional entity determined by the publication's geographic coverage, the size of its readership, its readership demographics, and the page area available for advertising.

In the netpage system, the netpage publication server computes the approximate multi-dimensional size of a publication's saleable advertising space on a per-section basis, taking into account the publication's geographic coverage, the section's readership, the size of each reader's section edition, each reader's advertising proportion, and each reader's demographic.

In comparison with other media, the netpage system allows the advertising space to be defined in greater detail, and allows smaller pieces of it to be sold separately. It therefore allows it to be sold at closer to its true value.

For example, the same advertising "slot" can be sold in varying proportions to several advertisers, with individual readers' pages randomly receiving the advertisement of one advertiser or another, overall preserving the proportion of space sold to each advertiser.

The netpage system allows advertising to be linked directly to detailed product information and online purchasing. It therefore raises the intrinsic value of the advertising space.

Because personalization and localization are handled automatically by netpage publication servers, an advertising aggregator can provide arbitrarily broad coverage of both geography and demographics. The subsequent disaggregation is efficient because it is automatic. This makes it more cost-effective for publishers to deal with advertising aggregators than to directly capture advertising. Even though the advertising aggregator is taking a proportion of advertising revenue, publishers may find the change profit-neutral because of the greater efficiency of aggregation. The advertising aggregator acts as an intermediary between advertisers and publishers, and may place the same advertisement in multiple publications.

It is worth noting that ad placement in a netpage publication can be more complex than ad placement in the publication's traditional counterpart, because the publication's advertising space is more complex. While ignoring the full complexities of negotiations between advertisers, advertising aggregators and publishers, the preferred form of the netpage system provides some automated support for these negotiations, including support for automated auctions of advertising space. Automation is particularly desirable for the placement of advertisements which generate small amounts of income, such as small or highly localized advertisements.

Once placement has been negotiated, the aggregator captures and edits the advertisement and records it on a netpage ad server. Correspondingly, the publisher records the ad placement on the relevant netpage publication server. When the netpage publication server lays out each user's personalized publication, it picks the relevant advertisements from the netpage ad server.

2.3 User Profiles

2.3.1 Information Filtering

The personalization of news and other publications relies on an assortment of user-specific profile information, including:

- publication customizations
- collaborative filtering vectors
- contact details
- presentation preferences

The customization of a publication is typically publication-specific, and so the customization information is maintained by the relevant netpage publication server.

A collaborative filtering vector consists of the user's ratings of a number of news items. It is used to correlate different users' interests for the purposes of making recommendations. Although there are benefits to maintaining a single collaborative filtering vector independently of any particular publication, there are two reasons why it is more practical to maintain a separate vector for each publication: there is likely to be more overlap between the vectors of subscribers to the same publication than between those of subscribers to different publications; and a publication is likely to want to present its users' collaborative filtering vectors as part of the value of its brand, not to be found elsewhere. Collaborative filtering vectors are therefore also maintained by the relevant netpage publication server.

Contact details, including name, street address, ZIP Code, state, country, telephone numbers, are global by nature, and are maintained by a netpage registration server.

Presentation preferences, including those for quantities, dates and times, are likewise global and maintained in the same way.

The localization of advertising relies on the locality indicated in the user's contact details, while the targeting of advertising relies on personal information such as date of birth, gender, marital status, income, profession, education, or qualitative derivatives such as age range and income range.

For those users who choose to reveal personal information for advertising purposes, the information is maintained by the relevant netpage registration server. In the absence of such information, advertising can be targeted on the basis of the demographic associated with the user's ZIP or ZIP+4 Code.

Each user, pen, printer, application provider and application is assigned its own unique identifier, and the netpage registration server maintains the relationships between them, as shown in Figures 21, 22, 23 and 24. For registration purposes, a publisher is a special kind of application provider, and a publication is a special kind of application.

Each user 800 may be authorized to use any number of printers 802, and each printer may allow any number of users to use it. Each user has a single default printer (at 66), to which periodical publications are delivered by default, whilst pages printed on demand are delivered to the printer through which the user is interacting. The server keeps track of which publishers a user has authorized to print to the user's default printer. A publisher does not record the ID of any particular printer, but instead resolves the ID when it is required. The user may also be designated as having administrative privileges 69 on the printer, allowing the user to authorize other users to use the printer. This only has meaning if the printer requires administrative privileges 84 for such operations.

When a user subscribes 808 to a publication 807, the publisher 806 (i.e. application provider 803) is authorized to print to a specified printer or the user's default printer. This authorization can be revoked at any time by the user. Each user may have several pens 801, but a pen is specific to a single user. If a user is authorized to use a particular printer, then that printer recognizes any of the user's pens.

The pen ID is used to locate the corresponding user profile maintained by a particular netpage registration server, via the DNS in the usual way.

A Web terminal 809 can be authorized to print on a particular netpage printer, allowing Web pages and netpage documents encountered during Web browsing to be conveniently printed on the nearest netpage printer.

The netpage system can collect, on behalf of a printer provider, fees and commissions on income earned through publications printed on the provider's printers. Such income can include advertising fees, click-through fees, e-commerce commissions, and transaction fees. If the printer is owned by the user, then the user is the printer provider.

Each user also has a netpage account 820 which is used to accumulate micro-debits and credits (such as those described in the preceding paragraph); contact details 815, including name, address and telephone numbers; global preferences 816, including privacy, delivery and localization settings; any number of biometric records 817, containing the user's encoded signature 818, fingerprint 819 etc; a handwriting model 819 automatically maintained by the system; and SET payment card accounts 821, with which e-commerce payments can be made.

In addition to the user-specific netpage account, each user also has a netpage account 936 specific to each printer the user is authorized to use. Each printer-specific account is used to accumulate micro-debits and credits related to the user's activities on that printer. The user is billed on a regular basis for any outstanding debit balances.

A user optionally appears in the netpage user directory 823, allowing other users to locate and direct e-mail (etc.) to the user.

2.4 INTELLIGENT PAGE LAYOUT

The netpage publication server automatically lays out the pages of each user's personalized publication on a section-by-section basis. Since most advertisements are in the form of pre-formatted rectangles, they are placed on the page before the editorial content.

The advertising ratio for a section can be achieved with wildly varying advertising ratios on individual pages within the section, and the ad layout algorithm exploits this. The algorithm is configured to attempt to co-locate closely tied editorial and advertising content, such as placing ads for roofing material specifically within the publication because of a special feature on do-it-yourself roofing repairs.

The editorial content selected for the user, including text and associated images and graphics, is then laid out according to various aesthetic rules.

The entire process, including the selection of ads and the selection of editorial content, must be iterated once the layout has converged, to attempt to more closely achieve the user's stated section size preference. The section size preference can, however, be matched *on average* over time, allowing significant day-to-day variations.

2.5 DOCUMENT FORMAT

Once the document is laid out, it is encoded for efficient distribution and persistent storage on the netpage network.

The primary efficiency mechanism is the separation of information specific to a single user's edition and information shared between multiple users' editions. The specific information consists of the page layout. The shared information consists of the objects to which the page layout refers, including images, graphics, and pieces of text.

A text object contains fully-formatted text represented in the Extensible Markup Language (XML) using the Extensible Stylesheet Language (XSL). XSL provides precise control over text formatting independently of the region into which the text is being set, which in this case is being provided by the layout. The text object contains embedded language codes to enable automatic translation, and embedded hyphenation hints to aid with paragraph formatting.

An image object encodes an image in the JPEG 2000 wavelet-based compressed image format. A graphic object encodes a 2D graphic in Scalable Vector Graphics (SVG) format.

The layout itself consists of a series of placed image and graphic objects, linked textflow objects through which text objects flow, hyperlinks and input fields as described above, and watermark regions. These layout objects are summarized in Table 3. The layout uses a compact format suitable for efficient distribution and storage.

Table 3 - netpage layout objects

Layout object	Attribute	Format of linked object
Image	Position	-
	Image object ID	JPEG 2000
Graphic	Position	-
	Graphic object ID	SVG
Textflow	Textflow ID	-
	Zone	-
	Optional text object ID	XML/XSL
Hyperlink	Type	-
	Zone	-
	Application ID, etc.	-
Field	Type	-

	Meaning	
	Zone	
Watermark	Zone	

2.6 DOCUMENT DISTRIBUTION

As described above, for purposes of efficient distribution and persistent storage on the netpage network, a user-specific page layout is separated from the shared objects to which it refers.

When a subscribed publication is ready to be distributed, the netpage publication server allocates, with the help of the netpage ID server 12, a unique ID for each page, page instance, document, and document instance.

The server computes a set of optimized subsets of the shared content and creates a multicast channel for each subset, and then tags each user-specific layout with the names of the multicast channels which will carry the shared content used by that layout. The server then pointcasts each user's layouts to that user's printer via the appropriate page server, and when the pointcasting is complete, multicasts the shared content on the specified channels. After receiving its pointcast, each page server and printer subscribes to the multicast channels specified in the page layouts. During the multicasts, each page server and printer extracts from the multicast streams those objects referred to by its page layouts. The page servers persistently archive the received page layouts and shared content.

Once a printer has received all the objects to which its page layouts refer, the printer re-creates the fully-populated layout and then rasterizes and prints it.

Under normal circumstances, the printer prints pages faster than they can be delivered. Assuming a quarter of each page is covered with images, the average page has a size of less than 400KB. The printer can therefore hold in excess of 100 such pages in its internal 64MB memory, allowing for temporary buffers etc. The printer prints at a rate of one page per second. This is equivalent to 400KB or about 3Mbit of page data per second, which is similar to the highest expected rate of page data delivery over a broadband network.

Even under abnormal circumstances, such as when the printer runs out of paper, it is likely that the user will be able to replenish the paper supply before the printer's 100-page internal storage capacity is exhausted.

However, if the printer's internal memory does fill up, then the printer will be unable to make use of a multicast when it first occurs. The netpage publication server therefore allows printers to submit requests for re-multicasts. When a critical number of requests is received or a timeout occurs, the server re-multicasts the corresponding shared objects.

Once a document is printed, a printer can produce an exact duplicate at any time by retrieving its page layouts and contents from the relevant page server.

2.7 ON-DEMAND DOCUMENTS

When a netpage document is requested on demand, it can be personalized and delivered in much the same way as a periodical. However, since there is no shared content, delivery is made directly to the requesting printer without the use of multicast.

When a non-netpage document is requested on demand, it is not personalized, and it is delivered via a designated netpage formatting server which reformats it as a netpage document. A netpage formatting server is a special instance of a netpage publication server. The netpage formatting server has knowledge of various Internet document formats, including Adobe's Portable Document Format (PDF), and Hypertext Markup Language (HTML). In the case of

HTML, it can make use of the higher resolution of the printed page to present Web pages in a multi-column format, with a table of contents. It can automatically include all Web pages directly linked to the requested page. The user can tune this behavior via a preference.

The netpage formatting server makes standard netpage behavior, including interactivity and persistence, available on any Internet document, no matter what its origin and format. It hides knowledge of different document formats from both the netpage printer and the netpage page server, and hides knowledge of the netpage system from Web servers.

3 SECURITY

3.1 CRYPTOGRAPHY

Cryptography is used to protect sensitive information, both in storage and in transit, and to authenticate parties to a transaction. There are two classes of cryptography in widespread use: secret-key cryptography and public-key cryptography. The netpage network uses both classes of cryptography.

Secret-key cryptography, also referred to as symmetric cryptography, uses the same key to encrypt and decrypt a message. Two parties wishing to exchange messages must first arrange to securely exchange the secret key.

Public-key cryptography, also referred to as asymmetric cryptography, uses two encryption keys. The two keys are mathematically related in such a way that any message encrypted using one key can only be decrypted using the other key. One of these keys is then published, while the other is kept private. The public key is used to encrypt any message intended for the holder of the private key. Once encrypted using the public key, a message can only be decrypted using the private key. Thus two parties can securely exchange messages without first having to exchange a secret key. To ensure that the private key is secure, it is normal for the holder of the private key to generate the key pair.

Public-key cryptography can be used to create a digital signature. The holder of the private key can create a known hash of a message and then encrypt the hash using the private key. Anyone can then verify that the encrypted hash constitutes the "signature" of the holder of the private key with respect to that particular message by decrypting the encrypted hash using the public key and verifying the hash against the message. If the signature is appended to the message, then the recipient of the message can verify both that the message is genuine and that it has not been altered in transit.

To make public-key cryptography work, there has to be a way to distribute public keys which prevents impersonation. This is normally done using certificates and certificate authorities. A certificate authority is a trusted third party which authenticates the connection between a public key and someone's identity. The certificate authority verifies the person's identity by examining identity documents, and then creates and signs a digital certificate containing the person's identity details and public key. Anyone who trusts the certificate authority can use the public key in the certificate with a high degree of certainty that it is genuine. They just have to verify that the certificate has indeed been signed by the certificate authority, whose public key is well-known.

In most transaction environments, public-key cryptography is only used to create digital signatures and to securely exchange secret session keys. Secret-key cryptography is used for all other purposes.

In the following discussion, when reference is made to the *secure* transmission of information between a netpage printer and a server, what actually happens is that the printer obtains the server's certificate, authenticates it with reference to the certificate authority, uses the public key-exchange key in the certificate to exchange a secret session key with the server, and then uses the secret session key to encrypt the message data. A *session* key, by definition, can have an

arbitrarily short lifetime.

3.2 NETPAGE PRINTER SECURITY

Each netpage printer is assigned a pair of unique identifiers at time of manufacture which are stored in read-only memory in the printer and in the netpage registration server database. The first ID 62 is public and uniquely identifies the printer on the netpage network. The second ID is secret and is used when the printer is first registered on the network.

When the printer connects to the netpage network for the first time after installation, it creates a signature public/private key pair. It transmits the secret ID and the public key securely to the netpage registration server. The server compares the secret ID against the printer's secret ID recorded in its database, and accepts the registration if the IDs match. It then creates and signs a certificate containing the printer's public ID and public signature key, and stores the certificate in the registration database.

The netpage registration server acts as a certificate authority for netpage printers, since it has access to secret information allowing it to verify printer identity.

When a user subscribes to a publication, a record is created in the netpage registration server database authorizing the publisher to print the publication to the user's default printer or a specified printer. Every document sent to a printer via a page server is addressed to a particular user and is signed by the publisher using the publisher's private signature key. The page server verifies, via the registration database, that the publisher is authorized to deliver the publication to the specified user. The page server verifies the signature using the publisher's public key, obtained from the publisher's certificate stored in the registration database.

The netpage registration server accepts requests to add printing authorizations to the database, so long as those requests are initiated via a pen registered to the printer.

3.3 NETPAGE PEN SECURITY

Each netpage pen is assigned a unique identifier at time of manufacture which is stored in read-only memory in the pen and in the netpage registration server database. The pen ID 61 uniquely identifies the pen on the netpage network.

A netpage pen can "know" a number of netpage printers, and a printer can "know" a number of pens. A pen communicates with a printer via a radio frequency signal whenever it is within range of the printer. Once a pen and printer are registered, they regularly exchange session keys. Whenever the pen transmits digital ink to the printer, the digital ink is always encrypted using the appropriate session key. Digital ink is never transmitted in the clear.

A pen stores a session key for every printer it knows, indexed by printer ID, and a printer stores a session key for every pen it knows, indexed by pen ID. Both have a large but finite storage capacity for session keys, and will forget a session key on a least-recently-used basis if necessary.

When a pen comes within range of a printer, the pen and printer discover whether they know each other. If they don't know each other, then the printer determines whether it is supposed to know the pen. This might be, for example, because the pen belongs to a user who is registered to use the printer. If the printer is meant to know the pen but doesn't, then it initiates the automatic pen registration procedure. If the printer isn't meant to know the pen, then it agrees with the pen to ignore it until the pen is placed in a charging cup, at which time it initiates the registration procedure.

In addition to its public ID, the pen contains a secret key-exchange key. The key-exchange key is also recorded in the netpage registration server database at time of manufacture. During registration, the pen transmits its pen

ID to the printer, and the printer transmits the pen ID to the netpage registration server. The server generates a session key for the printer and pen to use, and securely transmits the session key to the printer. It also transmits a copy of the session key encrypted with the pen's key-exchange key. The printer stores the session key internally, indexed by the pen ID, and transmits the encrypted session key to the pen. The pen stores the session key internally, indexed by the printer ID.

Although a fake pen can impersonate a pen in the pen registration protocol, only a real pen can decrypt the session key transmitted by the printer.

When a previously unregistered pen is first registered, it is of limited use until it is linked to a user. A registered but "un-owned" pen is only allowed to be used to request and fill in netpage user and pen registration forms, to register a new user to which the new pen is automatically linked, or to add a new pen to an existing user.

The pen uses secret-key rather than public-key encryption because of hardware performance constraints in the pen.

3.4 SECURE DOCUMENTS

The netpage system supports the delivery of secure documents such as tickets and coupons. The netpage printer includes a facility to print watermarks, but will only do so on request from publishers who are suitably authorized. The publisher indicates its authority to print watermarks in its certificate, which the printer is able to authenticate.

The "watermark" printing process uses an alternative dither matrix in specified "watermark" regions of the page. Back-to-back pages contain mirror-image watermark regions which coincide when printed. The dither matrices used in odd and even pages' watermark regions are designed to produce an interference effect when the regions are viewed together, achieved by looking *through* the printed sheet.

The effect is similar to a watermark in that it is not visible when looking at only one side of the page, and is lost when the page is copied by normal means.

Pages of secure documents cannot be copied using the built-in netpage copy mechanism described in Section 1.9 above. This extends to copying netpages on netpage-aware photocopiers.

Secure documents are typically generated as part of e-commerce transactions. They can therefore include the user's photograph which was captured when the user registered biometric information with the netpage registration server, as described in Section 2.

When presented with a secure netpage document, the recipient can verify its authenticity by requesting its status in the usual way. The unique ID of a secure document is only valid for the lifetime of the document, and secure document IDs are allocated non-contiguously to prevent their prediction by opportunistic forgers. A secure document verification pen can be developed with built-in feedback on verification failure, to support easy point-of-presentation document verification.

Clearly neither the watermark nor the user's photograph are secure in a cryptographic sense. They simply provide a significant obstacle to casual forgery. Online document verification, particularly using a verification pen, provides an added level of security where it is needed, but is still not entirely immune to forgeries.

3.5 NON-REPUDIATION

In the netpage system, forms submitted by users are delivered reliably to forms handlers and are persistently archived on netpage page servers. It is therefore impossible for recipients to repudiate delivery.

E-commerce payments made through the system, as described in Section 4, are also impossible for the payee

to repudiate.

4 ELECTRONIC COMMERCE MODEL

4.1 SECURE ELECTRONIC TRANSACTION (SET)

The netpage system uses the Secure Electronic Transaction (SET) system as one of its payment systems. SET, having been developed by MasterCard and Visa, is organized around payment cards, and this is reflected in the terminology. However, much of the system is independent of the type of accounts being used.

In SET, cardholders and merchants register with a certificate authority and are issued with certificates containing their public signature keys. The certificate authority verifies a cardholder's registration details with the card issuer as appropriate, and verifies a merchant's registration details with the acquirer as appropriate. Cardholders and merchants store their respective private signature keys securely on their computers. During the payment process, these certificates are used to mutually authenticate a merchant and cardholder, and to authenticate them both to the payment gateway.

SET has not yet been adopted widely, partly because cardholder maintenance of keys and certificates is considered burdensome. Interim solutions which maintain cardholder keys and certificates on a server and give the cardholder access via a password have met with some success.

4.2 SET PAYMENTS

In the netpage system the netpage registration server acts as a proxy for the netpage user (i.e. the cardholder) in SET payment transactions.

The netpage system uses biometrics to authenticate the user and authorize SET payments. Because the system is pen-based, the biometric used is the user's on-line signature, consisting of time-varying pen position and pressure. A fingerprint biometric can also be used by designing a fingerprint sensor into the pen, although at a higher cost. The type of biometric used only affects the capture of the biometric, not the authorization aspects of the system.

The first step to being able to make SET payments is to register the user's biometric with the netpage registration server. This is done in a controlled environment, for example a bank, where the biometric can be captured at the same time as the user's identity is verified. The biometric is captured and stored in the registration database, linked to the user's record. The user's photograph is also optionally captured and linked to the record. The SET cardholder registration process is completed, and the resulting private signature key and certificate are stored in the database. The user's payment card information is also stored, giving the netpage registration server enough information to act as the user's proxy in any SET payment transaction.

When the user eventually supplies the biometric to complete a payment, for example by signing a netpage order form, the printer securely transmits the order information, the pen ID and the biometric data to the netpage registration server. The server verifies the biometric with respect to the user identified by the pen ID, and from then on acts as the user's proxy in completing the SET payment transaction.

4.3 MICRO-PAYMENTS

The netpage system includes a mechanism for micro-payments, to allow the user to be conveniently charged for printing low-cost documents on demand and for copying copyright documents, and possibly also to allow the user to be reimbursed for expenses incurred in printing advertising material. The latter depends on the level of subsidy already provided to the user.

When the user registers for e-commerce, a network account is established which aggregates micro-payments. The user receives a statement on a regular basis, and can settle any outstanding debit balance using the standard payment mechanism.

The network account can be extended to aggregate subscription fees for periodicals, which would also otherwise be presented to the user in the form of individual statements.

4.4 TRANSACTIONS

When a user requests a netpage in a particular application context, the application is able to embed a user-specific transaction ID 55 in the page. Subsequent input through the page is tagged with the transaction ID, and the application is thereby able to establish an appropriate context for the user's input.

When input occurs through a page which is not user-specific, however, the application must use the user's unique identity to establish a context. A typical example involves adding items from a pre-printed catalog page to the user's virtual "shopping cart". To protect the user's privacy, however, the unique user ID 60 known to the netpage system is not divulged to applications. This is to prevent different application providers from easily correlating independently accumulated behavioral data.

The netpage registration server instead maintains an anonymous relationship between a user and an application via a unique alias ID 65, as shown in Figure 24. Whenever the user activates a hyperlink tagged with the "registered" attribute, the netpage page server asks the netpage registration server to translate the associated application ID 64, together with the pen ID 61, into an alias ID 65. The alias ID is then submitted to the hyperlink's application.

The application maintains state information indexed by alias ID, and is able to retrieve user-specific state information without knowledge of the global identity of the user.

The system also maintains an independent certificate and private signature key for each of a user's applications, to allow it to sign application transactions on behalf of the user using only application-specific information.

To assist the system in routing product bar code (UPC) "hyperlink" activations, the system records a favorite application on behalf of the user for any number of product types.

Each application is associated with an application provider, and the system maintains an account on behalf of each application provider, to allow it to credit and debit the provider for click-through fees etc.

An application provider can be a publisher of periodical subscribed content. The system records the user's willingness to receive the subscribed publication, as well as the expected frequency of publication.

5 COMMUNICATIONS PROTOCOLS

A communications protocol defines an ordered exchange of messages between entities. In the netpage system, entities such as pens, printers and servers utilise a set of defined protocols to cooperatively handle user interaction with the netpage system.

Each protocol is illustrated by way of a sequence diagram in which the horizontal dimension is used to represent message flow and the vertical dimension is used to represent time. Each entity is represented by a rectangle containing the name of the entity and a vertical column representing the lifeline of the entity. During the time an entity exists, the lifeline is shown as a dashed line. During the time an entity is active, the lifeline is shown as a double line. Because the protocols considered here do not create or destroy entities, lifelines are generally cut short as soon as an entity ceases to participate in a protocol.

5.1 SUBSCRIPTION DELIVERY PROTOCOL

A preferred embodiment of a subscription delivery protocol is shown in Figure 40.

A large number of users may subscribe to a periodical publication. Each user's edition may be laid out differently, but many users' editions will share common content such as text objects and image objects. The subscription delivery protocol therefore delivers document structures to individual printers via pointcast, but delivers shared content objects via multicast.

The application (i.e. publisher) first obtains a document ID 51 for each document from an ID server 12. It then sends each document structure, including its document ID and page descriptions, to the page server 10 responsible for the document's newly allocated ID. It includes its own application ID 64, the subscriber's alias ID 65, and the relevant set of multicast channel names. It signs the message using its private signature key.

The page server uses the application ID and alias ID to obtain from the registration server the corresponding user ID 60, the user's selected printer ID 62 (which may be explicitly selected for the application, or may be the user's default printer), and the application's certificate.

The application's certificate allows the page server to verify the message signature. The page server's request to the registration server fails if the application ID and alias ID don't together identify a subscription 808.

The page server then allocates document and page instance IDs and forwards the page descriptions, including page IDs 50, to the printer. It includes the relevant set of multicast channel names for the printer to listen to.

It then returns the newly allocated page IDs to the application for future reference.

Once the application has distributed all of the document structures to the subscribers' selected printers via the relevant page servers, it multicasts the various subsets of the shared objects on the previously selected multicast channels. Both page servers and printers monitor the appropriate multicast channels and receive their required content objects. They are then able to populate the previously pointcast document structures. This allows the page servers to add complete documents to their databases, and it allows the printers to print the documents.

5.2 HYPERLINK ACTIVATION PROTOCOL

A preferred embodiment of a hyperlink activation protocol is shown in Figure 42.

When a user clicks on a netpage with a netpage pen, the pen communicates the click to the nearest netpage printer 601. The click identifies the page and a location on the page. The printer already knows the ID 61 of the pen from the pen connection protocol.

The printer determines, via the DNS, the network address of the page server 10a handling the particular page ID 50. The address may already be in its cache if the user has recently interacted with the same page. The printer then forwards the pen ID, its own printer ID 62, the page ID and click location to the page server.

The page server loads the page description 5 identified by the page ID and determines which input element's zone 58, if any, the click lies in. Assuming the relevant input element is a hyperlink element 844, the page server then obtains the associated application ID 64 and link ID 54, and determines, via the DNS, the network address of the application server hosting the application 71.

The page server uses the pen ID 61 to obtain the corresponding user ID 60 from the registration server 11, and then allocates a globally unique hyperlink request ID 52 and builds a hyperlink request 934. The hyperlink request class diagram is shown in Figure 41. The hyperlink request records the IDs of the requesting user and printer, and

identifies the clicked hyperlink instance 862. The page server then sends its own server ID 53, the hyperlink request ID, and the link ID to the application.

The application produces a response document according to application-specific logic, and obtains a document ID 51 from an ID server 12. It then sends the document to the page server 10b responsible for the document's newly allocated ID, together with the requesting page server's ID and the hyperlink request ID.

The second page server sends the hyperlink request ID and application ID to the first page server to obtain the corresponding user ID and printer ID 62. The first page server rejects the request if the hyperlink request has expired or is for a different application.

The second page server allocates document instance and page IDs 50, returns the newly allocated page IDs to the application, adds the complete document to its own database, and finally sends the page descriptions to the requesting printer.

The hyperlink instance may include a meaningful transaction ID 55, in which case the first page server includes the transaction ID in the message sent to the application. This allows the application to establish a transaction-specific context for the hyperlink activation.

If the hyperlink requires a user alias, i.e. its "alias required" attribute is set, then the first page server sends both the pen ID 61 and the hyperlink's application ID 64 to the registration server 11 to obtain not just the user ID corresponding to the pen ID but also the alias ID 65 corresponding to the application ID and the user ID. It includes the alias ID in the message sent to the application, allowing the application to establish a user-specific context for the hyperlink activation.

5.3 Handwriting Recognition Protocol

When a user draws a stroke on a netpage with a netpage pen, the pen communicates the stroke to the nearest netpage printer. The stroke identifies the page and a path on the page.

The printer forwards the pen ID 61, its own printer ID 62, the page ID 50 and stroke path to the page server 10 in the usual way.

The page server loads the page description 5 identified by the page ID and determines which input element's zone 58, if any, the stroke intersects. Assuming the relevant input element is a text field 878, the page server appends the stroke to the text field's digital ink.

After a period of inactivity in the zone of the text field, the page server sends the pen ID and the pending strokes to the registration server 11 for interpretation. The registration server identifies the user corresponding to the pen, and uses the user's accumulated handwriting model 822 to interpret the strokes as handwritten text. Once it has converted the strokes to text, the registration server returns the text to the requesting page server. The page server appends the text to the text value of the text field.

5.4 Signature Verification Protocol

Assuming the input element whose zone the stroke intersects is a signature field 880, the page server 10 appends the stroke to the signature field's digital ink.

After a period of inactivity in the zone of the signature field, the page server sends the pen ID 61 and the pending strokes to the registration server 11 for verification. It also sends the application ID 64 associated with the form of which the signature field is part, as well as the form ID 56 and the current data content of the form. The registration

server identifies the user corresponding to the pen, and uses the user's dynamic signature biometric 818 to verify the strokes as the user's signature. Once it has verified the signature, the registration server uses the application ID 64 and user ID 60 to identify the user's application-specific private signature key. It then uses the key to generate a digital signature of the form data, and returns the digital signature to the requesting page server. The page server assigns the digital signature to the signature field and sets the associated form's status to frozen.

The digital signature includes the alias ID 65 of the corresponding user. This allows a single form to capture multiple users' signatures.

5.5 Form Submission Protocol

A preferred embodiment of a form submission protocol is shown in Figure 43.

Form submission occurs via a form hyperlink activation. It thus follows the protocol defined in Section 5.2, with some form-specific additions.

In the case of a form hyperlink, the hyperlink activation message sent by the page server 10 to the application 71 also contains the form ID 56 and the current data content of the form. If the form contains any signature fields, then the application verifies each one by extracting the alias ID 65 associated with the corresponding digital signature and obtaining the corresponding certificate from the registration server 11.

6 Netpage Pen Description

6.1 Pen Mechanics

Referring to Figures 8 and 9, the pen, generally designated by reference numeral 101, includes a housing 102 in the form of a plastics moulding having walls 103 defining an interior space 104 for mounting the pen components. The pen top 105 is in operation rotatably mounted at one end 106 of the housing 102. A semi-transparent cover 107 is secured to the opposite end 108 of the housing 102. The cover 107 is also of moulded plastics, and is formed from semi-transparent material in order to enable the user to view the status of the LED mounted within the housing 102. The cover 107 includes a main part 109 which substantially surrounds the end 108 of the housing 102 and a projecting portion 110 which projects back from the main part 109 and fits within a corresponding slot 111 formed in the walls 103 of the housing 102. A radio antenna 112 is mounted behind the projecting portion 110, within the housing 102. Screw threads 113 surrounding an aperture 113A on the cover 107 are arranged to receive a metal end piece 114, including corresponding screw threads 115. The metal end piece 114 is removable to enable ink cartridge replacement.

Also mounted within the cover 107 is a tri-color status LED 116 on a flex PCB 117. The antenna 112 is also mounted on the flex PCB 117. The status LED 116 is mounted at the top of the pen 101 for good all-around visibility.

The pen can operate both as a normal marking ink pen and as a non-marking stylus. An ink pen cartridge 118 with nib 119 and a stylus 120 with stylus nib 121 are mounted side by side within the housing 102. Either the ink cartridge nib 119 or the stylus nib 121 can be brought forward through open end 122 of the metal end piece 114, by rotation of the pen top 105. Respective slider blocks 123 and 124 are mounted to the ink cartridge 118 and stylus 120, respectively. A rotatable cam barrel 125 is secured to the pen top 105 in operation and arranged to rotate therewith. The cam barrel 125 includes a cam 126 in the form of a slot within the walls 181 of the cam barrel. Cam followers 127 and 128 projecting from slider blocks 123 and 124 fit within the cam slot 126. On rotation of the cam barrel 125, the slider blocks 123 or 124 move relative to each other to project either the pen nib 119 or stylus nib 121 out through the hole 122 in the metal end piece 114. The pen 101 has three states of operation. By turning the top 105 through 90° steps, the three states are:

- Stylus 120 nib 121 out;
- Ink cartridge 118 nib 119 out; and
- Neither ink cartridge 118 nib 119 out nor stylus 120 nib 121 out.

A second flex PCB 129, is mounted on an electronics chassis 130 which sits within the housing 102. The second flex PCB 129 mounts an infrared LED 131 for providing infrared radiation for projection onto the surface. An image sensor 132 is provided mounted on the second flex PCB 129 for receiving reflected radiation from the surface. The second flex PCB 129 also mounts a radio frequency chip 133, which includes an RF transmitter and RF receiver, and a controller chip 134 for controlling operation of the pen 101. An optics block 135 (formed from moulded clear plastics) sits within the cover 107 and projects an infrared beam onto the surface and receives images onto the image sensor 132. Power supply wires 136 connect the components on the second flex PCB 129 to battery contacts 137 which are mounted within the cam barrel 125. A terminal 138 connects to the battery contacts 137 and the cam barrel 125. A three volt rechargeable battery 139 sits within the cam barrel 125 in contact with the battery contacts. An induction charging coil 140 is mounted about the second flex PCB 129 to enable recharging of the battery 139 via induction. The second flex PCB 129 also mounts an infrared LED 143 and infrared photodiode 144 for detecting displacement in the cam barrel 125 when either the stylus 120 or the ink cartridge 118 is used for writing, in order to enable a determination of the force being applied to the surface by the pen nib 119 or stylus nib 121. The IR photodiode 144 detects light from the IR LED 143 via reflectors (not shown) mounted on the slider blocks 123 and 124.

Rubber grip pads 141 and 142 are provided towards the end 108 of the housing 102 to assist gripping the pen 101, and top 105 also includes a clip 142 for clipping the pen 101 to a pocket.

6.2 Pen Controller

The pen 101 is arranged to determine the position of its nib (stylus nib 121 or ink cartridge nib 119) by imaging, in the infrared spectrum, an area of the surface in the vicinity of the nib. It records the location data from the nearest location tag, and is arranged to calculate the distance of the nib 121 or 119 from the location tab utilising optics 135 and controller chip 134. The controller chip 134 calculates the orientation of the pen and the nib-to-tag distance from the perspective distortion observed on the imaged tag.

Utilising the RF chip 133 and antenna 112 the pen 101 can transmit the digital ink data (which is encrypted for security and packaged for efficient transmission) to the computing system.

When the pen is in range of a receiver, the digital ink data is transmitted as it is formed. When the pen 101 moves out of range, digital ink data is buffered within the pen 101 (the pen 101 circuitry includes a buffer arranged to store digital ink data for approximately 12 minutes of the pen motion on the surface) and can be transmitted later.

The controller chip 134 is mounted on the second flex PCB 129 in the pen 101. Figure 10 is a block diagram illustrating in more detail the architecture of the controller chip 134. Figure 10 also shows representations of the RF chip 133, the image sensor 132, the tri-color status LED 116, the IR illumination LED 131, the IR force sensor LED 143, and the force sensor photodiode 144.

The pen controller chip 134 includes a controlling processor 145. Bus 146 enables the exchange of data between components of the controller chip 134. Flash memory 147 and a 512 KB DRAM 148 are also included. An analog-to-digital converter 149 is arranged to convert the analog signal from the force sensor photodiode 144 to a digital signal.

An image sensor interface 152 interfaces with the image sensor 132. A transceiver controller 153 and base

band circuit 154 are also included to interface with the RF chip 133 which includes an RF circuit 155 and RF resonators and inductors 156 connected to the antenna 112.

The controlling processor 145 captures and decodes location data from tags from the surface via the image sensor 132, monitors the force sensor photodiode 144, controls the LEDs 116, 131 and 143, and handles short-range radio communication via the radio transceiver 153. It is a medium-performance (~40MHz) general-purpose RISC processor.

The processor 145, digital transceiver components (transceiver controller 153 and baseband circuit 154), image sensor interface 152, flash memory 147 and 512KB DRAM 148 are integrated in a single controller ASIC. Analog RF components (RF circuit 155 and RF resonators and inductors 156) are provided in the separate RF chip.

The image sensor is a 215x215 pixel CCD (such a sensor is produced by Matsushita Electronic Corporation, and is described in a paper by Itakura, K T Nobusada, N Okusenya, R Nagayoshi, and M Ozaki, "A 1mm 50k-Pixel IT CCD Image Sensor for Miniature Camera System", IEEE Transactions on Electronic Devices, Volt 47, number 1, January 2000, which is incorporated herein by reference) with an IR filter.

The controller ASIC 134 enters a quiescent state after a period of inactivity when the pen 101 is not in contact with a surface. It incorporates a dedicated circuit 150 which monitors the force sensor photodiode 144 and wakes up the controller 134 via the power manager 151 on a pen-down event.

The radio transceiver communicates in the unlicensed 900MHz band normally used by cordless telephones, or alternatively in the unlicensed 2.4GHz industrial, scientific and medical (ISM) band, and uses frequency hopping and collision detection to provide interference-free communication.

In an alternative embodiment, the pen incorporates an Infrared Data Association (IrDA) interface for short-range communication with a base station or netpage printer.

In a further embodiment, the pen 101 includes a pair of orthogonal accelerometers mounted in the normal plane of the pen 101 axis. The accelerometers 190 are shown in Figures 9 and 10 in ghost outline.

The provision of the accelerometers enables this embodiment of the pen 101 to sense motion without reference to surface location tags, allowing the location tags to be sampled at a lower rate. Each location tag ID can then identify an object of interest rather than a position on the surface. For example, if the object is a user interface input element (e.g. a command button), then the tag ID of each location tag within the area of the input element can directly identify the input element.

The acceleration measured by the accelerometers in each of the x and y directions is integrated with respect to time to produce an instantaneous velocity and position.

Since the starting position of the stroke is not known, only relative positions within a stroke are calculated. Although position integration accumulates errors in the sensed acceleration, accelerometers typically have high resolution, and the time duration of a stroke, over which errors accumulate, is short.

7 NETPAGE PRINTER DESCRIPTION

7.1 PRINTER MECHANICS

The vertically-mounted netpage wallprinter 601 is shown fully assembled in Figure 11. It prints netpages on Letter/A4 sized media using duplexed 8½" Memjet™ print engines 602 and 603, as shown in Figures 12 and 12a. It uses a straight paper path with the paper 604 passing through the duplexed print engines 602 and 603 which print both sides of a sheet simultaneously, in full color and with full bleed.

An integral binding assembly 605 applies a strip of glue along one edge of each printed sheet, allowing it to adhere to the previous sheet when pressed against it. This creates a final bound document 618 which can range in thickness from one sheet to several hundred sheets.

The replaceable ink cartridge 627, shown in Figure 13 coupled with the duplexed print engines, has bladders or chambers for storing fixative, adhesive, and cyan, magenta, yellow, black and infrared inks. The cartridge also contains a micro air filter in a base molding. The micro air filter interfaces with an air pump 638 inside the printer via a hose 639. This provides filtered air to the printheads to prevent ingress of micro particles into the Memjet™ printheads 350 which might otherwise clog the printhead nozzles. By incorporating the air filter within the cartridge, the operational life of the filter is effectively linked to the life of the cartridge. The ink cartridge is a fully recyclable product with a capacity for printing and gluing 3000 pages (1500 sheets).

Referring to Figure 12, the motorized media pick-up roller assembly 626 pushes the top sheet directly from the media tray past a paper sensor on the first print engine 602 into the duplexed Memjet™ printhead assembly. The two Memjet™ print engines 602 and 603 are mounted in an opposing in-line sequential configuration along the straight paper path. The paper 604 is drawn into the first print engine 602 by integral, powered pick-up rollers 626. The position and size of the paper 604 is sensed and full bleed printing commences. Fixative is printed simultaneously to aid drying in the shortest possible time.

The paper exits the first Memjet™ print engine 602 through a set of powered exit spike wheels (aligned along the straight paper path), which act against a rubberized roller. These spike wheels contact the 'wet' printed surface and continue to feed the sheet 604 into the second Memjet™ print engine 603.

Referring to Figures 12 and 12a, the paper 604 passes from the duplexed print engines 602 and 603 into the binder assembly 605. The printed page passes between a powered spike wheel axle 670 with a fibrous support roller and another movable axle with spike wheels and a momentary action glue wheel. The movable axle/glue assembly 673 is mounted to a metal support bracket and it is transported forward to interface with the powered axle 670 via gears by action of a camshaft. A separate motor powers this camshaft.

The glue wheel assembly 673 consists of a partially hollow axle 679 with a rotating coupling for the glue supply hose 641 from the ink cartridge 627. This axle 679 connects to a glue wheel, which absorbs adhesive by capillary action through radial holes. A molded housing 682 surrounds the glue wheel, with an opening at the front. Pivoting side moldings and sprung outer doors are attached to the metal bracket and hinge out sideways when the rest of the assembly 673 is thrust forward. This action exposes the glue wheel through the front of the molded housing 682. Tension springs close the assembly and effectively cap the glue wheel during periods of inactivity.

As the sheet 604 passes into the glue wheel assembly 673, adhesive is applied to one vertical edge on the front side (apart from the first sheet of a document) as it is transported down into the binding assembly 605.

7.2 PRINTER CONTROLLER ARCHITECTURE

The netpage printer controller consists of a controlling processor 750, a factory-installed or field-installed network interface module 625, a radio transceiver (transceiver controller 753, baseband circuit 754, RF circuit 755, and RF resonators and inductors 756), dual raster image processor (RIP) DSPs 757, duplexed print engine controllers 760a and 760b, flash memory 658. and 64MB of DRAM 657, as illustrated in Figure 14.

The controlling processor handles communication with the network 19 and with local wireless netpage pens 101, senses the help button 617, controls the user interface LEDs 613-616, and feeds and synchronizes the RIP DSPs 757

and print engine controllers 760. It consists of a medium-performance general-purpose microprocessor. The controlling processor 750 communicates with the print engine controllers 760 via a high-speed serial bus 659.

The RIP DSPs rasterize and compress page descriptions to the netpage printer's compressed page format. Each print engine controller expands, dithers and prints page images to its associated Memjet™ printhead 350 in real time (i.e. at over 30 pages per minute). The duplexed print engine controllers print both sides of a sheet simultaneously.

The master print engine controller 760a controls the paper transport and monitors ink usage in conjunction with the master QA chip 665 and the ink cartridge QA chip 761.

The printer controller's flash memory 658 holds the software for both the processor 750 and the DSPs 757, as well as configuration data. This is copied to main memory 657 at boot time.

The processor 750, DSPs 757, and digital transceiver components (transceiver controller 753 and baseband circuit 754) are integrated in a single controller ASIC 656. Analog RF components (RF circuit 755 and RF resonators and inductors 756) are provided in a separate RF chip 762. The network interface module 625 is separate, since netpage printers allow the network connection to be factory-selected or field-selected. Flash memory 658 and the 2×256Mbit (64MB) DRAM 657 is also off-chip. The print engine controllers 760 are provided in separate ASICs.

A variety of network interface modules 625 are provided, each providing a netpage network interface 751 and optionally a local computer or network interface 752. Netpage network Internet interfaces include POTS modems, Hybrid Fiber-Coax (HFC) cable modems, ISDN modems, DSL modems, satellite transceivers, current and next-generation cellular telephone transceivers, and wireless local loop (WLL) transceivers. Local interfaces include IEEE 1284 (parallel port), 10Base-T and 100Base-T Ethernet, USB and USB 2.0, IEEE 1394 (Firewire), and various emerging home networking interfaces. If an Internet connection is available on the local network, then the local network interface can be used as the netpage network interface.

The radio transceiver 753 communicates in the unlicensed 900MHz band normally used by cordless telephones, or alternatively in the unlicensed 2.4GHz industrial, scientific and medical (ISM) band, and uses frequency hopping and collision detection to provide interference-free communication.

The printer controller optionally incorporates an Infrared Data Association (IrDA) interface for receiving data "squirted" from devices such as netpage cameras. In an alternative embodiment, the printer uses the IrDA interface for short-range communication with suitably configured netpage pens.

7.2.1 RASTERIZATION AND PRINTING

Once the main processor 750 has received and verified the document's page layouts and page objects, it runs the appropriate RIP software on the DSPs 757.

The DSPs 757 rasterize each page description and compress the rasterized page image. The main processor stores each compressed page image in memory. The simplest way to load-balance multiple DSPs is to let each DSP rasterize a separate page. The DSPs can always be kept busy since an arbitrary number of rasterized pages can, in general, be stored in memory. This strategy only leads to potentially poor DSP utilization when rasterizing short documents.

Watermark regions in the page description are rasterized to a contone-resolution bi-level bitmap which is losslessly compressed to negligible size and which forms part of the compressed page image.

The infrared (IR) layer of the printed page contains coded netpage tags at a density of about six per inch. Each tag encodes the page ID, tag ID, and control bits, and the data content of each tag is generated during rasterization

and stored in the compressed page image.

The main processor 750 passes back-to-back page images to the duplexed print engine controllers 760. Each print engine controller 760 stores the compressed page image in its local memory, and starts the page expansion and printing pipeline. Page expansion and printing is pipelined because it is impractical to store an entire 114MB bi-level CMYK+IR page image in memory.

7.2.2 PRINT ENGINE CONTROLLER

The page expansion and printing pipeline of the print engine controller 760 consists of a high speed IEEE 1394 serial interface 659, a standard JPEG decoder 763, a standard Group 4 Fax decoder 764, a custom halftoner/compositor unit 765, a custom tag encoder 766, a line loader/formatter unit 767, and a custom interface 768 to the Memjet™ printhead 350.

The print engine controller 360 operates in a double buffered manner. While one page is loaded into DRAM 769 via the high speed serial interface 659, the previously loaded page is read from DRAM 769 and passed through the print engine controller pipeline. Once the page has finished printing, the page just loaded is printed while another page is loaded.

The first stage of the pipeline expands (at 763) the JPEG-compressed contone CMYK layer, expands (at 764) the Group 4 Fax-compressed bi-level black layer, and renders (at 766) the bi-level netpage tag layer according to the tag format defined in section 1.2, all in parallel. The second stage dithers (at 765) the contone CMYK layer and composites (at 765) the bi-level black layer over the resulting bi-level CMYK layer. The resultant bi-level CMYK+IR dot data is buffered and formatted (at 767) for printing on the Memjet™ printhead 350 via a set of line buffers. Most of these line buffers are stored in the off-chip DRAM. The final stage prints the six channels of bi-level dot data (including fixative) to the Memjet™ printhead 350 via the printhead interface 768.

When several print engine controllers 760 are used in unison, such as in a duplexed configuration, they are synchronized via a shared line sync signal 770. Only one print engine 760, selected via the external master/slave pin 771, generates the line sync signal 770 onto the shared line.

The print engine controller 760 contains a low-speed processor 772 for synchronizing the page expansion and rendering pipeline, configuring the printhead 350 via a low-speed serial bus 773, and controlling the stepper motors 675, 676.

In the 8½" versions of the netpage printer, the two print engines each prints 30 Letter pages per minute along the long dimension of the page (11"), giving a line rate of 8.8 kHz at 1600 dpi. In the 12" versions of the netpage printer, the two print engines each prints 45 Letter pages per minute along the short dimension of the page (8½"), giving a line rate of 10.2 kHz. These line rates are well within the operating frequency of the Memjet™ printhead, which in the current design exceeds 30 kHz.

8 ONLINE CLASSIFIEDS

The netpage system provides an online classifieds application which allows advertisers to list classified advertisements, and allows users to search the classified listings.

8.1 USER INTERFACE DIAGRAM NOTATION

Each application user interface flow is illustrated as a collection of documents linked by command arrows. A command arrow indicates that the target document is printed as a result of the user pressing the corresponding command

button on the source page. Some command arrows are labelled with multiple commands separated by slashes ('/'s), indicating that any one of the specified commands causes the target document to be printed. Although multiple commands may label the same command arrow, they typically have different side-effects.

In application terms, it is important to distinguish between netpage documents and netpage forms. Documents contain printed information, as well as command buttons which can be pressed by the user to request further information or some other action. Forms, in addition to behaving like normal documents, also contain input fields which can be filled in by the user. They provide the system with a data input mechanism. It is also useful to distinguish between documents which contain generic information and documents which contain information specific to a particular interaction between the user and an application. Generic documents may be pre-printed publications such as magazines sold at news stands or advertising posters encountered in public places. Forms may also be pre-printed, including, for example, subscription forms encountered in pre-printed publications. They may, of course, also be generated on-the-fly by a netpage printer in response to user requests. User-specific documents and forms are normally generated on the fly by a netpage printer in response to user requests. Figure 44 shows a generic document 990, a generic form 991, a user-specific document 992, and a user-specific form 993.

Netpages which participate in a user interface flow are further described by abstract page layouts. A page layout may contain various kinds of elements, each of which has a unique style to differentiate it from the others. As shown in Figure 45, these include fixed information 994, variable information 995, input fields 996, command buttons 997, draggable commands 998, and text hyperlinks or hypertext links 999.

When a user interface flow is broken up into multiple diagrams, any document which is duplicated is shown with dashed outlines in all but the main diagram which defines it.

8.2 Online Classifieds Object Model

The Classifieds object model revolves around categories and classified listings.

The netpage classifieds are made up of a hierarchy of categories and subcategories. Each category 501 contains a set of subcategories and/or a set of classified listings 504. The classifieds class diagram is shown in Figure 46.

The classifieds provider 500 has registered customers 505 (i.e. advertisers), each with a unique identifier 65. The name and description of a customer derive from the details of the corresponding netpage user. Each advertiser 505 has an account 506 with the classifieds provider 500, with a running balance. Account payments 507 are associated directly with the customer account 506. The payments class diagram is shown in Figure 47.

The most common payment methods are shown in Figure 47. The set of payment methods supported by a particular provider will be specific to that provider, and may be different for different customers depending on their credit ratings etc.

When the netpage account payment method 509 is used, the user's netpage account 820 is debited, and the transaction appears on the user's netpage account statement.

When the customer account payment method 510 is used, the user is invoiced for payment.

When the SET payment method 512 is used, the corresponding SET payment card 821 linked to the user is used to make payment according to the normal SET protocol.

When the payment card payment method 511 is used, the specified payment card is used to make payment according to the normal protocol between the provider and their acquiring bank or institution which handles the particular payment card type.

Advertisers can place listings under one or more classified categories. Each listing 504 has a unique listing number 514, the date and time the listing was placed, a start and end date for the appearance of the listing in the classifieds, a brief description, the full listing text and a listing fee. The listing fee is added to the user's advertiser account balance.

Any netpage user can browse and search through classified listings without being registered with the provider, but only registered users can place listings.

8.3 Online Classifieds User Interface

The user may obtain the netpage Classifieds main page from a variety of links including:

- the netpage directory
- the netpage user's own bookmark
- an advertisement

The netpage Classifieds user interface flow is shown in Figure 48.

8.3.1 Classifieds Main Page

The classifieds Main Page 515, as shown in Figure 50, displays the major classifieds categories.

To view the subcategories and listings under a category the user clicks on the category name. A page 516 is printed showing the subcategories and listings for this category, as shown in Figure 51.

The user can carry out a basic search of the classifieds from the main page. The user enters keywords or phrases in the search field. To specify a multi-word phrase, the user encloses the phrase in quotes. To specify that a word must be included in the search, the user writes a plus sign (+) immediately before the word. To exclude a word from the search the user writes a minus sign (-) immediately before the word. The user can carry out a wild card search by typing an asterisk (*) at the end of a word. For example, if the user searches for "small*" this will match on "small", "smaller", "smallest" etc.

The user may specify the number of matches to be returned by the search by checking the appropriate box under the search field.

When all the desired words or phrases have been specified the user clicks the <Search> button. The classified listings matching the search criteria are printed on one or more Search Results pages 518, shown in Figure 52. The user can print the details of a particular listing 517 (not shown) by clicking on the listing description.

The user can register with the classifieds provider by clicking on the <Register> button. A User Registration form 519 (not shown) is printed. When a user registers, an account is created for the user and the user is then permitted to place listings in the classifieds.

The user can view their account details by clicking the <View Account> button. An Account Details page 522 (not shown) is printed giving details of the charges and payments, and the outstanding balance for the account. The user can select to make a payment to their account from this page using the payment card method or the SET payment card method.

The user can place a listing with the classifieds provider by clicking the <Place Listing> button. A Place Listing Step 1 form 520 is printed, as shown in Figure 53.

The user can view all their current classified listings by clicking the <My Listings> button. A View/Modify Listings page 521 (not shown) is printed. From this page the user has the ability to view full details of a listing, change the listing end date, or remove the listing from the classifieds.

The user can click the <Blank Form> button at the bottom of the main page to print a blank netpage Classifieds main page 515.

8.3.2 Viewing Subcategories and Listings

When the user selects a category from the netpage Classifieds main page 515, the Subcategory and Listings page 516 is printed, as shown in Figure 51. Each category may contain more subcategories, classified listings, or both. Next to each subcategory name a number is shown in parentheses. This is a count of the listings that appear under that subcategory. The user can continue to move through the classifieds by clicking on another subcategory, or can print the details for a particular listing by clicking on the listing description.

The user can also perform a basic text search from this page. The user can specify to search all categories, or only search the current category, by checking the appropriate box on the form. The user writes the query in the Search For field, and clicks the <Search> button. The classified listings matching the search criteria are printed on one or more Search Results pages 518, shown in Figure 52.

The user can print the details of a particular listing by clicking on the listing description.

Only two pages of results are printed at a time. If there are more results available, the user clicks the <Next> button to print the next two pages of results.

8.3.3 Placing A Listing

A user can place a listing by first clicking <Place A Listing> from the classifieds main page. If the user is registered with the classifieds provider a Place Listing - Step 1 form 520 is printed. If the user is not already registered with the classifieds provider a User Registration form 519 (not shown) is printed.

The user enters the start date and end date for the classified listing, a brief description of the listing, and the details of the listing in the form fields. Optionally the user could include a picture or drawing with the listing. The user clicks <Continue> to go to the next step. A Place Listing - Step 2 form 523 is printed, shown in Figure 54.

The Place Listing function is a multi-page transaction. To assist the user in keeping track of the pages relevant to a single listing search transaction, the transaction number and the current date and time are printed at the top of the Place Listing pages. The user can click the <Reset Form> button at the bottom of the page to invalidate the current form and print a fresh form as part of the current transaction.

On the Place Listing - Step 2 form 523 the user selects one or more categories under which the listing will appear. Once complete the user clicks the <Continue> button to go to the next step. A Place Listing - Step 3 form 524 is printed, shown in Figure 55.

The Place Listing - Step 3 form 524 shows the categories chosen, the start and end date for the listing, the brief and full description of the listing, and the listing fee. If the listing details are correct the user signs the form and clicks the <Press & Charge> button to finalize the listing. The signature is verified from netpage records.

A Listing Confirmation page 525, shown in Figure 56, is printed, showing the full details of the listing, and the new balance of the user's account.

The user interface flow for placing a listing is shown in Figure 49.

CONCLUSION

The present invention has been described with reference to a preferred embodiment and number of specific alternative embodiments. However, it will be appreciated by those skilled in the relevant fields that a number of other embodiments, differing from those specifically described, will also fall within the spirit and scope of the present invention. Accordingly, it will be understood that the invention is not intended to be limited to the specific embodiments described in the present specification, including documents incorporated by cross-reference as appropriate. The scope of the invention is only limited by the attached claims.

CLAIMS

1. A method of enabling searching of classified advertising, the method including the steps of:

providing a user with a form containing information relating to a listing search transaction, the form including coded data indicative of an identity of the form and of at least one reference point of the form;

receiving, in a computer system, indicating data from a sensing device regarding the identity of the form and a position of the sensing device relative to the form, the sensing device, when placed in an operative position relative to the form, sensing the indicating data using at least some of the coded data; and

identifying, in the computer system and from the indicating data, at least one parameter relating to the listing search transaction.

2. The method of claim 1 in which said at least one parameter relating to the listing search transaction is associated with at least one zone of the form and in which the method includes identifying, in the computer system and from the zone relative to which the sensing device is located, said at least one parameter.

3. The method of claim 2 which includes

receiving, in the computer system, data regarding movement of the sensing device relative to the form, the sensing device sensing its movement relative to the form using at least some of the coded data; and

identifying, in the computer system and from said movement being at least partially within said at least one zone, said at least one parameter of the listing search transaction.

4. A method of enabling searching of classified advertising, the method including the steps of:

providing a user with a form containing information relating to a listing search transaction, the form including coded data indicative of at least one parameter of the listing search transaction;

receiving, in a computer system, data from a sensing device regarding said at least one parameter and regarding movement of the sensing device relative to the form, the sensing device, when moved relative to the form, sensing the data regarding said at least one parameter using at least some of the coded data and generating the data regarding its own movement relative to the form; and

interpreting, in the computer system, said movement of the sensing device as it relates to said at least one parameter.

5. A method of enabling searching of classified advertising, the method including the steps of:

providing a user with a form including coded data indicative of an identity of the form;

receiving, in a computer system, data from a sensing device regarding an identity of the user and regarding the identity of the form, the sensing device containing the data regarding the identity of the user and sensing the data regarding the identity of the form using at least some of the coded data; and

identifying, in the computer system and from the data regarding the identity of the user and the identity of the form, a listing search transaction.

6. The method of claim 5 in which the coded data is also indicative of at least one parameter of the listing search transaction, and the method includes receiving, in the computer system, indicating data from the sensing device regarding said at least one parameter of the listing search transaction, the sensing device sensing the indicating data using at least some of the coded data.

7. The method of claim 6 which includes receiving, in the computer system, data from the sensing device regarding movement of the sensing device relative to the form, the sensing device generating data regarding its own movement relative to the form.

8. The method of any one of claims 2, 4 or 6 in which the parameter is an action parameter of the listing search transaction, the method including effecting, in the computer system, an operation in respect of the action parameter.

9. The method of claim 8 in which the action parameter of the listing search transaction is selected from the group comprising:

a category,

a search request, and

a request for more search results.

10. The method of any one of claims 3, 4 or 7 in which the parameter is an option parameter of the listing search transaction, the method including identifying, in the computer system, that the user has entered a hand-drawn mark by means of the sensing device and effecting, in the computer system, an operation associated with the option parameter.

11. The method of claim 10 in which the option parameter is associated with at least one of:

a category,

a search request,

a request for more search results, and

a number of search results to be returned.

12. The method of any one of claims 3, 4 or 7 in which the parameter is a text parameter of the listing search transaction, the method including identifying, in the computer system, that the user has entered handwritten text data by means of the sensing device and effecting, in the computer system, an operation associated with the text parameter.

13. The method of claim 12 which includes converting, in the computer system, the handwritten text data to computer text.

14. The method of claim 13 in which the text parameter is associated with at least one of:

a search term.

15. The method of any one of claims 3, 4 or 7 in which the parameter is an authorization parameter of the listing search transaction, the method including identifying, in the computer system, that the user has entered a handwritten signature by means of the sensing device and effecting, in the computer system, an operation associated with the authorization parameter.

16. The method of claim 15 which includes verifying, in the computer system, that the signature is that of the user.

17. The method of claim 16 in which the authorization parameter is associated with authorization for at least one of:

access to account information, and

account payment.

18. The method of any one of claims 3, 4 or 7 in which the parameter is a picture parameter of the listing search transaction, the method including identifying, in the computer system, that the user has entered a hand-drawn picture by means of the sensing device and effecting, in the computer system, an operation associated with the picture parameter.

19. The method of claim 18 in which the picture parameter is associated with a picture of the item being advertised.

20. The method of any one of claims 1, 4 or 5 in which the form contains information relating to at least one of:

listing categories,

a listing search,

listing search results, and

listing details.

21. The method of any one of claims 1, 4 or 5 which includes printing the form on demand.

22. The method of claim 21 which includes printing the form on a surface of a surface-defining means and, at the same time that the form is printed, printing the coded data on the surface.

23. The method of claim 22 which includes printing the coded data to be substantially invisible in the visible spectrum.

24. The method of claim 1 or 5 which includes retaining a retrievable record of each form generated, the form being retrievable using its identity as contained in its coded data.

25. The method of any one of claims 1, 4 or 5 which includes distributing a plurality of forms using a mixture of multicast and pointcast communications protocols.

26. The method of claim 1 or 4 in which the sensing device contains an identification means which imparts a unique identity to the sensing device and identifies it as being associated with a particular user and in which the method includes monitoring, in the computer system, said identity.

27. The method of any one of claims 1, 4 or 5 which includes providing all required information relating to the listing search transaction in the form to eliminate the need for a separate display device.

28. The method of any one of claims 1, 4 or 5 in which the form is printed on multiple pages and in which the method includes binding the pages.

29. A system for enabling searching of classified advertising, the system including

a form containing information relating to a listing search transaction, the form including coded data indicative of an identity of the form and of at least one reference point of the form; and

a computer system for receiving indicating data from a sensing device for identifying at least one parameter relating to the listing search transaction, the indicating data being indicative of the identity of the form and a position of the sensing device relative to the form, the sensing device sensing the indicating data using at least some of the coded

data.

30. The system of claim 29 in which said at least one parameter relating to the listing search transaction is associated with at least one zone of the form.

31. The system of claim 29 which includes the sensing device, the sensing device sensing its movement relative to the form using at least some of the coded data.

32. A system for enabling searching of classified advertising, the system including:

a form containing information relating to a listing search transaction, the form including coded data indicative of at least one parameter of the listing search transaction; and

a computer system for receiving data from a sensing device regarding said at least one parameter and regarding movement of the sensing device relative to the form, and for interpreting said movement of the sensing device as it relates to said at least one parameter, the sensing device, when moved relative to the form, sensing the data regarding said at least one parameter using at least some of the coded data and generating the data regarding its own movement relative to the form.

33. A system for enabling searching of classified advertising, the system including:

a form including coded data indicative of an identity of the form; and

a computer system for receiving from a sensing device data regarding an identity of a user and the identity of the form, and for identifying, from said received data, a listing search transaction, the sensing device containing the data regarding the identity of the user and sensing the data regarding the identity of the form using at least some of the coded data.

34. The system of claim 33 in which the coded data is also indicative of at least one parameter of the listing search transaction, the computer system receiving indicating data from the sensing device regarding said at least one parameter of the listing search transaction, and the sensing device sensing the indicating data using at least some of the coded data.

35. The system of claim 33 which includes the sensing device, the sensing device sensing its movement relative to the form.

36. The system of any one of claims 29, 32 or 34 in which said at least one parameter of the listing search transaction is selected from the group comprising an action parameter of the listing search transaction, an option parameter of the listing search transaction, a text parameter of the listing search transaction, an authorization parameter of the listing search transaction, and a picture parameter of the listing search transaction.

37. The system of claim 36 in which the action parameter of the listing search transaction is selected from the group comprising:

a category,

a search request, and

a request for more search results.

38. The system of claim 36 in which the option parameter is associated with at least one of:

a category,

a search request,

a request for more search results, and

a number of search results to be returned.

39. The system of claim 36 in which the text parameter is associated with at least one of:

a search term.

40. The system of claim 36 in which the authorization parameter is associated with authorization for at least one of:

access to account information, and

account payment.

41. The system of claim 36 in which the picture parameter is associated with a picture of the item being advertised.

42. The system of any one of claims 31, 32 or 35 in which the sensing device includes a marking nib.

43. The system of claim 31 or 32 in which the sensing device contains an identification means which imparts a unique identity to the sensing device and identifies it as belonging to a particular user.

44. The system of any one of claims 29, 32 or 33 in which the form is printed on a surface of a surface-defining means and in which the system includes a printer for printing the form on demand.

45. The system of claim 44 in which the printer prints the coded data at the same time as printing the form on the surface-defining means.

46. The system of any one of claims 29, 32 or 33 in which the coded data is substantially invisible in the visible spectrum.

47. The system of claim 29 or 33 which includes a database for keeping a retrievable record of each form generated, each form being retrievable by using its identity as included in its coded data.

48. The system of claim 44 in which, to cater for a form printed on multiple pages, the printer includes a binding means for binding the pages.

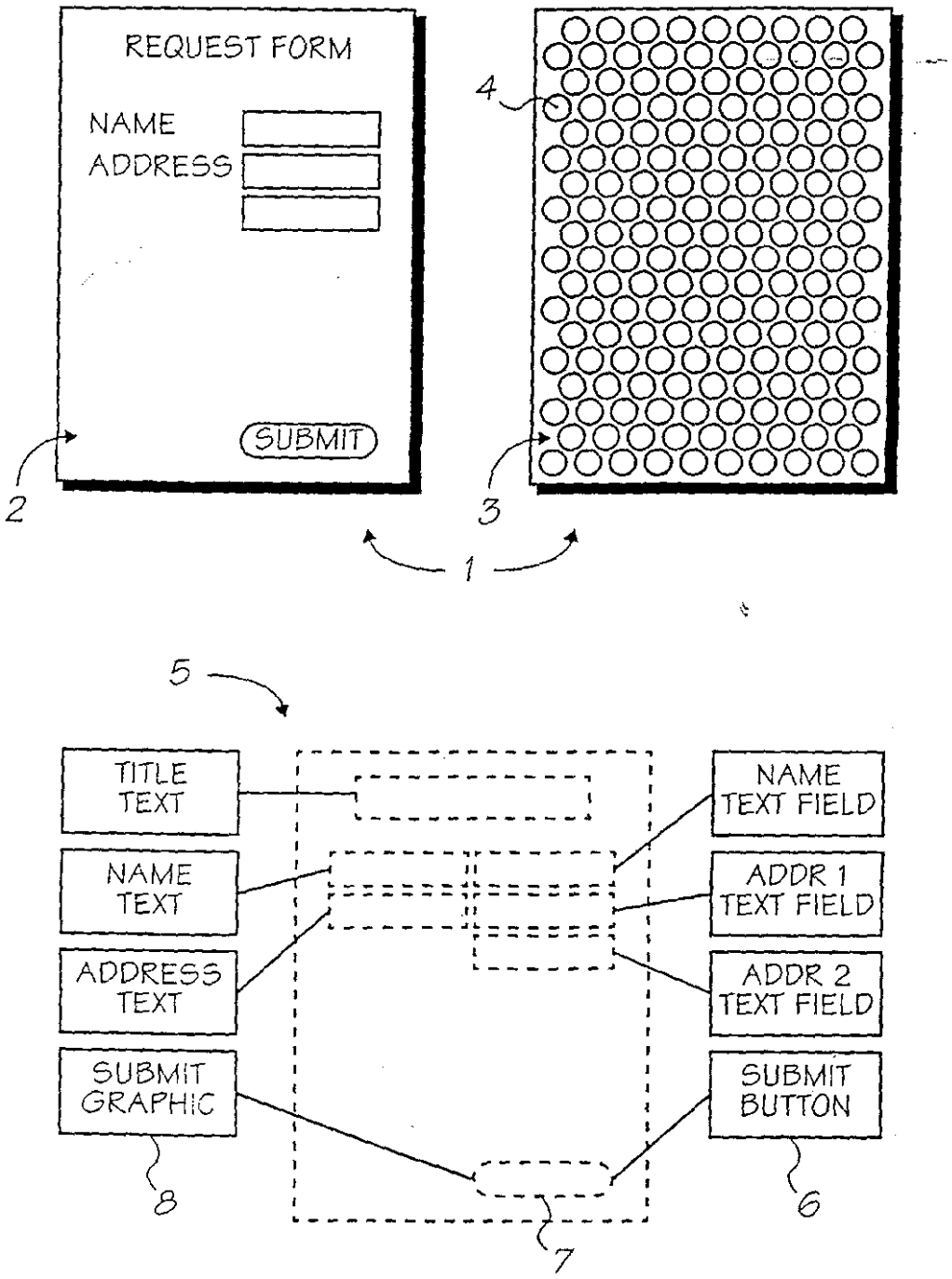

REQUEST FORM
NAME
ADDRESS
SUBMIT
2
3
4
1
5
TITLE TEXT
NAME TEXT
ADDRESS TEXT
SUBMIT GRAPHIC
NAME TEXT FIELD
ADDR 1 TEXT FIELD
ADDR 2 TEXT FIELD
SUBMIT BUTTON
8
6
7

FIG. 1

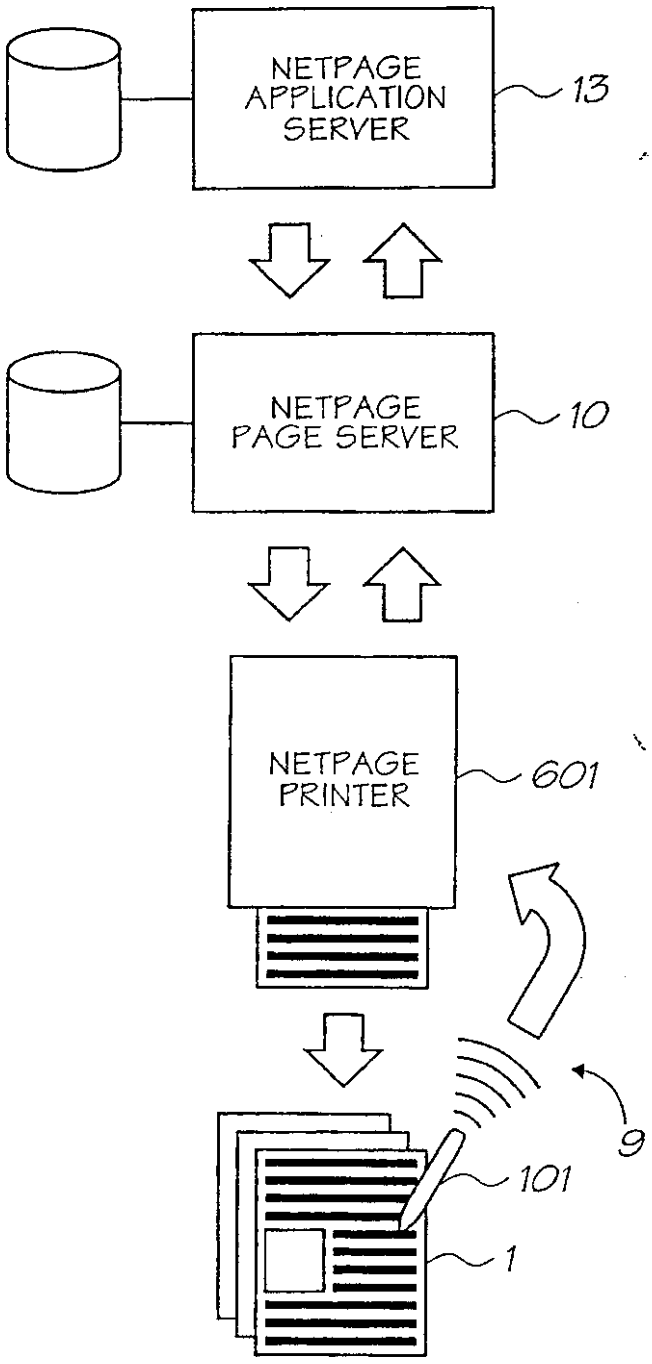

NETPAGE APPLICATION SERVER
13
NETPAGE PAGE SERVER
10
NETPAGE PRINTER
601
9
101
1

FIG. 2

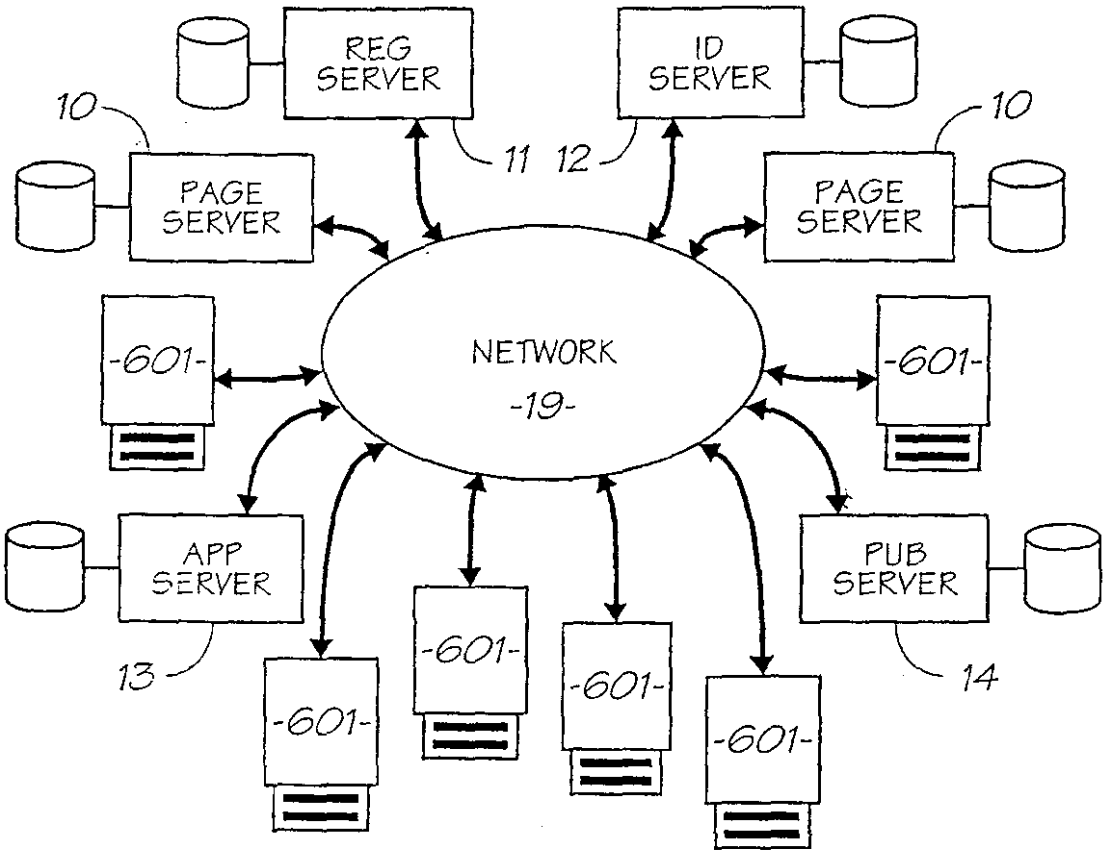

REG SERVER
ID SERVER
10
10
PAGE SERVER
PAGE SERVER
11
12
NETWORK
-19-
-601-
-601-
APP SERVER
PUB SERVER
13
14
-601-
-601-
-601-
-601-

FIG. 3

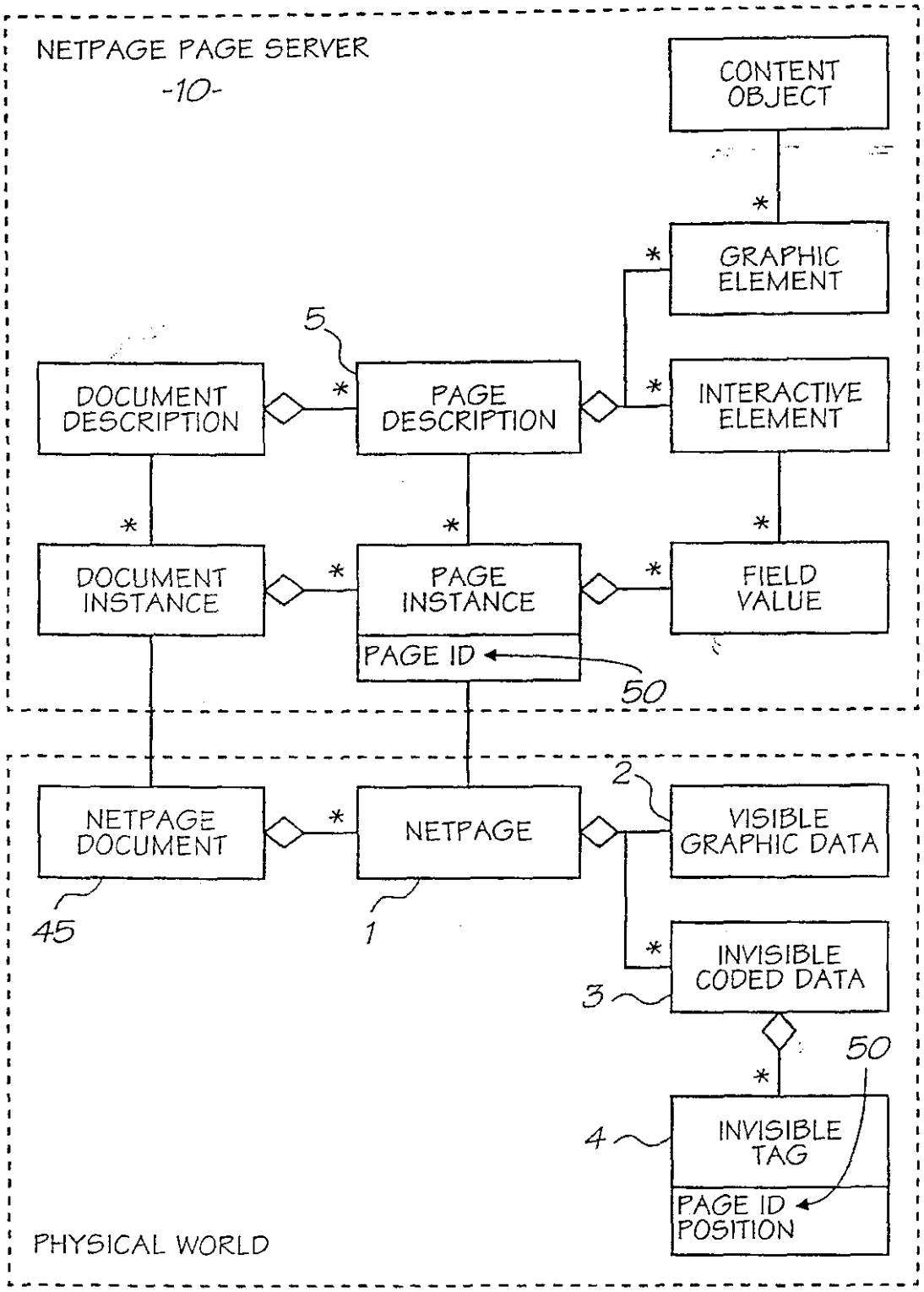

NETPAGE PAGE SERVER
-10-
CONTENT OBJECT
GRAPHIC ELEMENT
5
DOCUMENT DESCRIPTION
PAGE DESCRIPTION
INTERACTIVE ELEMENT
DOCUMENT INSTANCE
PAGE INSTANCE
FIELD VALUE
PAGE ID
50
2
NETPAGE DOCUMENT
NETPAGE
VISIBLE GRAPHIC DATA
45
1
INVISIBLE CODED DATA
3
50
4
INVISIBLE TAG
PAGE ID POSITION
PHYSICAL WORLD

FIG. 4

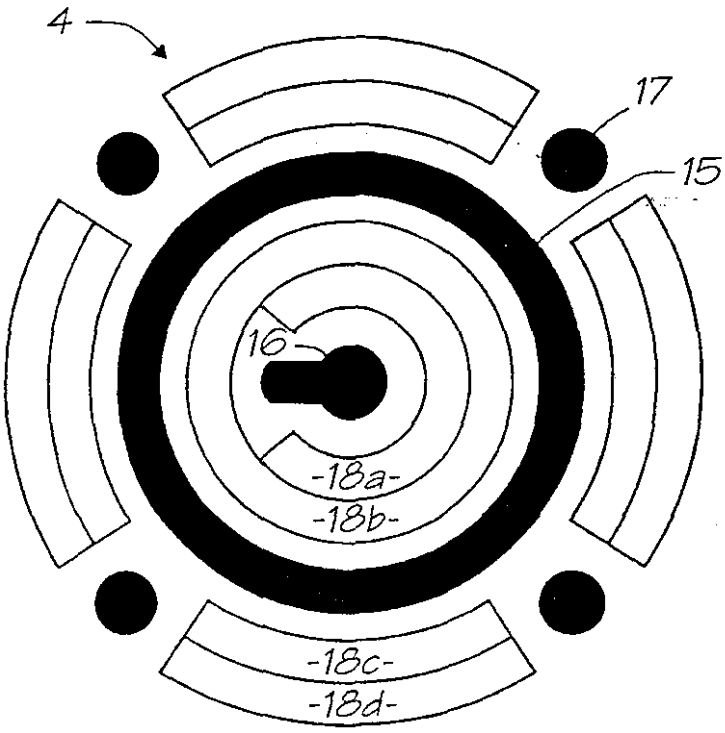


FIG. 5

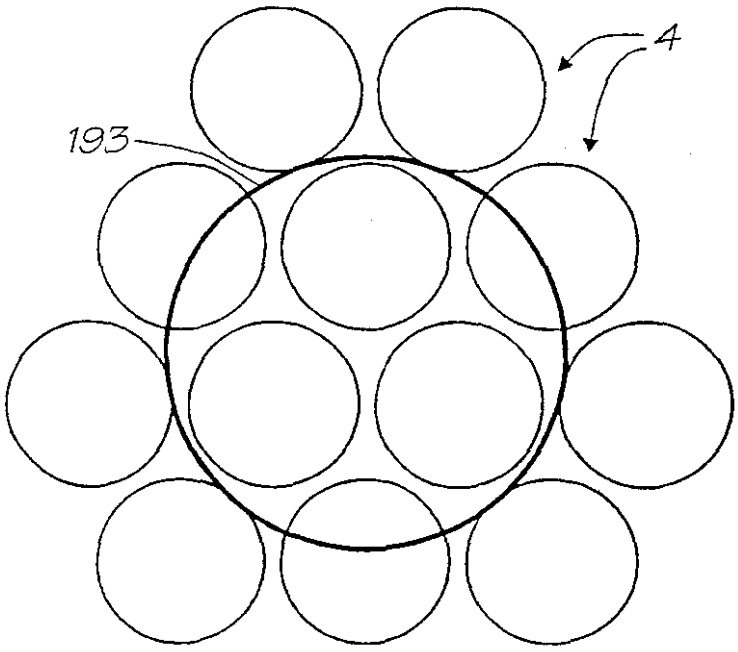


FIG. 6

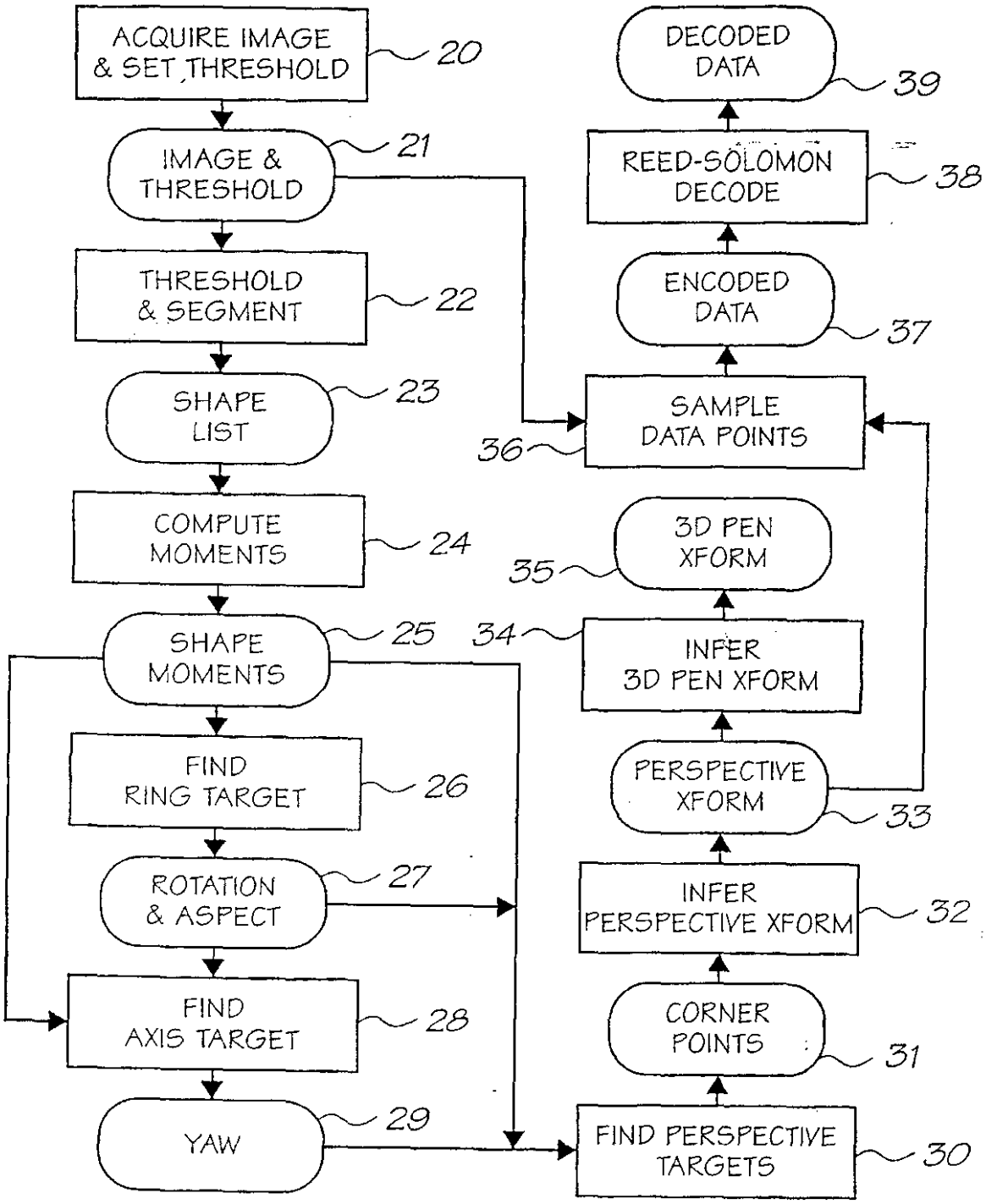

ACQUIRE IMAGE & SET THRESHOLD
20
IMAGE & THRESHOLD
21
THRESHOLD & SEGMENT
22
SHAPE LIST
23
COMPUTE MOMENTS
24
SHAPE MOMENTS
25
FIND RING TARGET
26
ROTATION & ASPECT
27
FIND AXIS TARGET
28
YAW
29
FIND PERSPECTIVE TARGETS
30
CORNER POINTS
31
INFER PERSPECTIVE XFORM
32
PERSPECTIVE XFORM
33
INFER 3D PEN XFORM
34
3D PEN XFORM
35
SAMPLE DATA POINTS
36
ENCODED DATA
37
REED-SOLOMON DECODE
38
DECODED DATA
39

FIG. 7

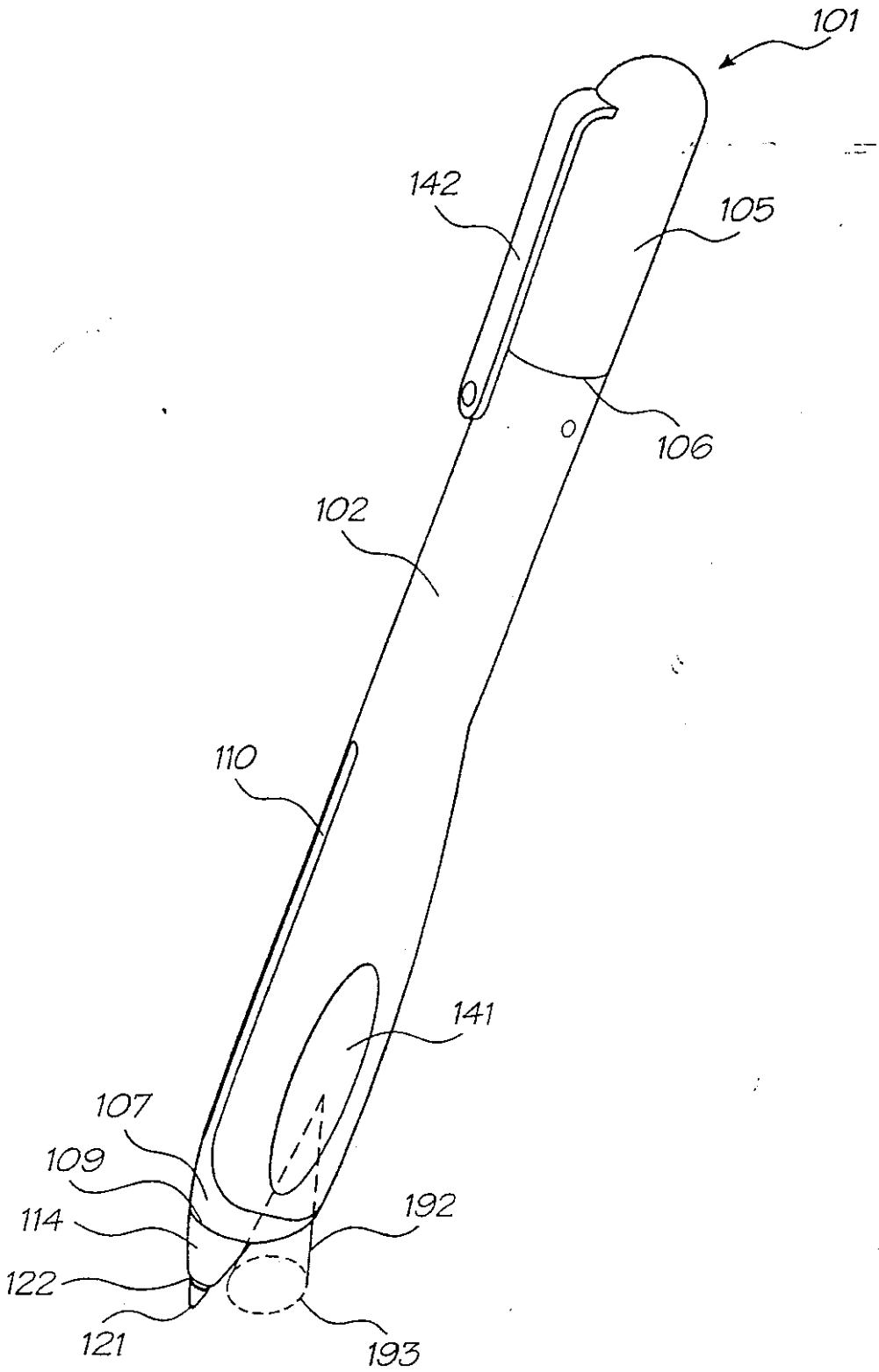


FIG. 8

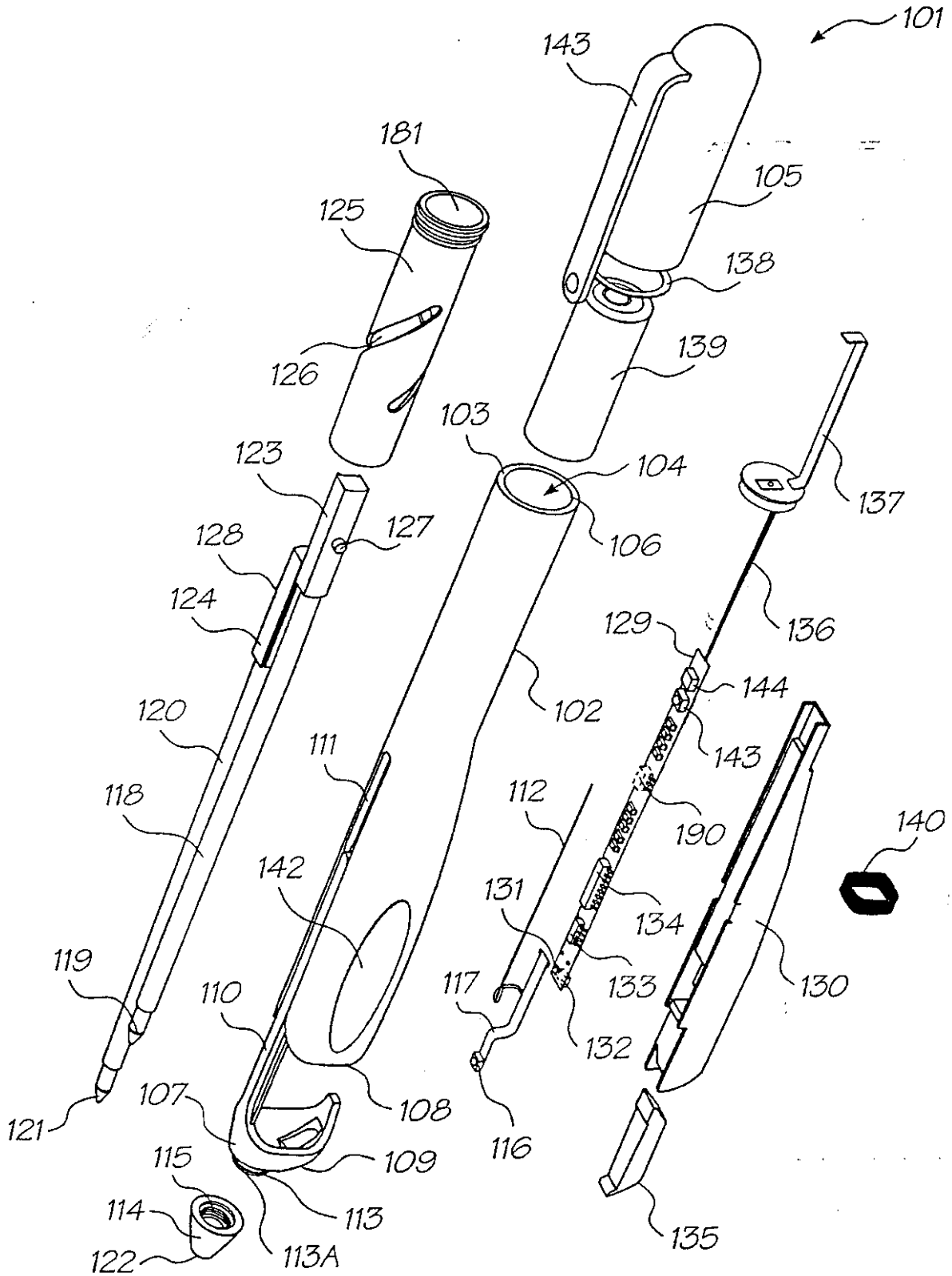

101
143
181
105
125
138
139
126
103
104
123
137
106
128
127
124
129
136
102
144
120
111
143
118
112
190
140
142
131
134
119
133
130
110
117
132
107
108
116
109
115
113
114
135
122
113A

FIG. 9

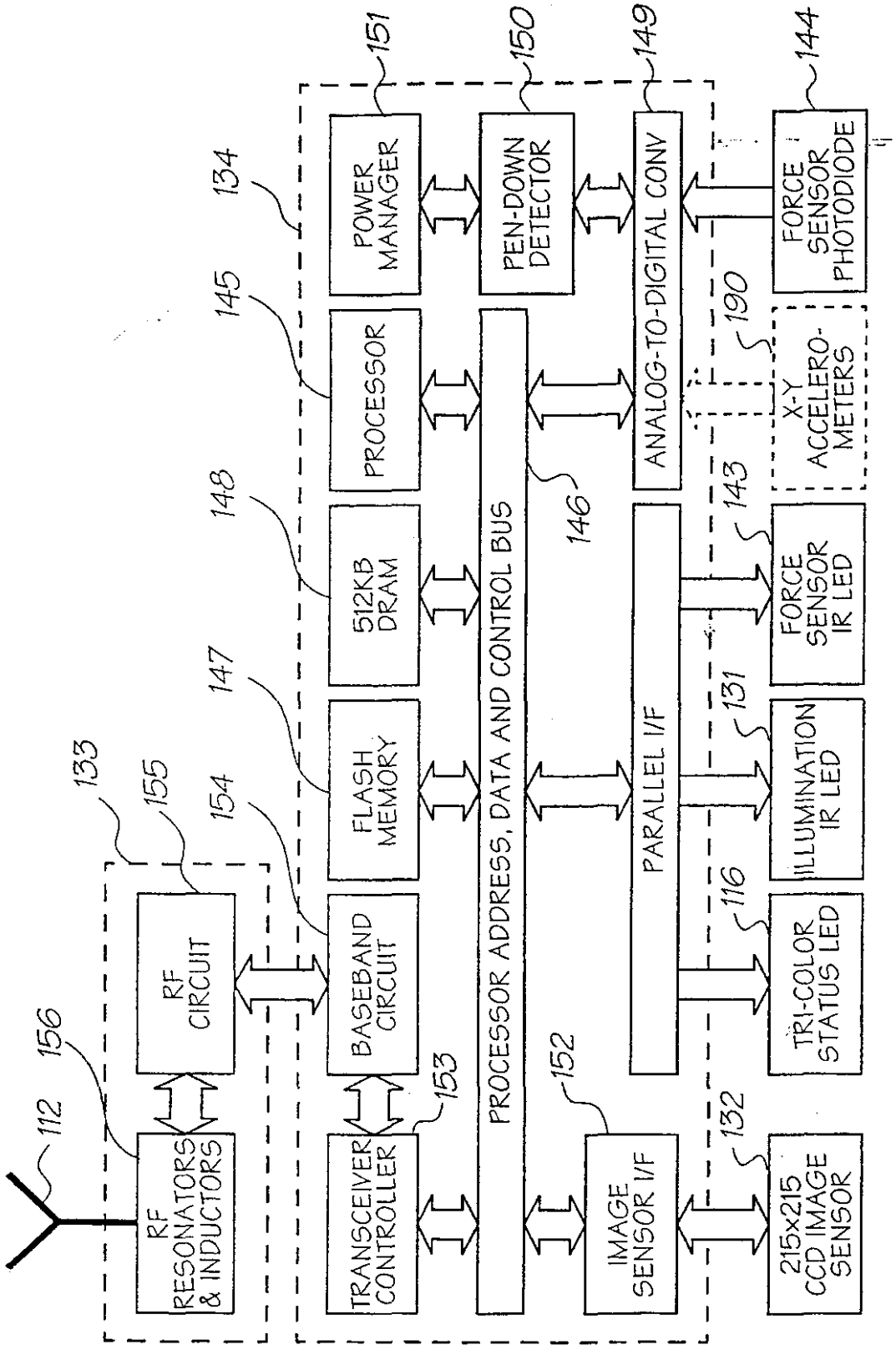

112
156
RF RESONATORS & INDUCTORS
133
155
RF CIRCUIT
154
BASEBAND CIRCUIT
153
TRANSCEIVER CONTROLLER
147
FLASH MEMORY
148
512KB DRAM
145
PROCESSOR
134
POWER MANAGER
151
PROCESSOR ADDRESS, DATA AND CONTROL BUS
146
152
IMAGE SENSOR I/F
132
215x215 CCD IMAGE SENSOR
PARALLEL I/F
131
116
TRI-COLOR STATUS LED
ILLUMINATION IR LED
143
FORCE SENSOR IR LED
PEN-DOWN DETECTOR
150
ANALOG-TO-DIGITAL CONV
149
190
X-Y ACCELERO-METERS
144
FORCE SENSOR PHOTODIODE

FIG. 10

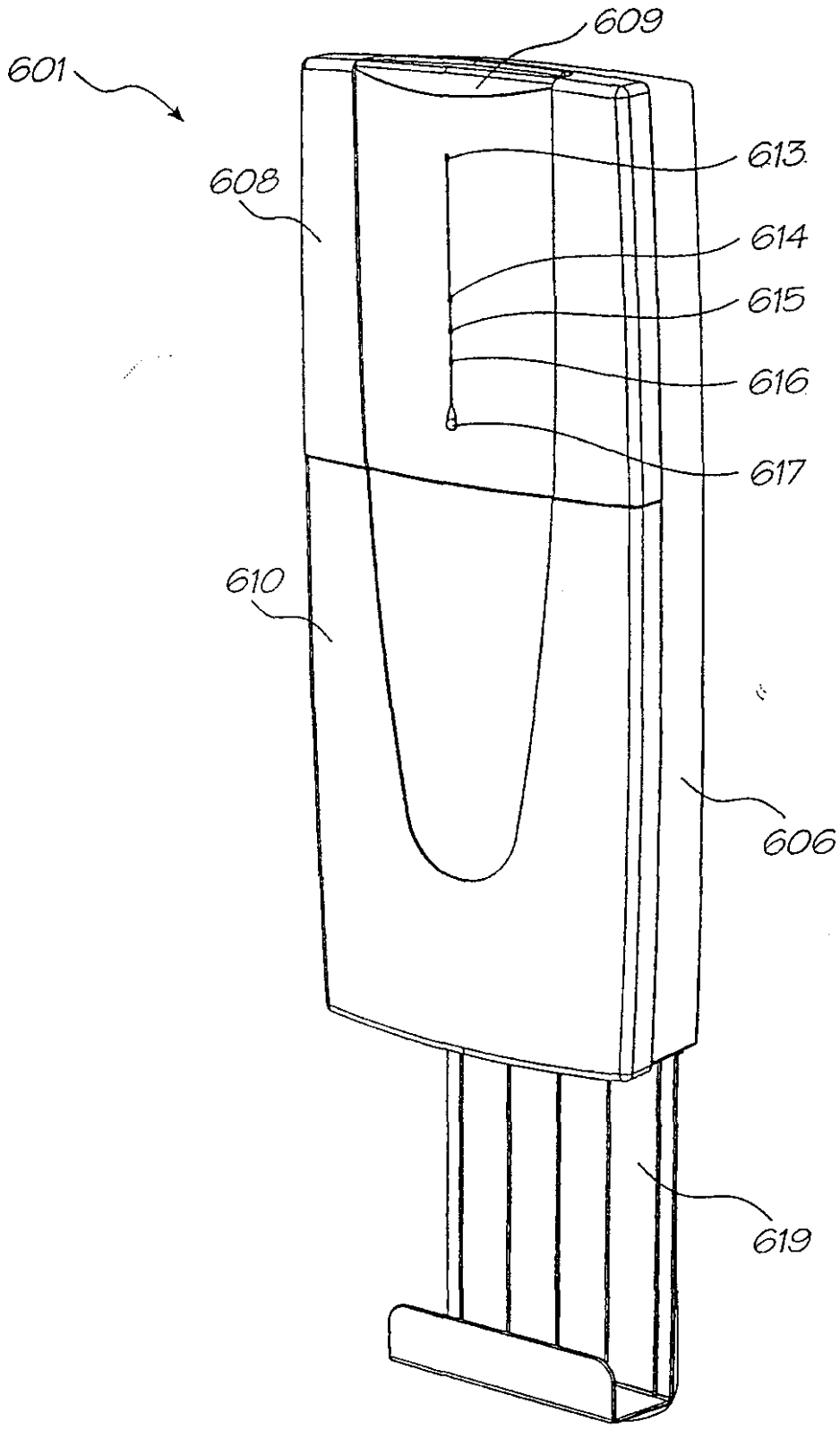


FIG. 11

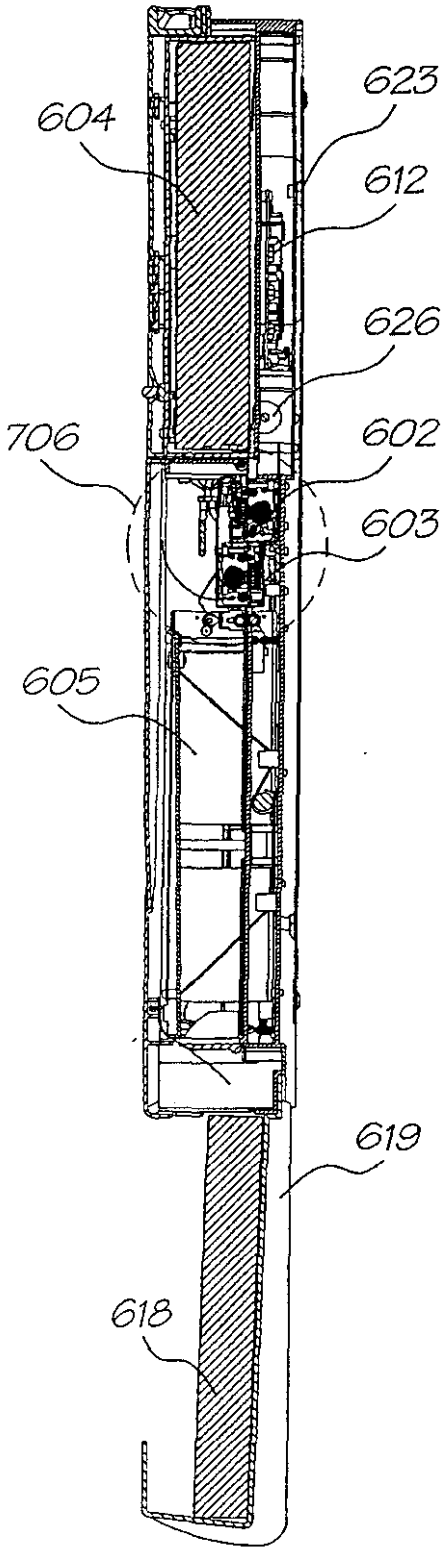


FIG. 12

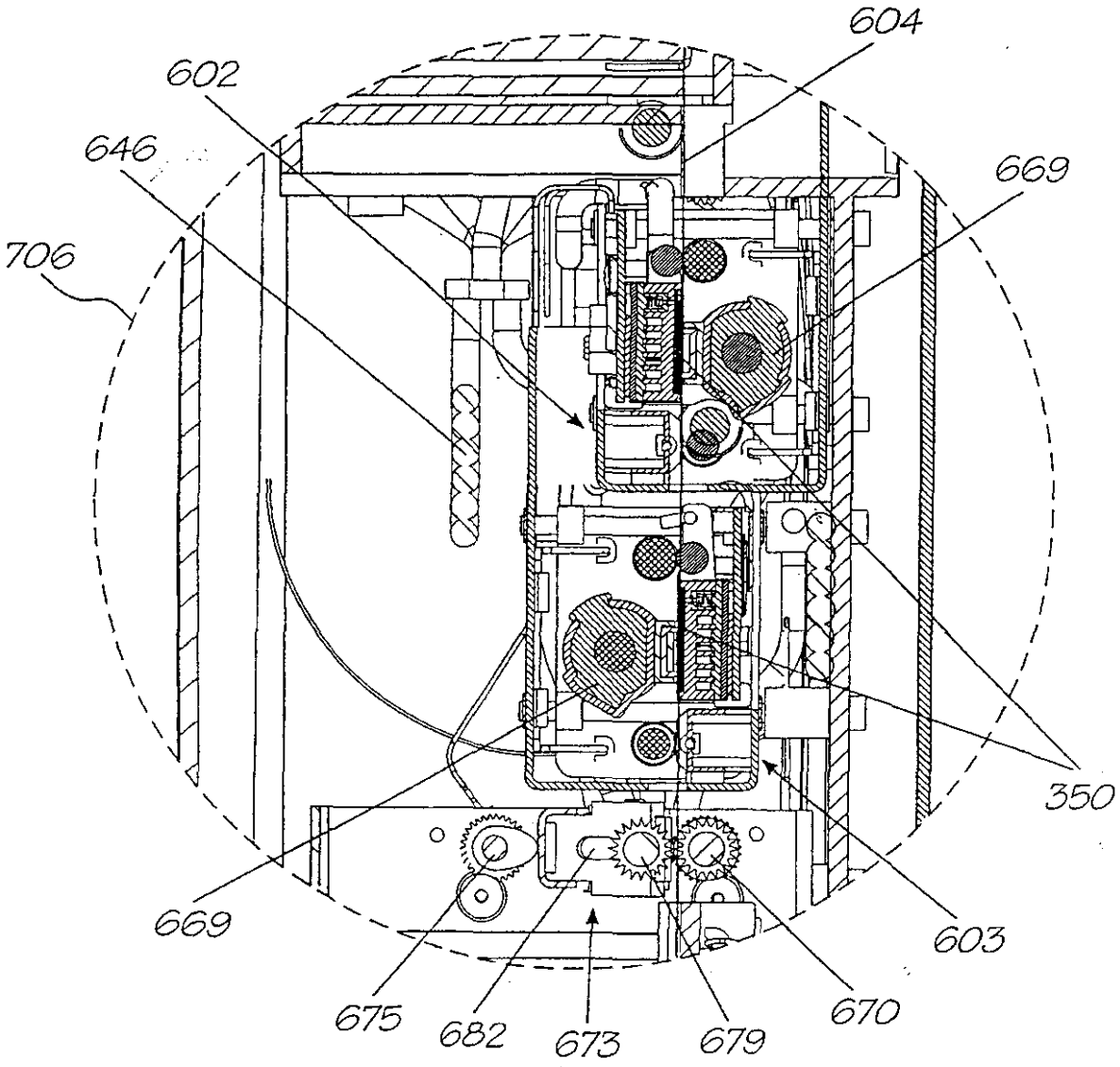


FIG. 12a

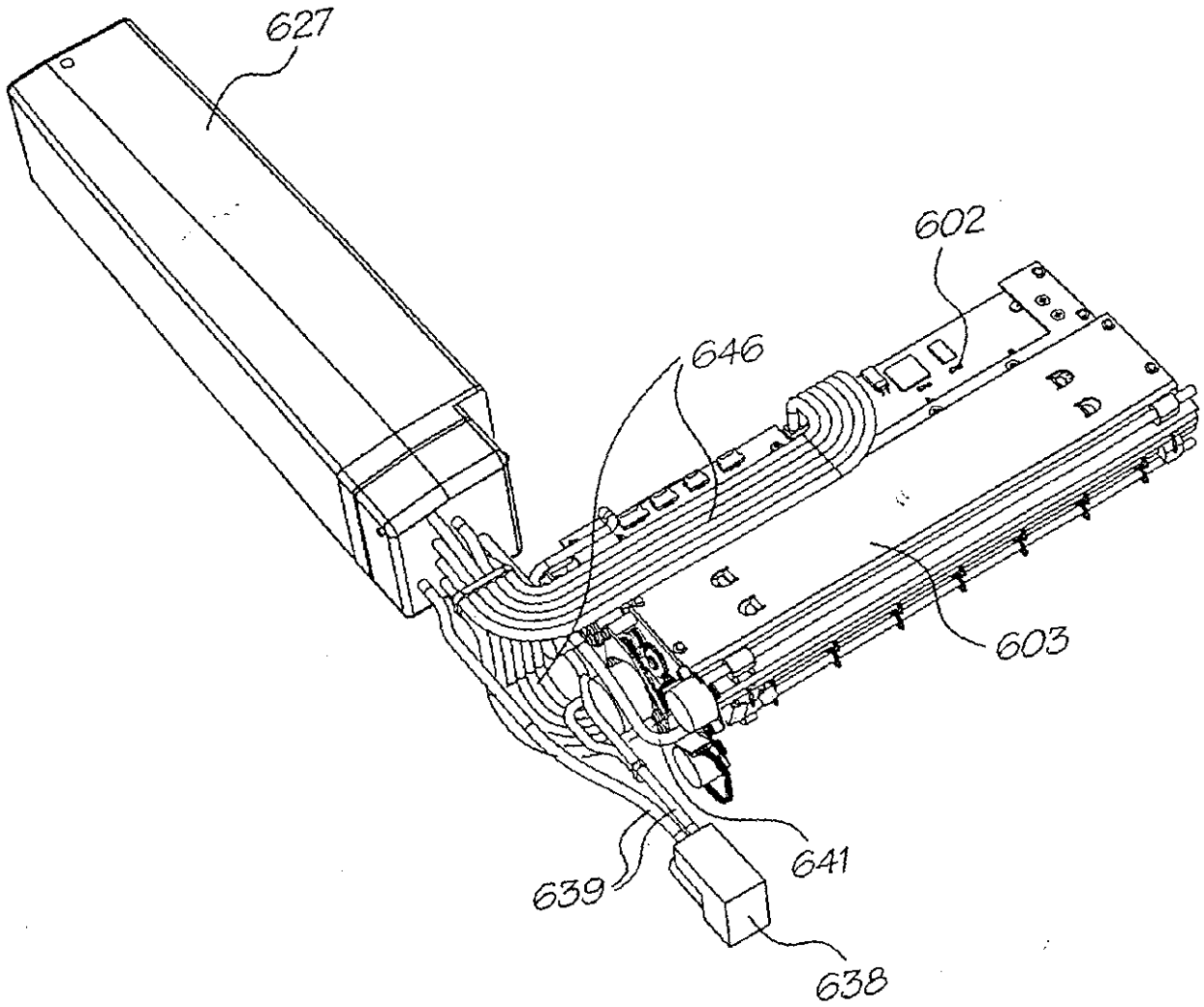


FIG. 13

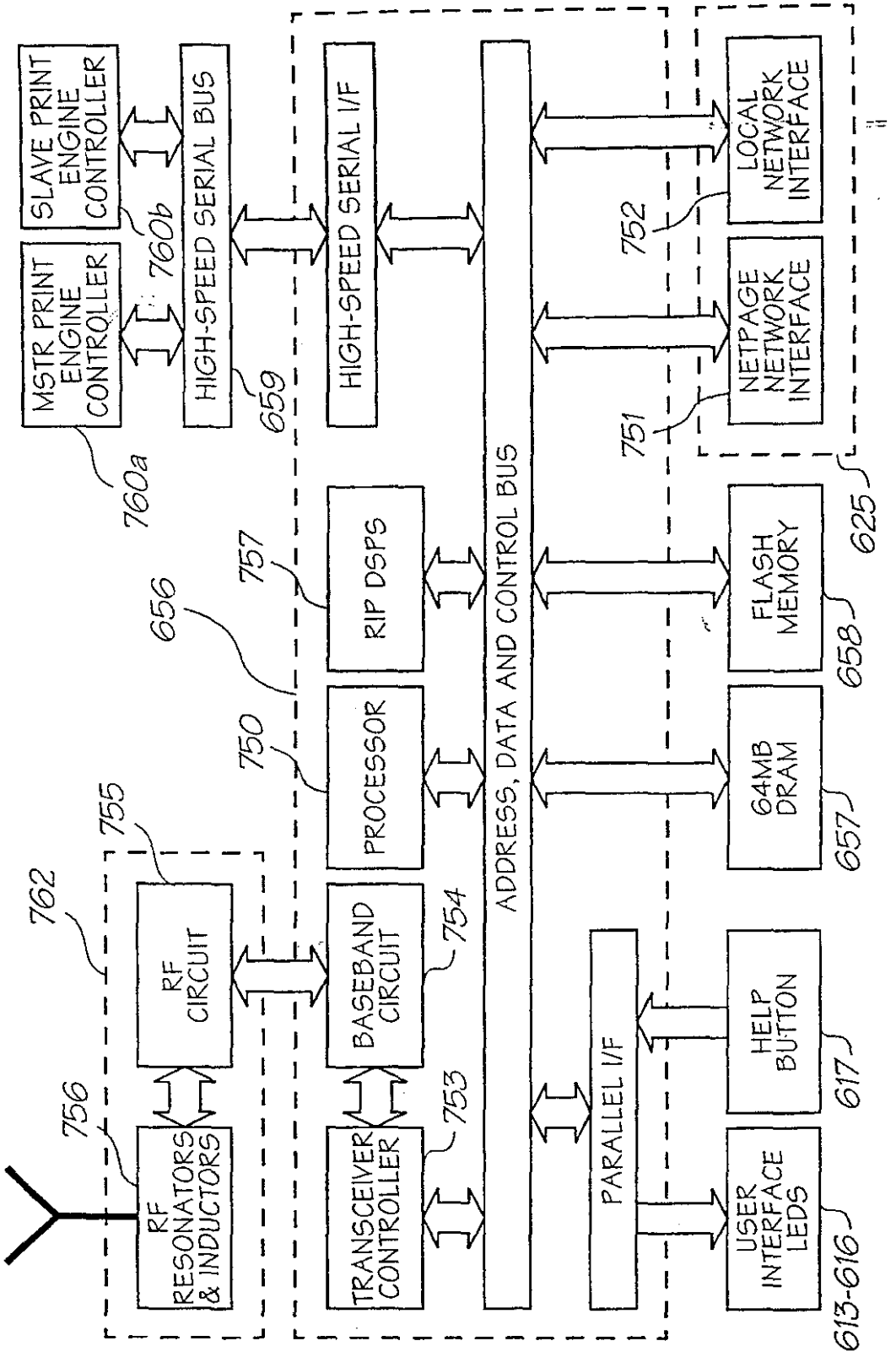

SLAVE PRINT ENGINE CONTROLLER
MSTR PRINT ENGINE CONTROLLER
760b
760a
HIGH-SPEED SERIAL BUS
659
HIGH-SPEED SERIAL I/F
LOCAL NETWORK INTERFACE
752
NETPAGE NETWORK INTERFACE
751
625
656
757
RIP DSPS
FLASH MEMORY
658
750
PROCESSOR
ADDRESS, DATA AND CONTROL BUS
64MB DRAM
657
755
762
RF CIRCUIT
BASEBAND CIRCUIT
754
756
753
RF RESONATORS & INDUCTORS
TRANSCEIVER CONTROLLER
PARALLEL I/F
HELP BUTTON
617
USER INTERFACE LEDS
613-616

FIG. 14

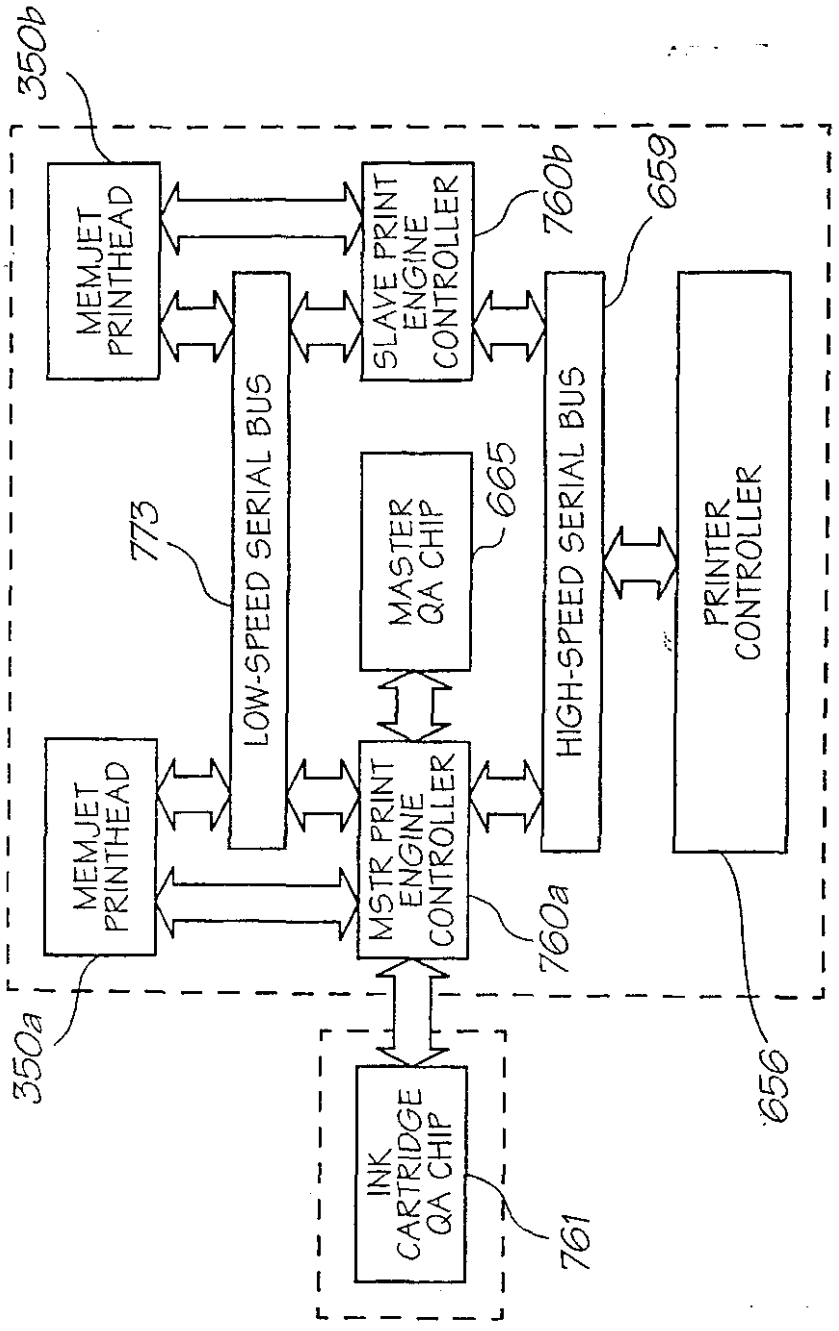

350b
MEMJET PRINTHEAD
SLAVE PRINT ENGINE CONTROLLER
760b
659
773
LOW-SPEED SERIAL BUS
MASTER QA CHIP
665
HIGH-SPEED SERIAL BUS
PRINTER CONTROLLER
MEMJET PRINTHEAD
MSTR PRINT ENGINE CONTROLLER
760a
350a
656
INK CARTRIDGE QA CHIP
761

FIG. 15

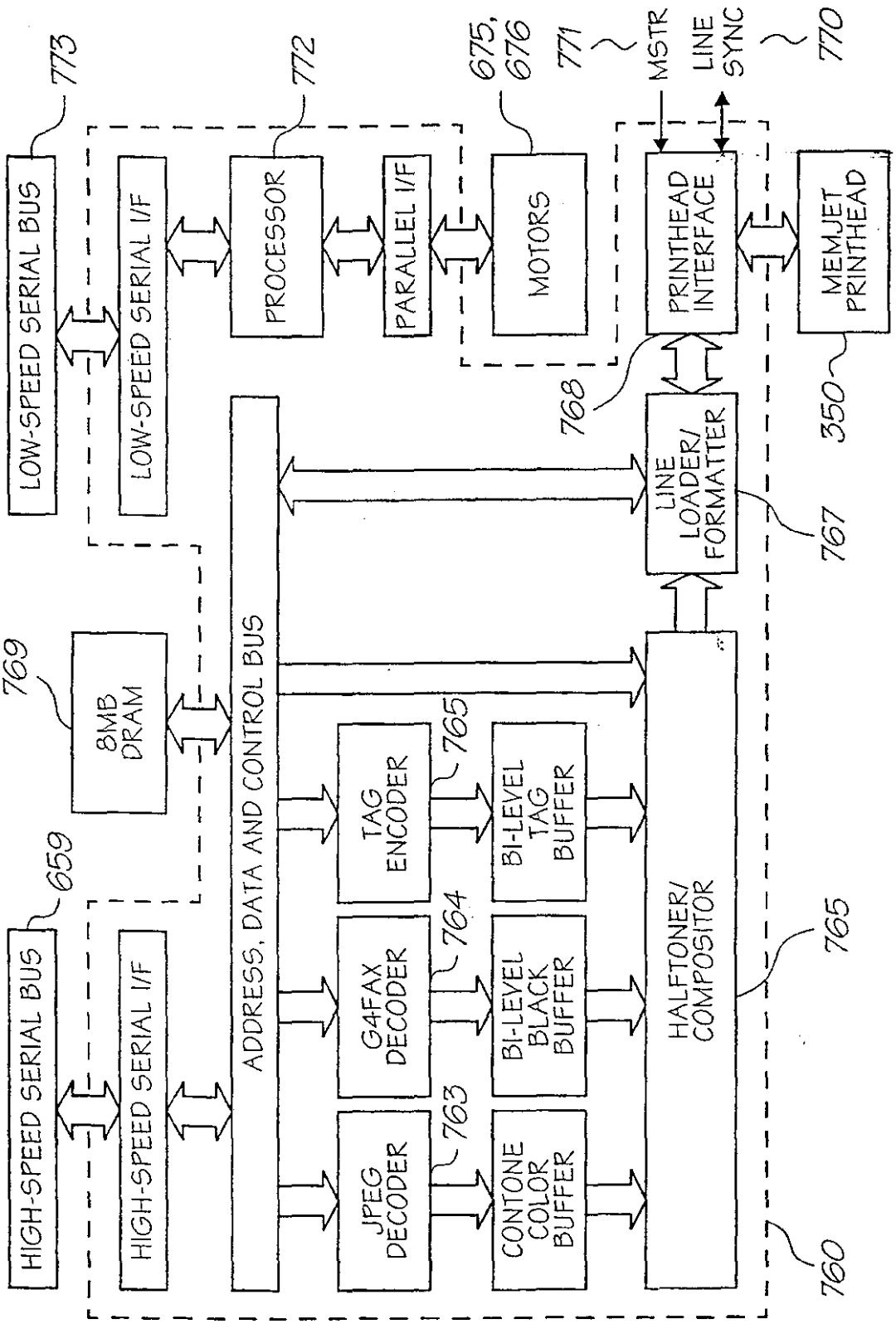

LOW-SPEED SERIAL BUS
773
LOW-SPEED SERIAL I/F
PROCESSOR
772
PARALLEL I/F
675, 676
MOTORS
771
MSTR
LINE SYNC
770
PRINTHEAD INTERFACE
MEMJET PRINTHEAD
350
768
LINE LOADER/ FORMATTER
767
ADDRESS, DATA AND CONTROL BUS
769
8MB DRAM
TAG ENCODER
765
BI-LEVEL TAG BUFFER
659
HIGH-SPEED SERIAL BUS
HIGH-SPEED SERIAL I/F
G4FAX DECODER
764
BI-LEVEL BLACK BUFFER
HALFTONER/ COMPOSITOR
765
JPEG DECODER
763
CONTONE COLOR BUFFER
760

FIG. 16

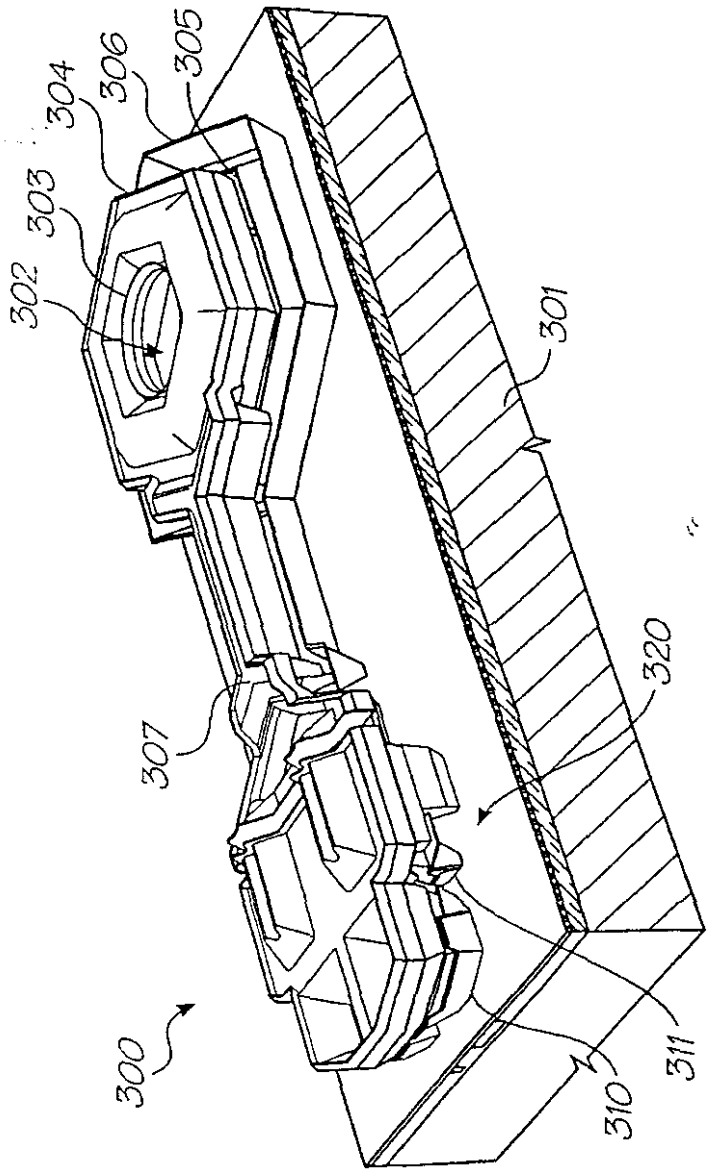


FIG. 17

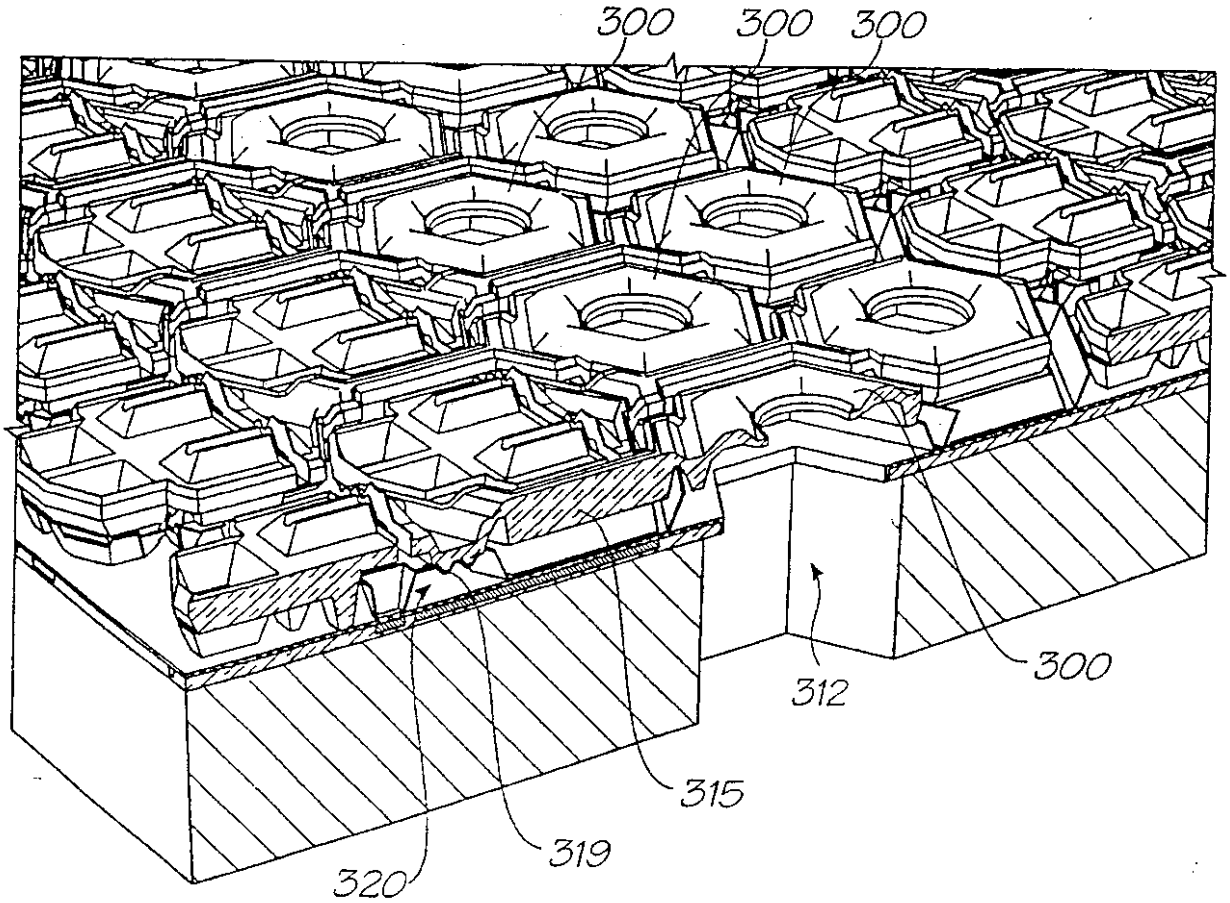


FIG. 18

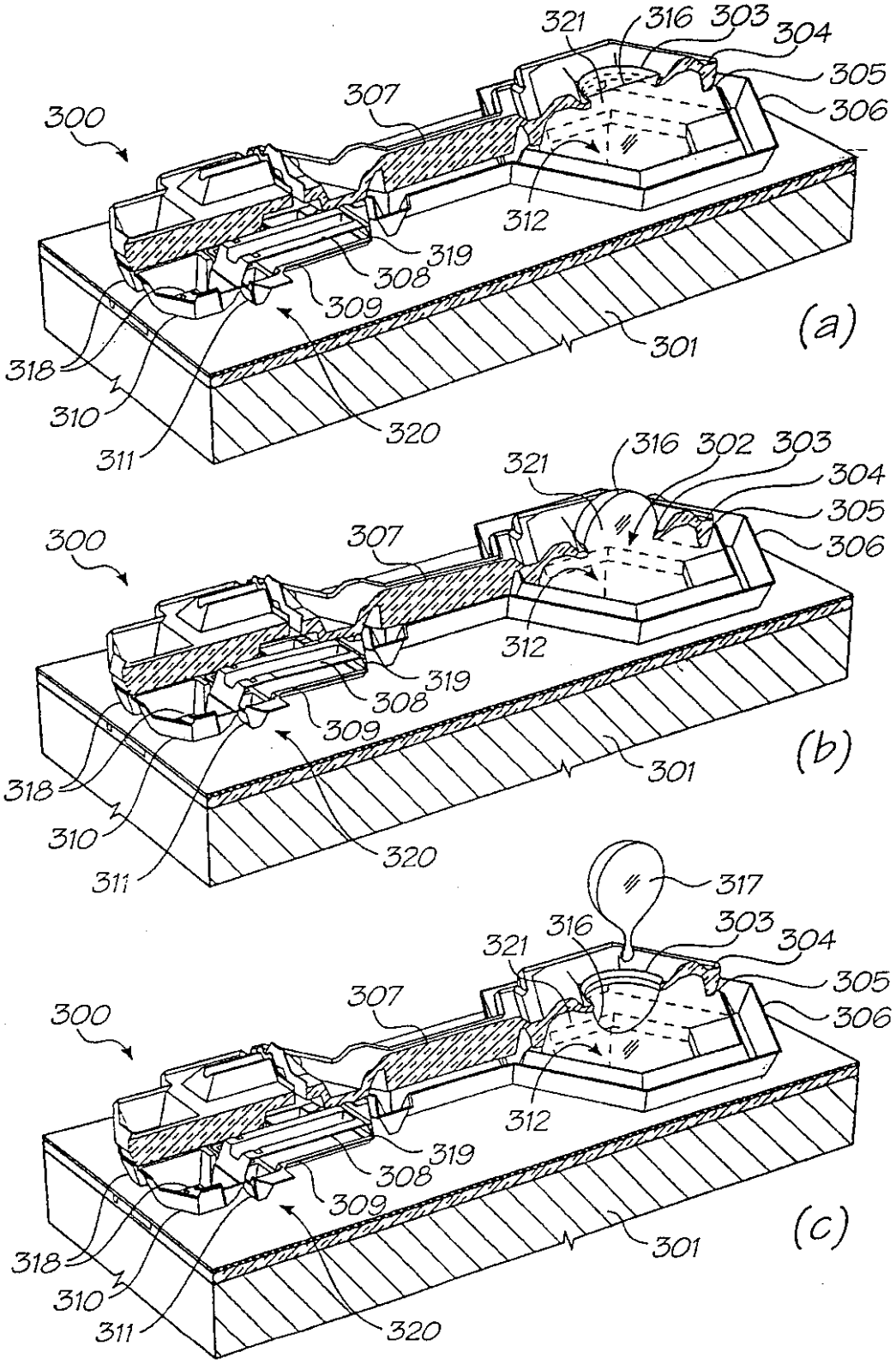

321
316
303
304
305
306
307
300
312
319
308
309
318
310
311
320
301
(a)
316
302
303
321
304
305
306
307
300
312
319
308
309
318
310
311
320
301
(b)
317
316
303
321
304
305
307
306
300
312
319
308
309
318
310
311
320
301
(c)

FIG. 19

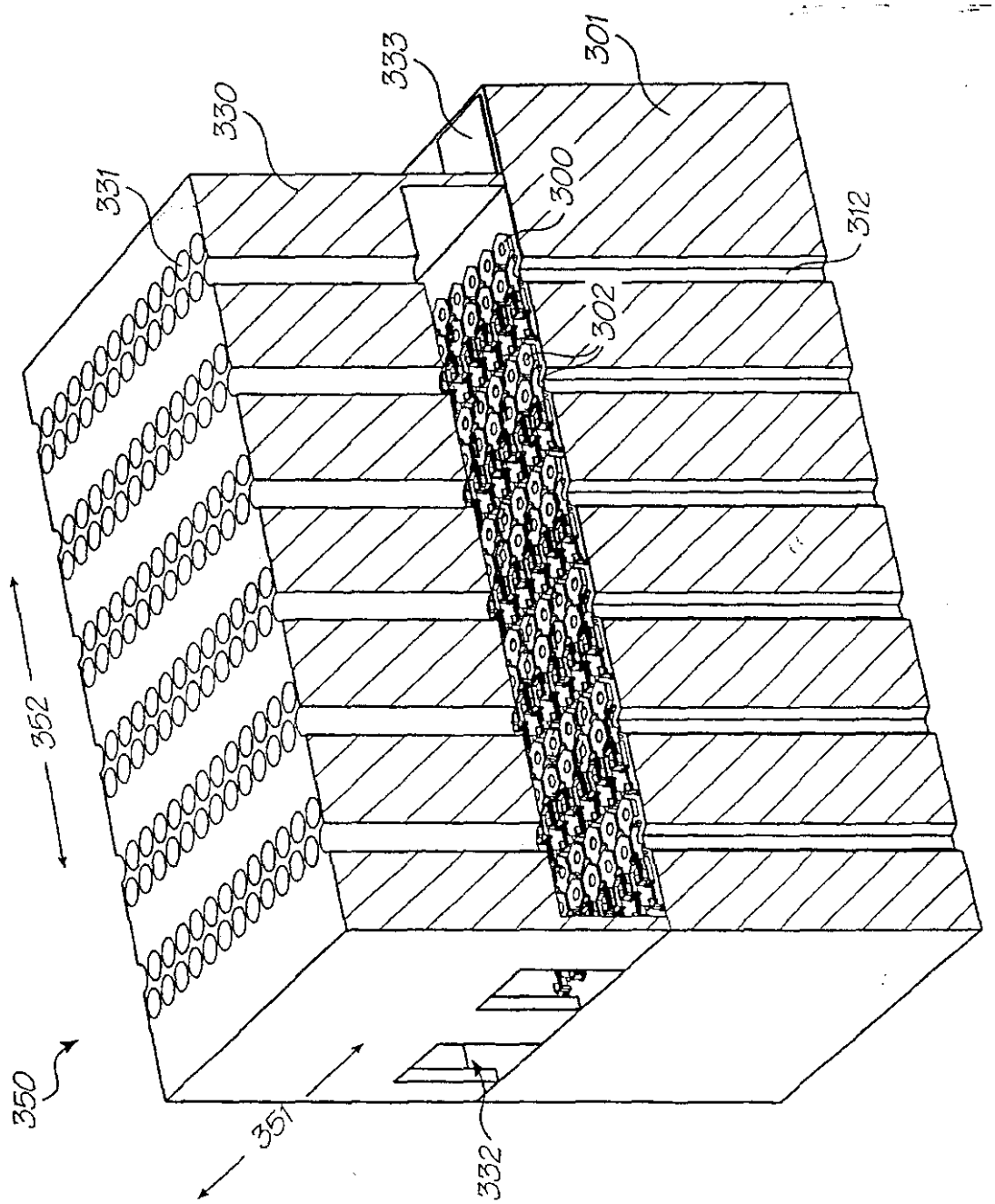


FIG. 20

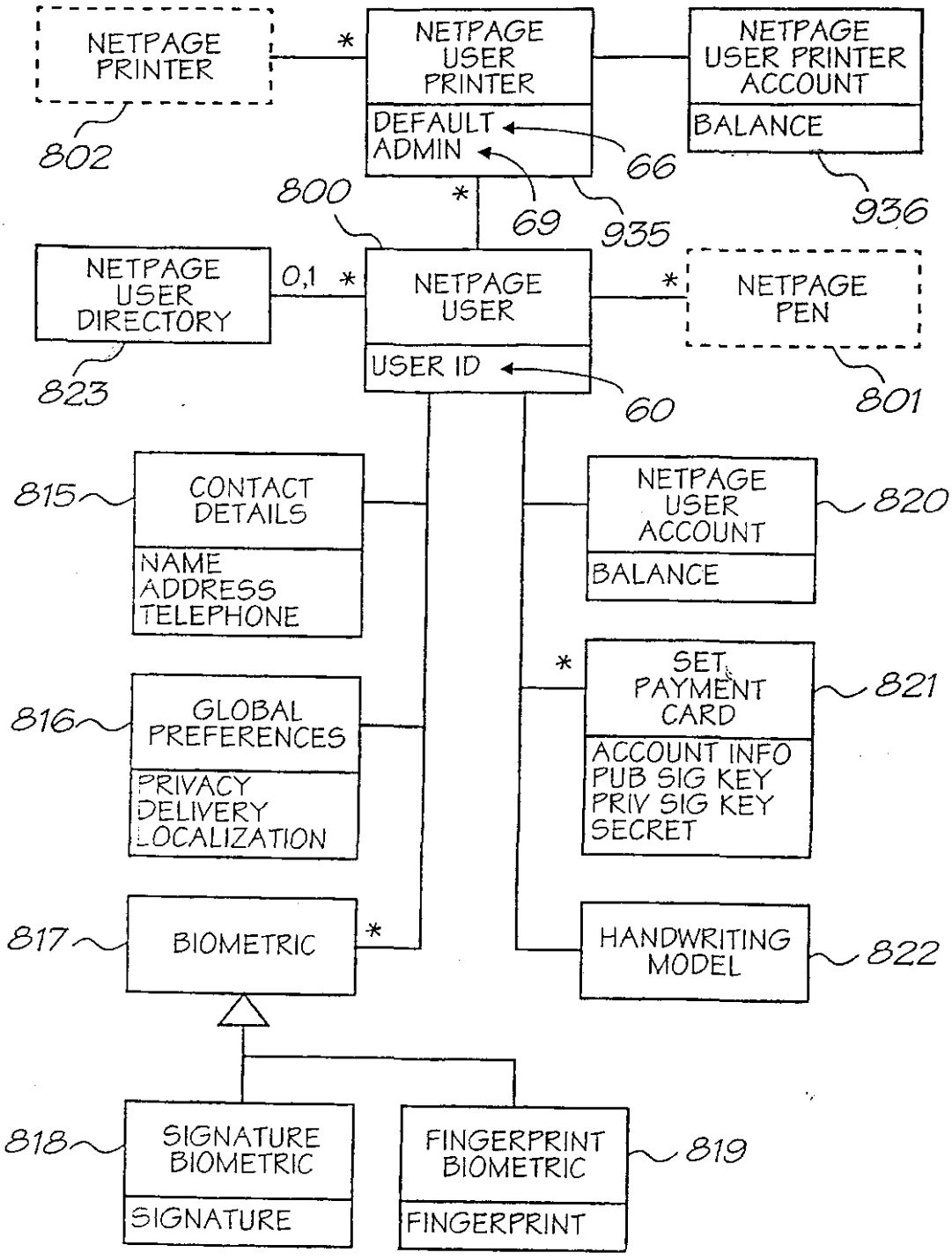

NETPAGE PRINTER
802
*
NETPAGE USER PRINTER
DEFAULT
ADMIN
66
69
935
NETPAGE USER PRINTER ACCOUNT
BALANCE
936
800
*
NETPAGE USER DIRECTORY
823
0,1 *
NETPAGE USER
USER ID
60
*
NETPAGE PEN
801
815
CONTACT DETAILS
NAME
ADDRESS
TELEPHONE
NETPAGE USER ACCOUNT
BALANCE
820
816
GLOBAL PREFERENCES
PRIVACY
DELIVERY
LOCALIZATION
*
SET PAYMENT CARD
ACCOUNT INFO
PUB SIG KEY
PRIV SIG KEY
SECRET
821
817
BIOMETRIC
*
HANDWRITING MODEL
822
818
SIGNATURE BIOMETRIC
SIGNATURE
FINGERPRINT BIOMETRIC
FINGERPRINT
819

FIG. 21

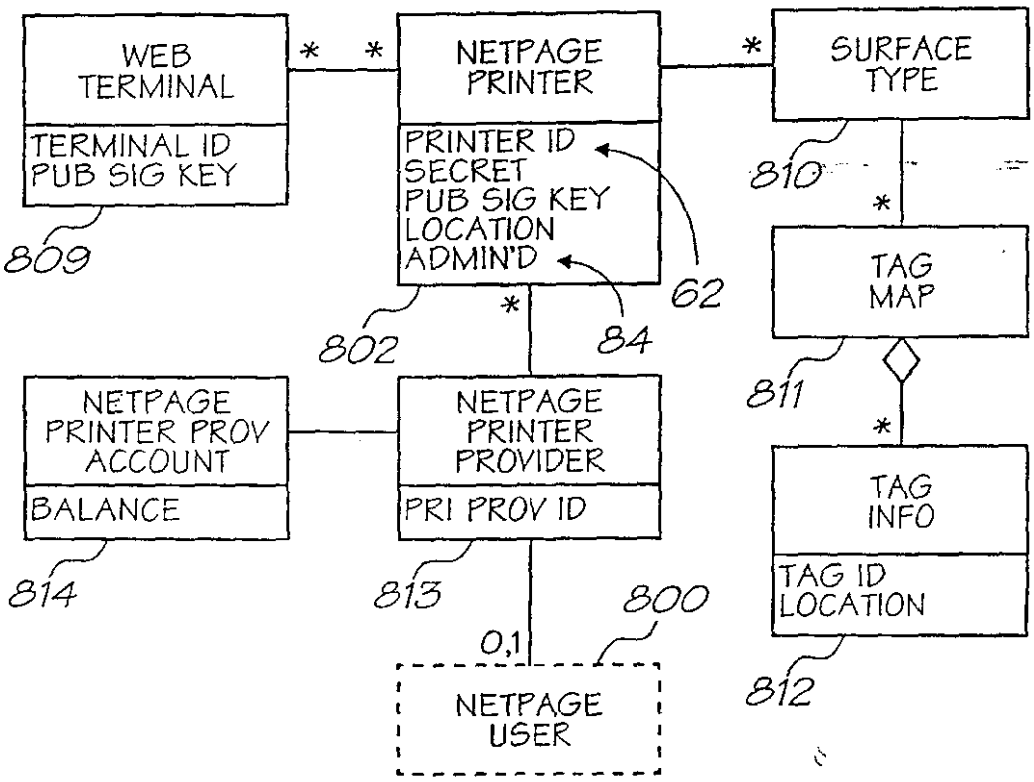

WEB TERMINAL
TERMINAL ID
PUB SIG KEY
809
NETPAGE PRINTER
PRINTER ID
SECRET
PUB SIG KEY
LOCATION
ADMIN'D
802
62
84
SURFACE TYPE
810
TAG MAP
811
TAG INFO
TAG ID
LOCATION
812
NETPAGE PRINTER PROV ACCOUNT
BALANCE
814
NETPAGE PRINTER PROVIDER
PRI PROV ID
813
0,1
800
NETPAGE USER

FIG. 22

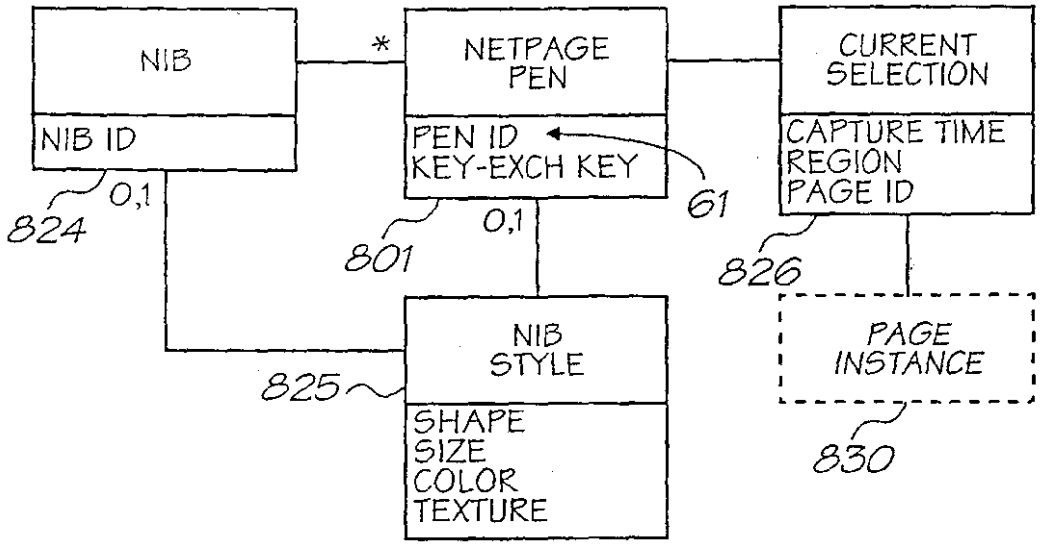

NIB
NIB ID
824
0,1
NETPAGE PEN
PEN ID
KEY-EXCH KEY
801
0,1
61
CURRENT SELECTION
CAPTURE TIME
REGION
PAGE ID
826
NIB STYLE
825
SHAPE
SIZE
COLOR
TEXTURE
PAGE INSTANCE
830

FIG. 23

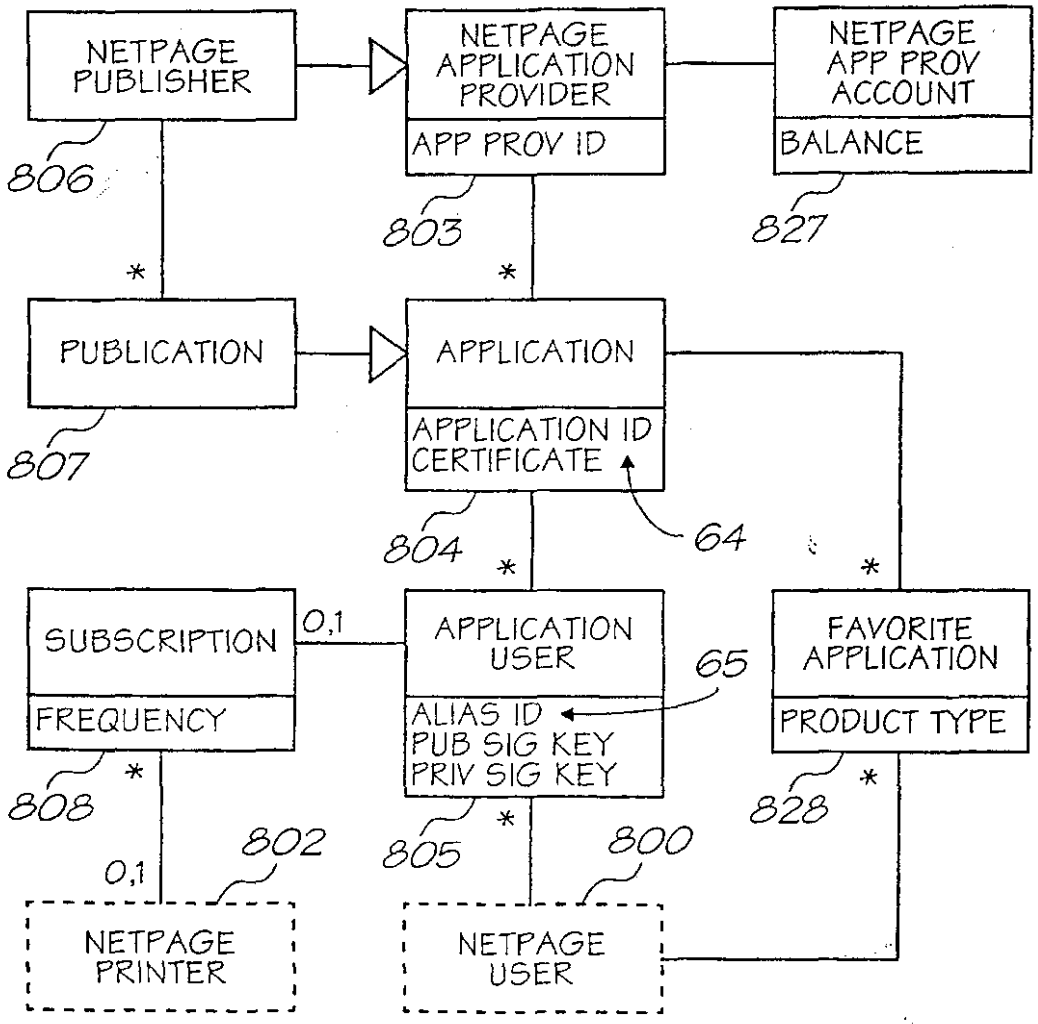

NETPAGE PUBLISHER
NETPAGE APPLICATION PROVIDER
APP PROV ID
NETPAGE APP PROV ACCOUNT
BALANCE
806
803
827
*
*
PUBLICATION
APPLICATION
APPLICATION ID
CERTIFICATE
807
804
64
*
*
SUBSCRIPTION
FREQUENCY
0,1
APPLICATION USER
ALIAS ID
PUB SIG KEY
PRIV SIG KEY
65
FAVORITE APPLICATION
PRODUCT TYPE
808
*
805
*
828
*
0,1
802
800
NETPAGE PRINTER
NETPAGE USER

FIG. 24

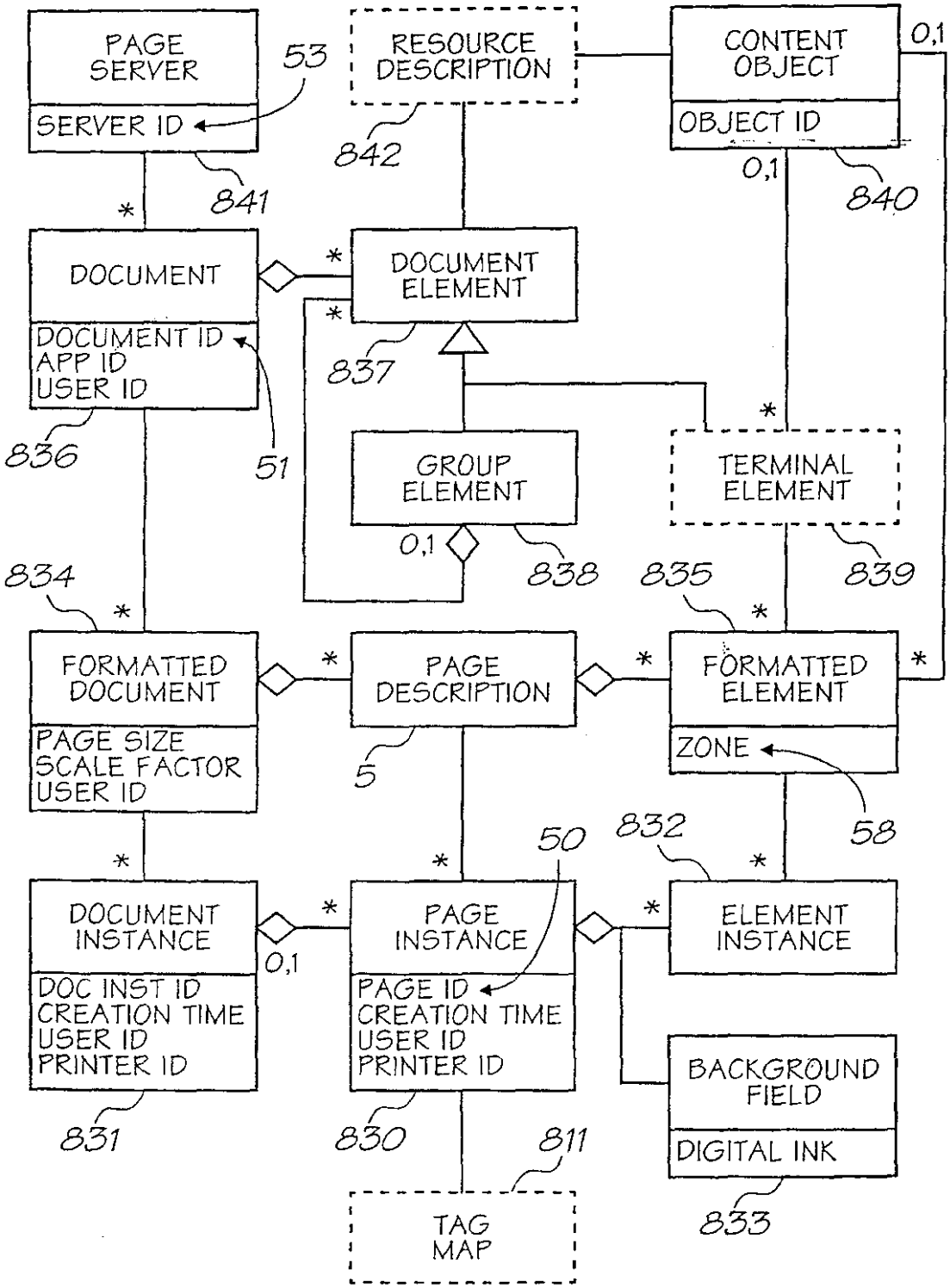

PAGE SERVER
SERVER ID
53
RESOURCE DESCRIPTION
842
CONTENT OBJECT
OBJECT ID
0,1
0,1
840
841
*
DOCUMENT
DOCUMENT ID
APP ID
USER ID
836
51
*
DOCUMENT ELEMENT
*
837
GROUP ELEMENT
0,1
838
*
TERMINAL ELEMENT
839
834
*
835
*
FORMATTED DOCUMENT
PAGE SIZE
SCALE FACTOR
USER ID
*
PAGE DESCRIPTION
5
*
FORMATTED ELEMENT
ZONE
58
*
832
*
50
*
DOCUMENT INSTANCE
DOC INST ID
CREATION TIME
USER ID
PRINTER ID
831
*
0,1
PAGE INSTANCE
PAGE ID
CREATION TIME
USER ID
PRINTER ID
830
*
ELEMENT INSTANCE
BACKGROUND FIELD
DIGITAL INK
833
811
TAG MAP

FIG. 25

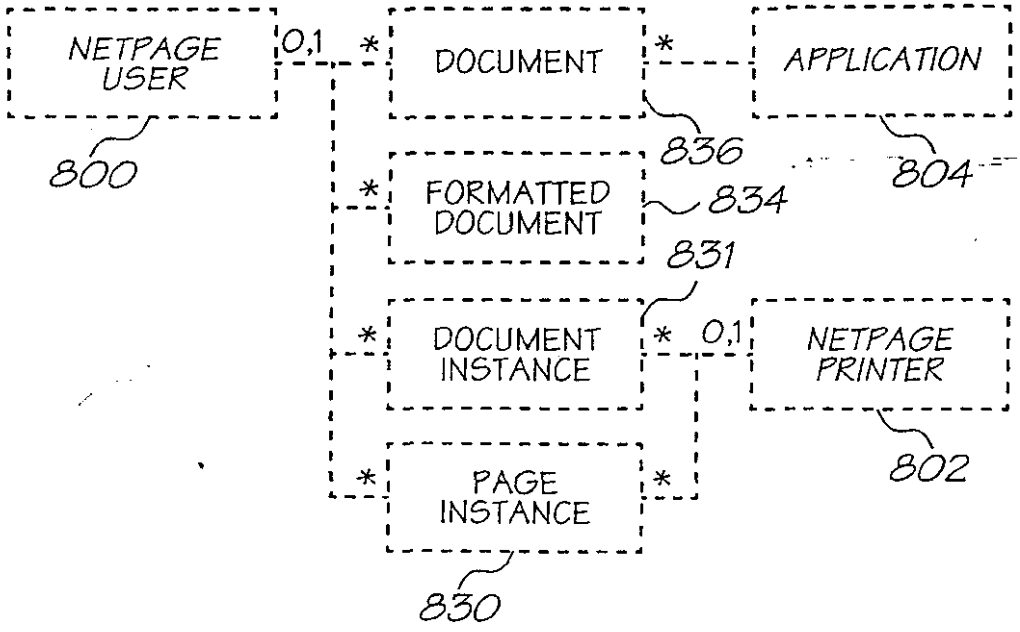

NETPAGE USER
0,1
*
DOCUMENT
*
APPLICATION
800
836
804
*
FORMATTED DOCUMENT
834
831
*
DOCUMENT INSTANCE
*
0,1
NETPAGE PRINTER
802
*
PAGE INSTANCE
*
830

FIG. 26

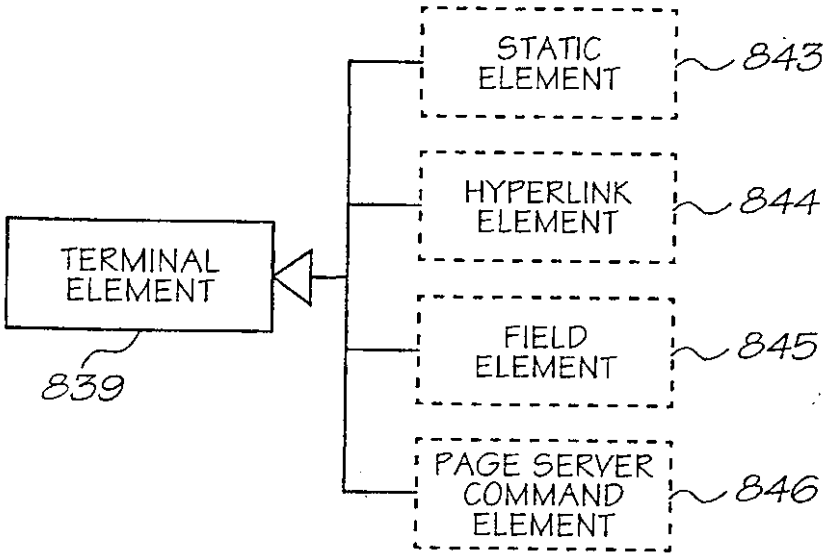

STATIC ELEMENT
843
HYPERLINK ELEMENT
844
TERMINAL ELEMENT
839
FIELD ELEMENT
845
PAGE SERVER COMMAND ELEMENT
846

FIG. 27

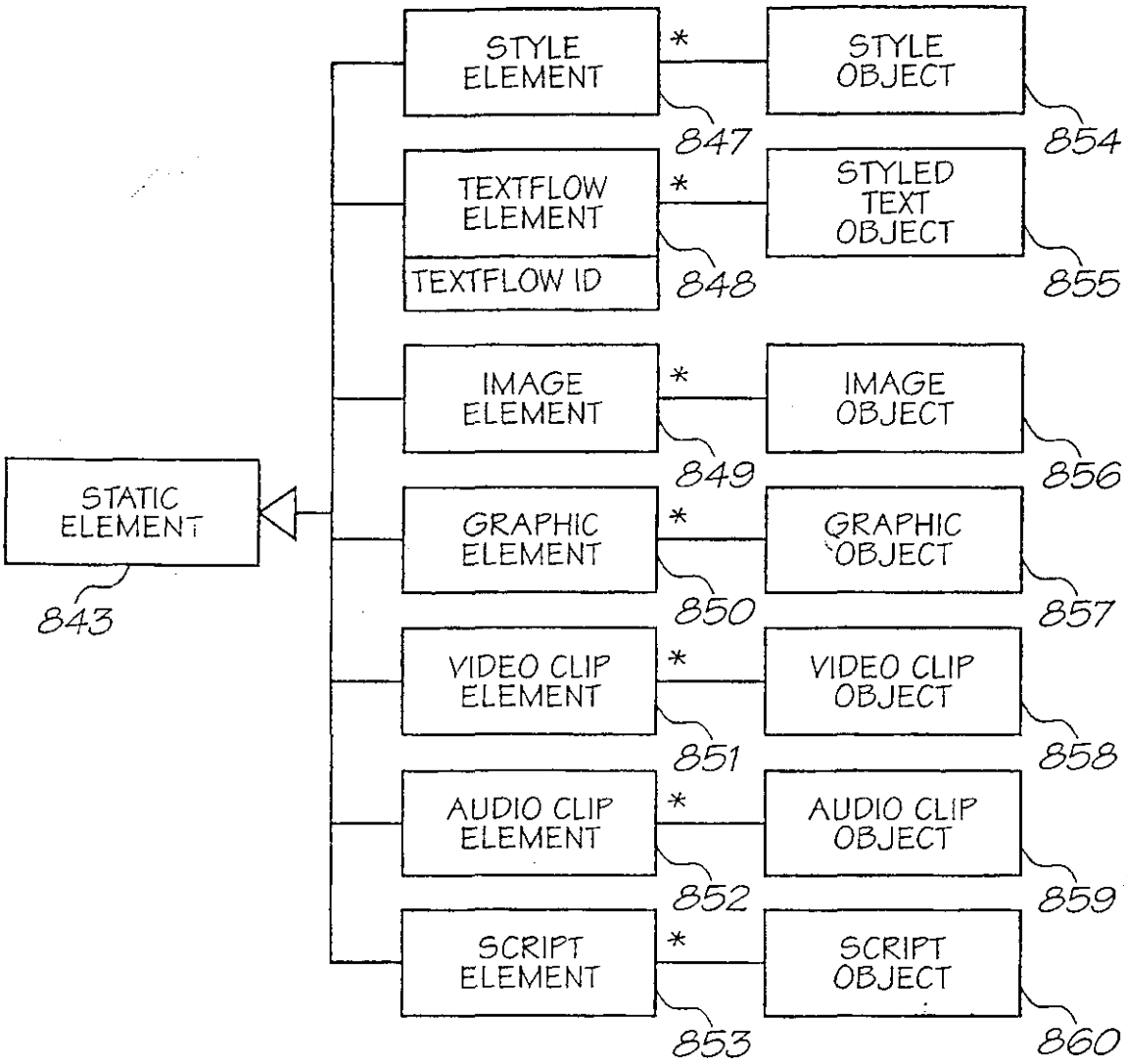

STYLE ELEMENT
*
STYLE OBJECT
847
854
TEXTFLOW ELEMENT
TEXTFLOW ID
*
STYLED TEXT OBJECT
848
855
IMAGE ELEMENT
*
IMAGE OBJECT
849
856
STATIC ELEMENT
843
GRAPHIC ELEMENT
*
GRAPHIC OBJECT
850
857
VIDEO CLIP ELEMENT
*
VIDEO CLIP OBJECT
851
858
AUDIO CLIP ELEMENT
*
AUDIO CLIP OBJECT
852
859
SCRIPT ELEMENT
*
SCRIPT OBJECT
853
860

FIG. 28

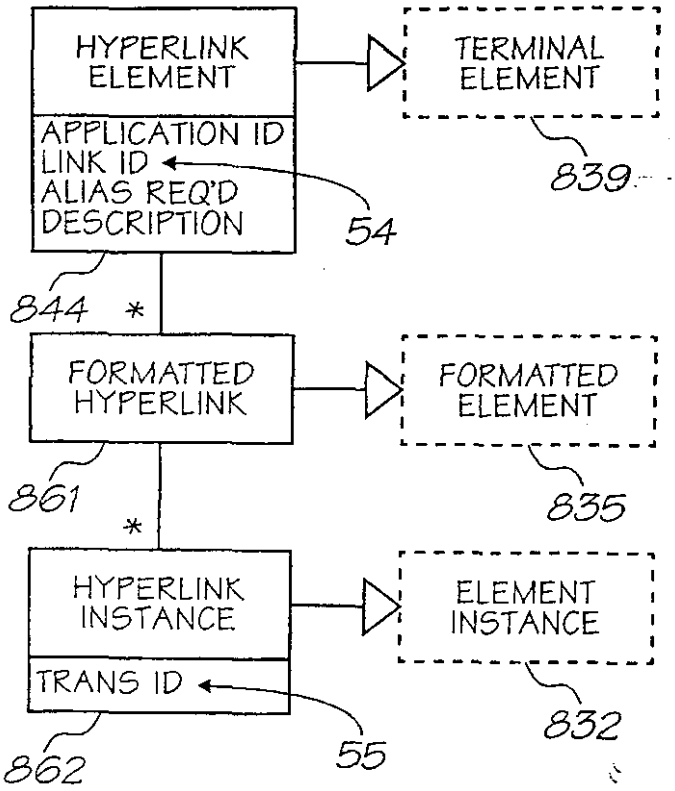

HYPERLINK ELEMENT
APPLICATION ID
LINK ID
ALIAS REQ'D
DESCRIPTION
54
844
*
TERMINAL ELEMENT
839
FORMATTED HYPERLINK
861
*
FORMATTED ELEMENT
835
HYPERLINK INSTANCE
TRANS ID
55
862
ELEMENT INSTANCE
832

FIG. 29

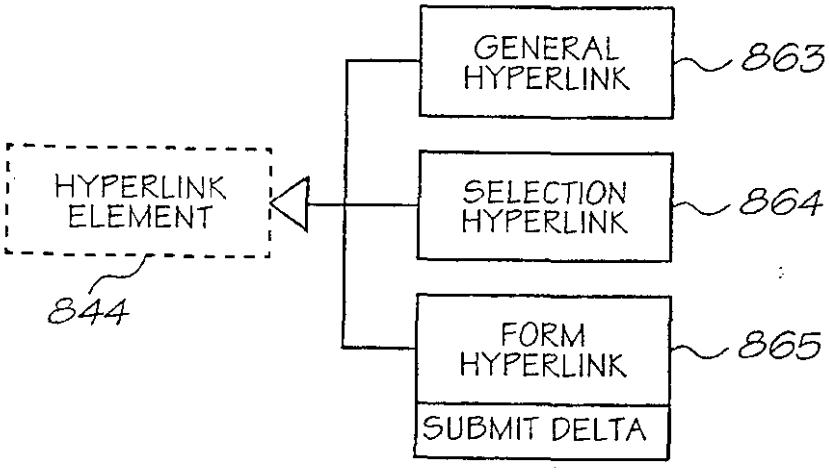

HYPERLINK ELEMENT
844
GENERAL HYPERLINK
863
SELECTION HYPERLINK
864
FORM HYPERLINK
SUBMIT DELTA
865

FIG. 30

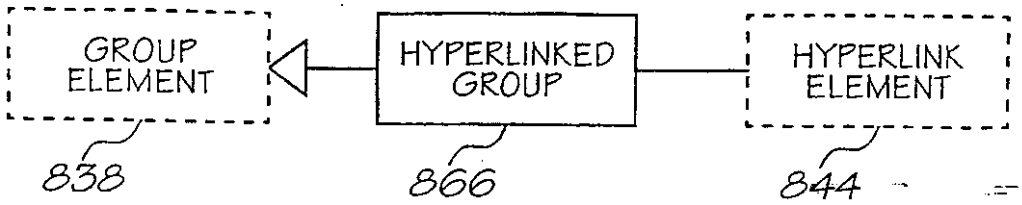

GROUP ELEMENT
HYPERLINKED GROUP
HYPERLINK ELEMENT
838
866
844

FIG. 31

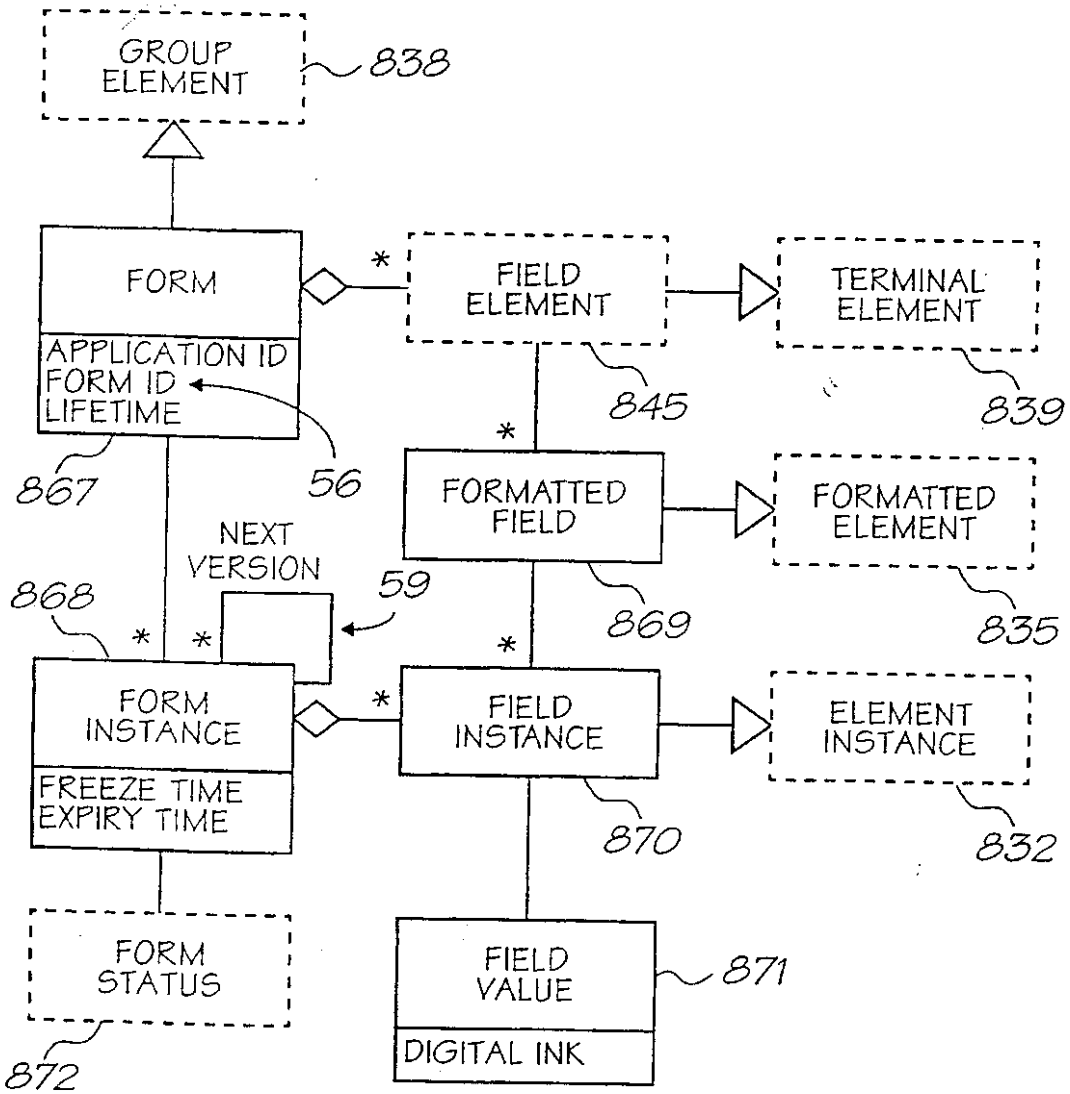

GROUP ELEMENT
838
FORM
APPLICATION ID
FORM ID
LIFETIME
867
56
*
FIELD ELEMENT
845
TERMINAL ELEMENT
839
*
FORMATTED FIELD
FORMATTED ELEMENT
869
835
NEXT VERSION
59
868
*
*
*
FORM INSTANCE
FREEZE TIME
EXPIRY TIME
*
FIELD INSTANCE
ELEMENT INSTANCE
870
832
FORM STATUS
872
FIELD VALUE
871
DIGITAL INK

FIG. 32

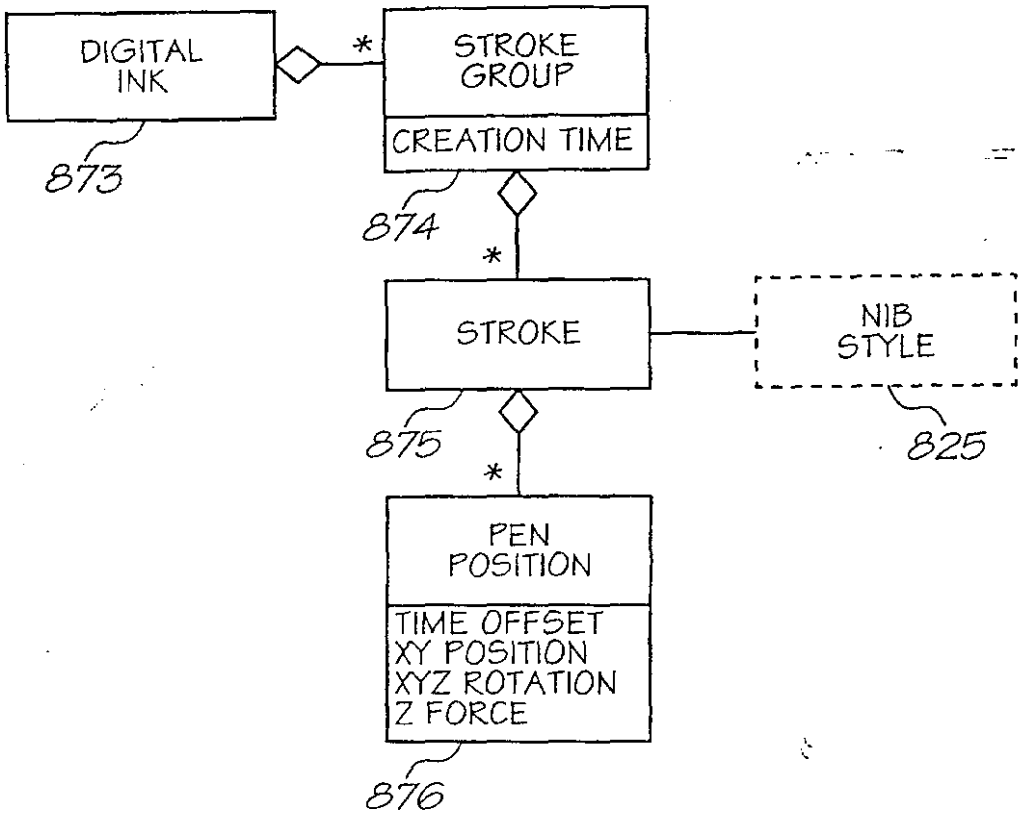

DIGITAL INK
*
STROKE GROUP
CREATION TIME
873
874
*
STROKE
NIB STYLE
875
825
*
PEN POSITION
TIME OFFSET
XY POSITION
XYZ ROTATION
Z FORCE
876

FIG. 33

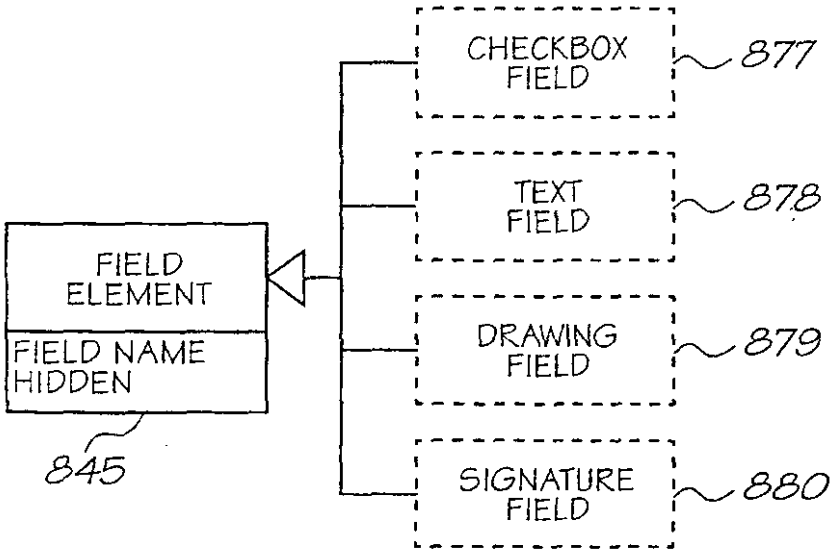

CHECKBOX FIELD
877
TEXT FIELD
878
FIELD ELEMENT
FIELD NAME
HIDDEN
DRAWING FIELD
879
SIGNATURE FIELD
880
845

FIG. 34

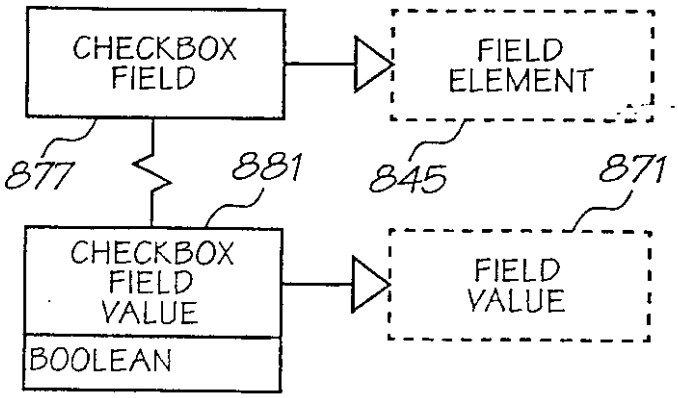


FIG. 35

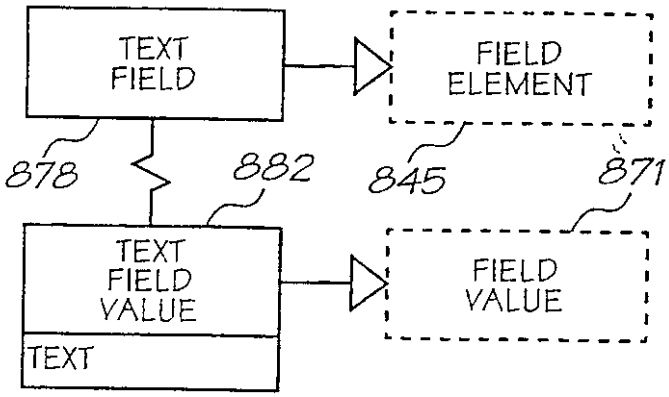


FIG. 36

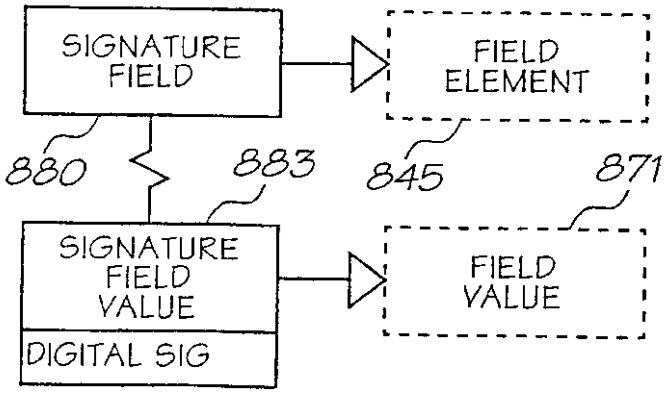


FIG. 37

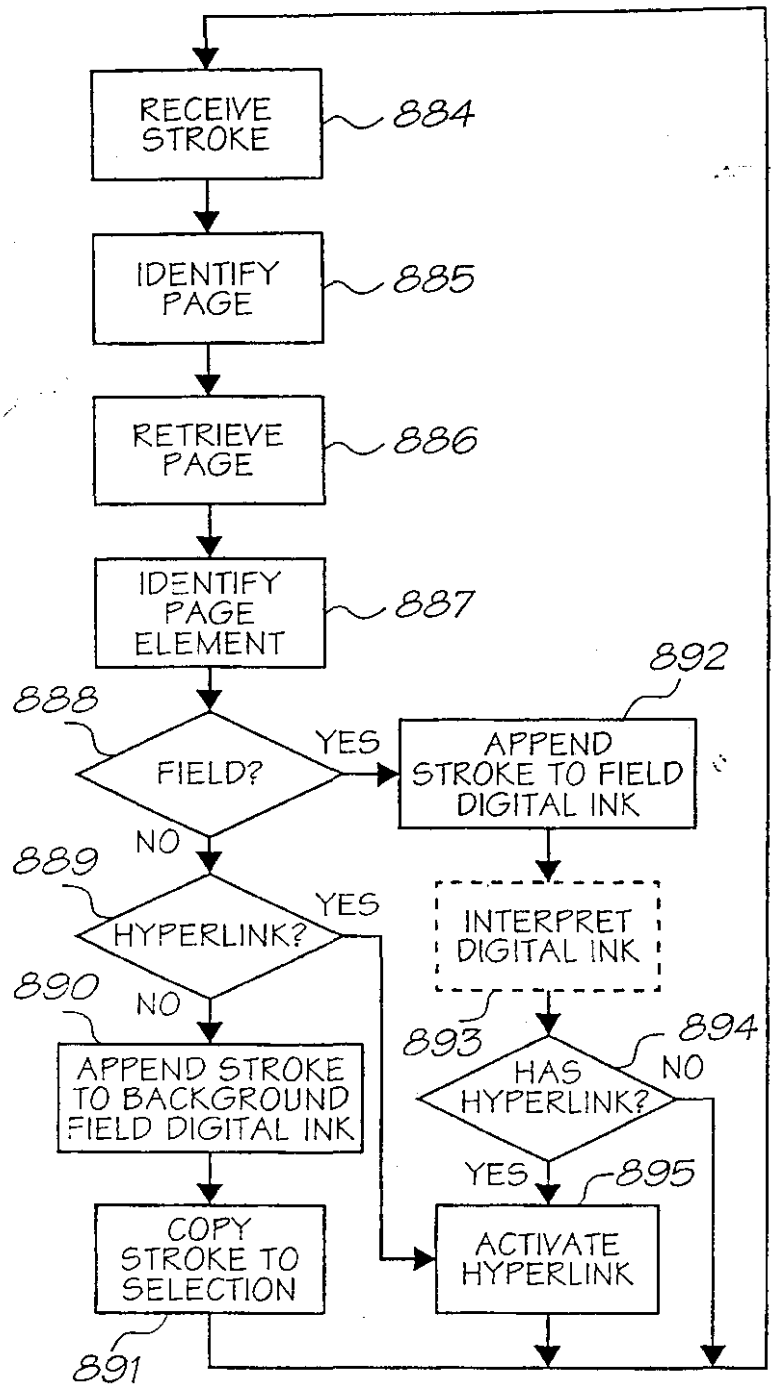

RECEIVE STROKE
884
IDENTIFY PAGE
885
RETRIEVE PAGE
886
IDENTIFY PAGE ELEMENT
887
888
FIELD?
YES
892
APPEND STROKE TO FIELD DIGITAL INK
NO
889
HYPERLINK?
YES
INTERPRET DIGITAL INK
890
NO
893
894
HAS HYPERLINK?
NO
APPEND STROKE TO BACKGROUND FIELD DIGITAL INK
YES
895
COPY STROKE TO SELECTION
ACTIVATE HYPERLINK
891

FIG. 38

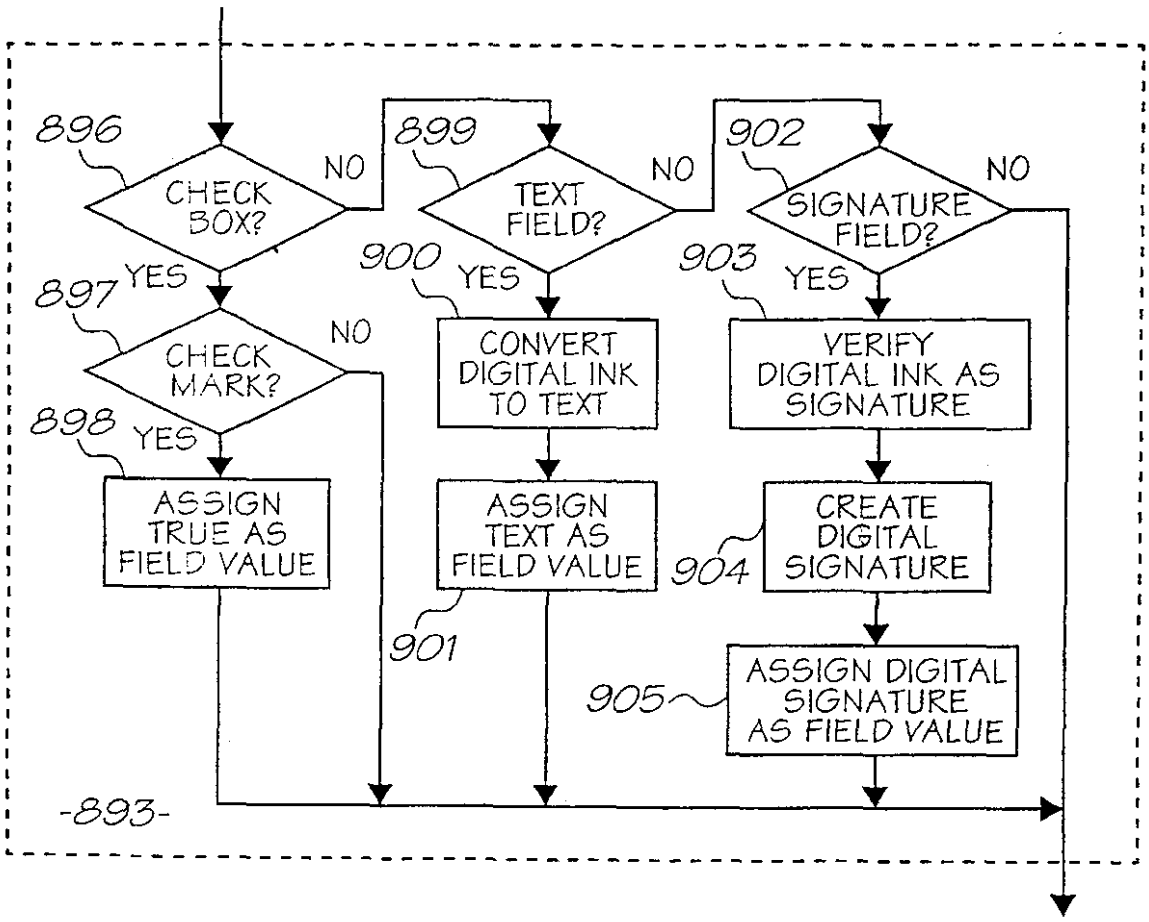

896
CHECK BOX?
NO
899
TEXT FIELD?
NO
902
SIGNATURE FIELD?
NO
897
YES
CHECK MARK?
NO
900
YES
CONVERT DIGITAL INK TO TEXT
903
YES
VERIFY DIGITAL INK AS SIGNATURE
898
YES
ASSIGN TRUE AS FIELD VALUE
ASSIGN TEXT AS FIELD VALUE
901
CREATE DIGITAL SIGNATURE
904
ASSIGN DIGITAL SIGNATURE AS FIELD VALUE
905
-893-

FIG. 38a

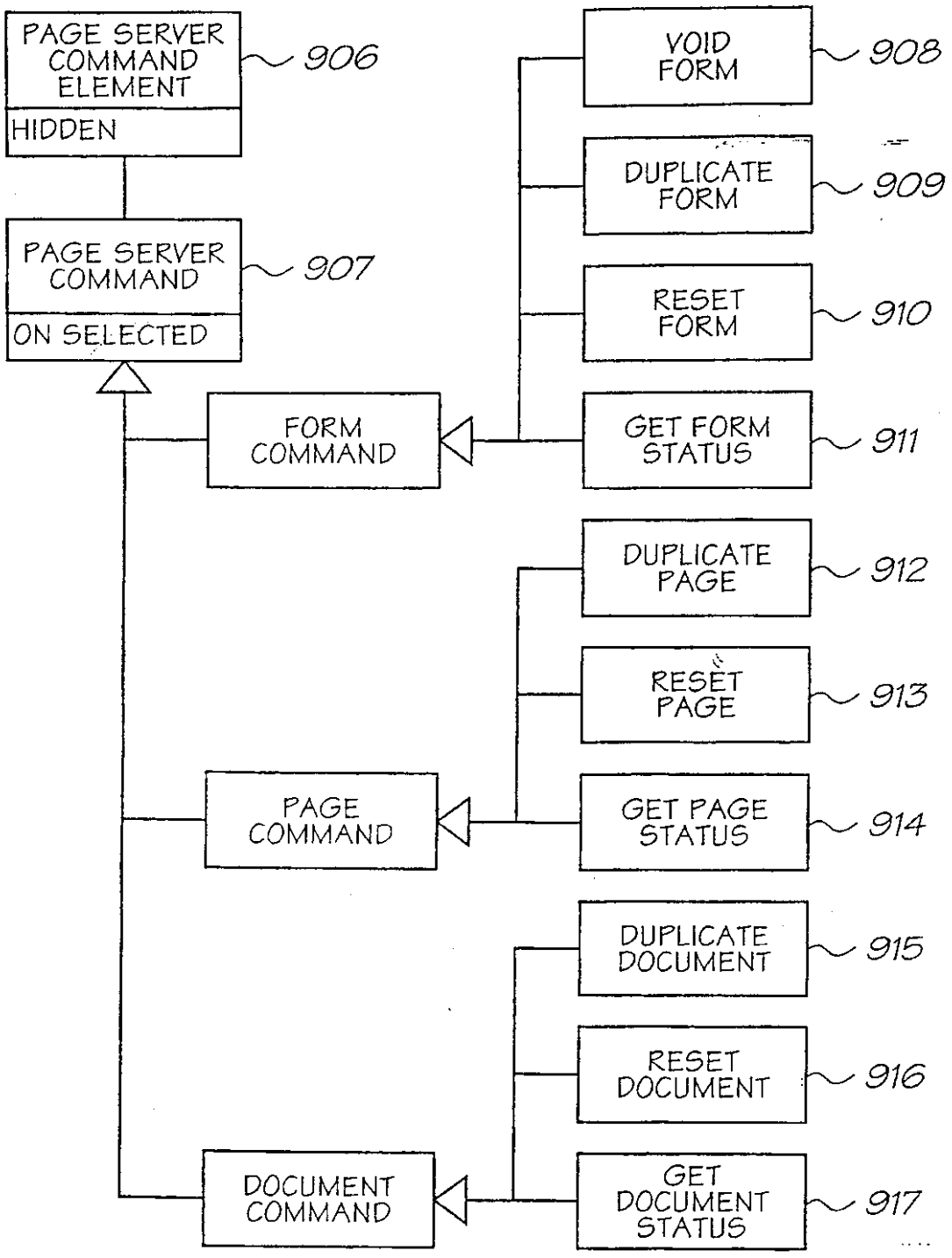

PAGE SERVER COMMAND ELEMENT
HIDDEN
906
PAGE SERVER COMMAND
ON SELECTED
907
FORM COMMAND
VOID FORM
908
DUPLICATE FORM
909
RESET FORM
910
GET FORM STATUS
911
PAGE COMMAND
DUPLICATE PAGE
912
RESET PAGE
913
GET PAGE STATUS
914
DOCUMENT COMMAND
DUPLICATE DOCUMENT
915
RESET DOCUMENT
916
GET DOCUMENT STATUS
917

FIG. 39

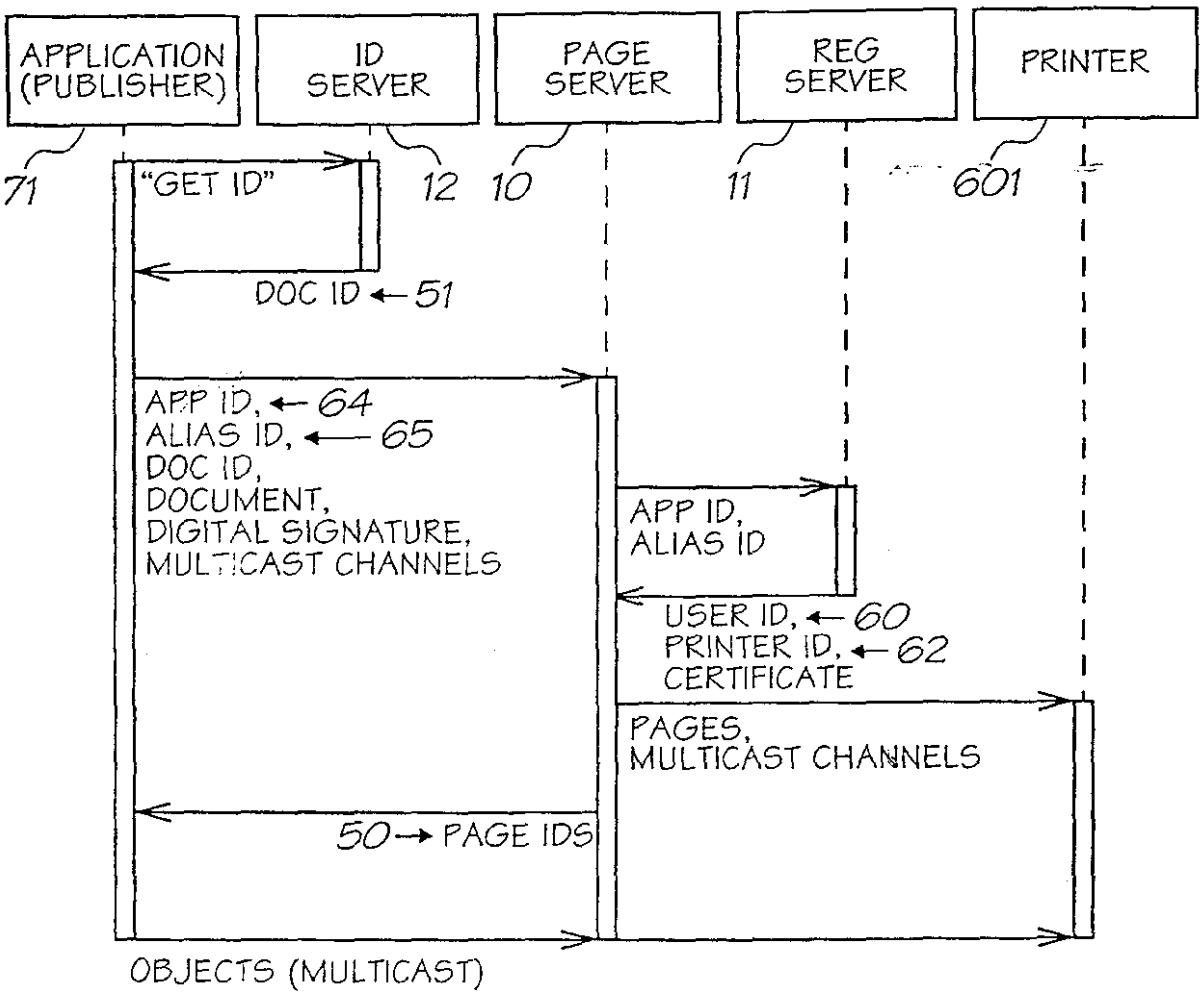

APPLICATION (PUBLISHER)
ID SERVER
PAGE SERVER
REG SERVER
PRINTER
71
12
10
11
601
"GET ID"
DOC ID ← 51
APP ID, ← 64
ALIAS ID, ← 65
DOC ID,
DOCUMENT,
DIGITAL SIGNATURE,
MULTICAST CHANNELS
APP ID,
ALIAS ID
USER ID, ← 60
PRINTER ID, ← 62
CERTIFICATE
PAGES,
MULTICAST CHANNELS
50 → PAGE IDS
OBJECTS (MULTICAST)

FIG. 40

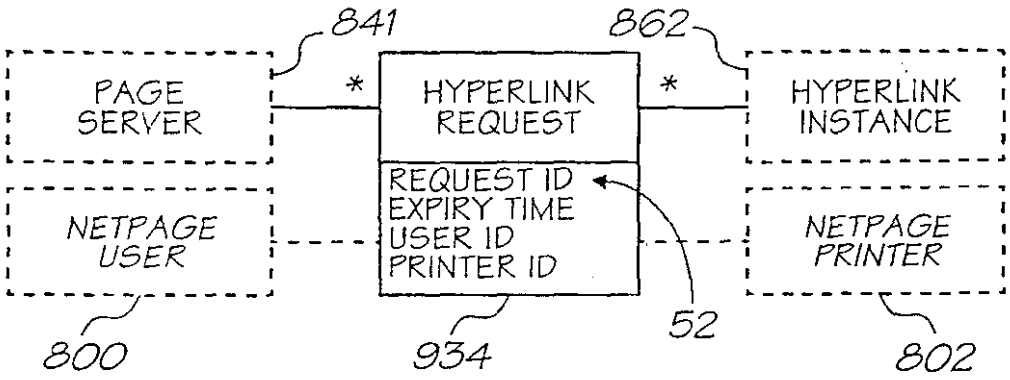

841
862
PAGE SERVER
*
HYPERLINK REQUEST
*
HYPERLINK INSTANCE
REQUEST ID
EXPIRY TIME
USER ID
PRINTER ID
NETPAGE USER
NETPAGE PRINTER
800
934
52
802

FIG. 41

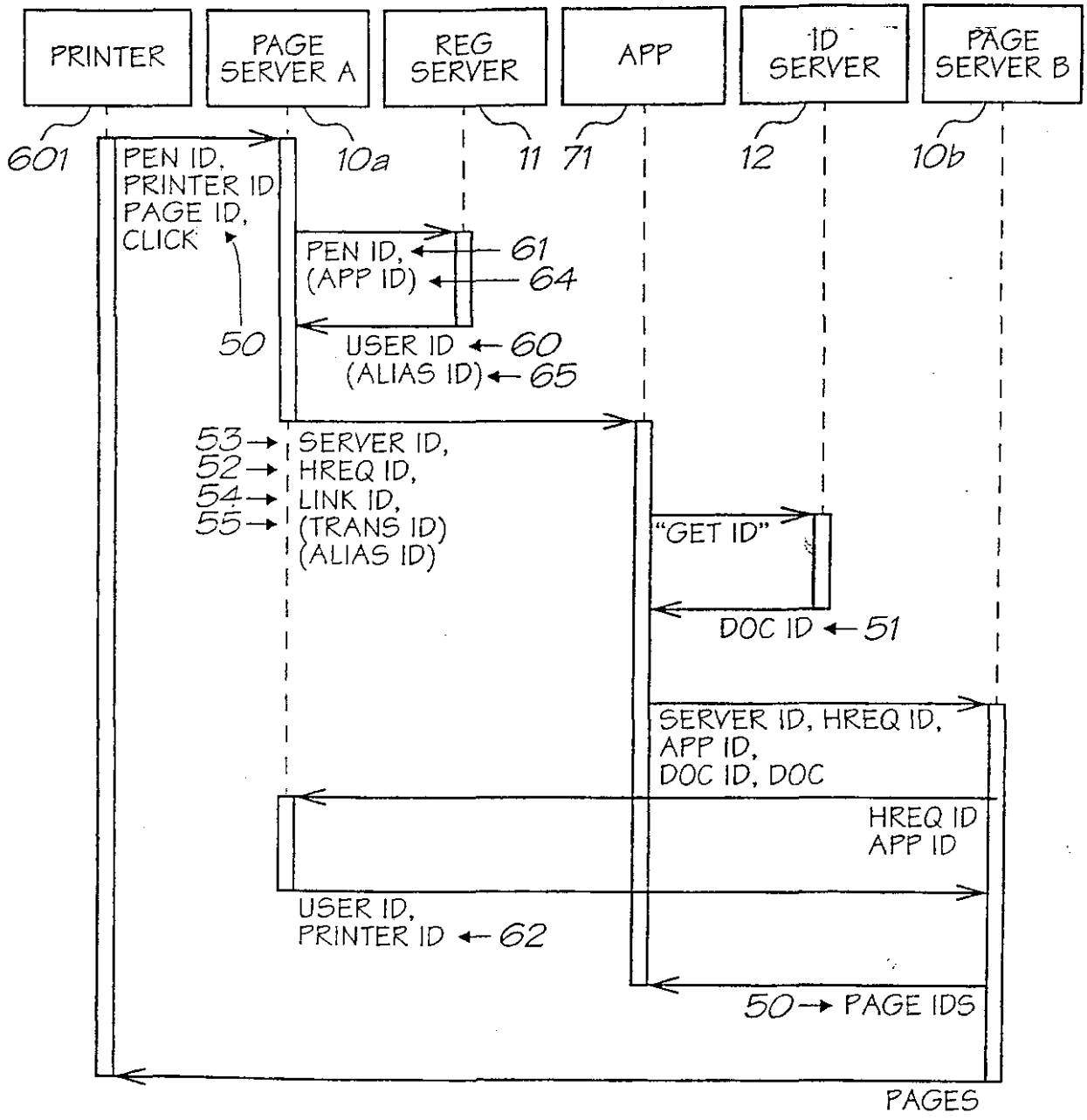

PRINTER
PAGE SERVER A
REG SERVER
APP
ID SERVER
PAGE SERVER B
601
10a
11
71
12
10b
PEN ID,
PRINTER ID
PAGE ID,
CLICK
50
PEN ID, 61
(APP ID) 64
USER ID 60
(ALIAS ID) 65
53 SERVER ID,
52 HREQ ID,
54 LINK ID,
55 (TRANS ID)
(ALIAS ID)
"GET ID"
DOC ID 51
SERVER ID, HREQ ID,
APP ID,
DOC ID, DOC
HREQ ID
APP ID
USER ID,
PRINTER ID 62
50 PAGE IDS
PAGES

FIG. 42

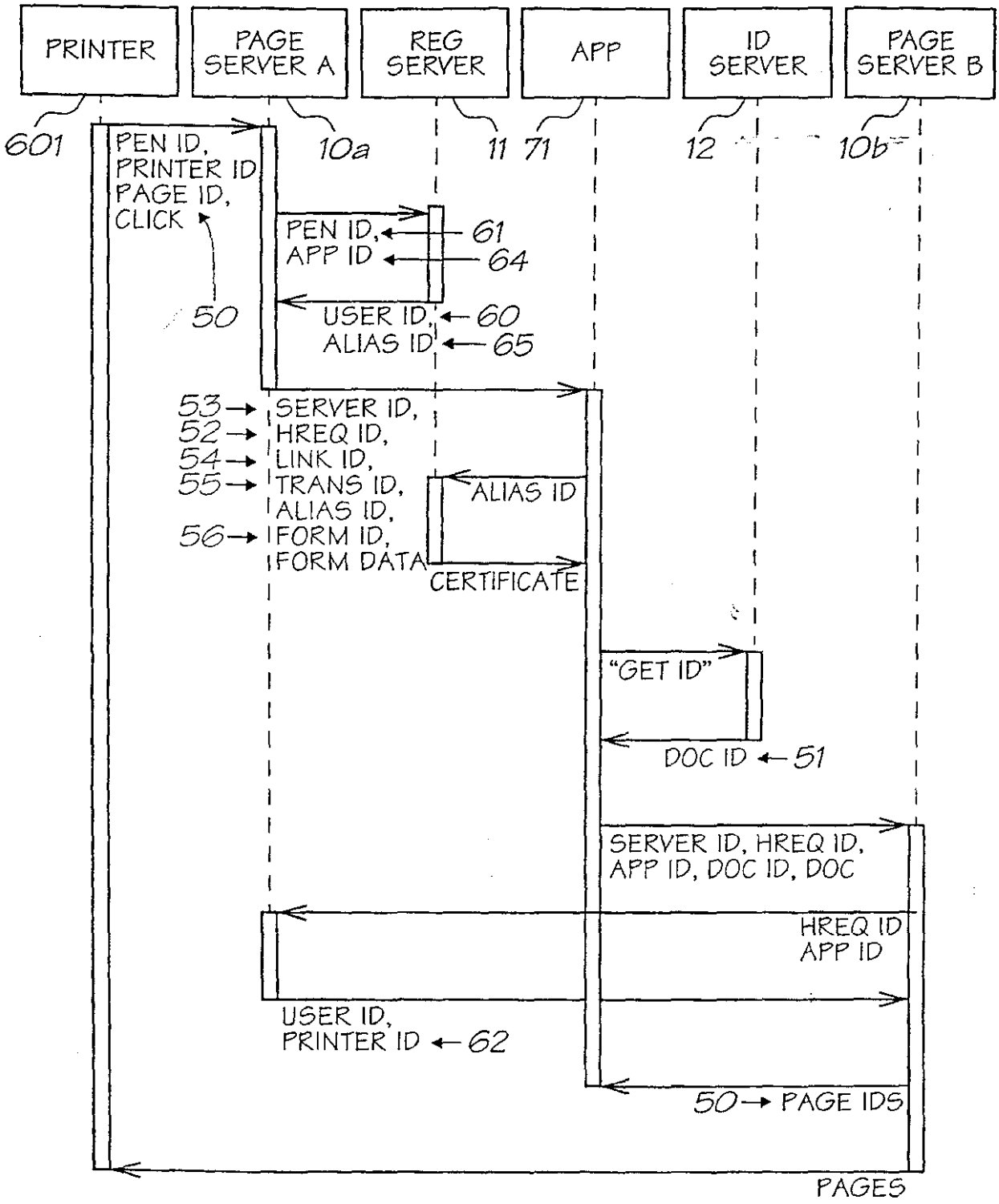

PRINTER
PAGE SERVER A
REG SERVER
APP
ID SERVER
PAGE SERVER B
601
10a
11
71
12
10b
PEN ID,
PRINTER ID
PAGE ID,
CLICK
50
PEN ID, 61
APP ID 64
USER ID, 60
ALIAS ID 65
53 SERVER ID,
52 HREQ ID,
54 LINK ID,
55 TRANS ID,
ALIAS ID,
56 FORM ID,
FORM DATA
ALIAS ID
CERTIFICATE
"GET ID"
DOC ID 51
SERVER ID, HREQ ID,
APP ID, DOC ID, DOC
HREQ ID
APP ID
USER ID,
PRINTER ID 62
50 PAGE IDS
PAGES

FIG. 43

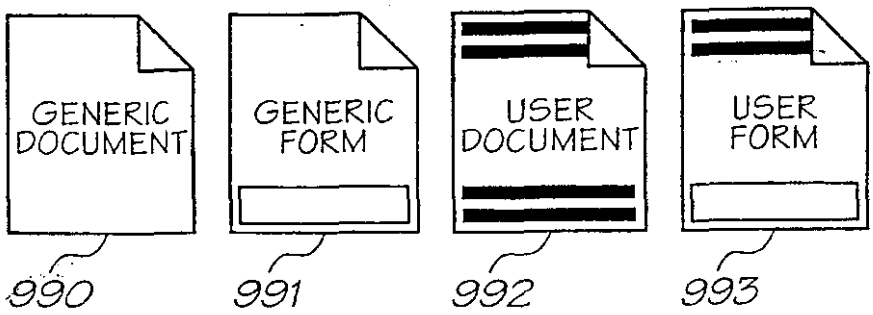

GENERIC DOCUMENT
GENERIC FORM
USER DOCUMENT
USER FORM
990
991
992
993

FIG. 44

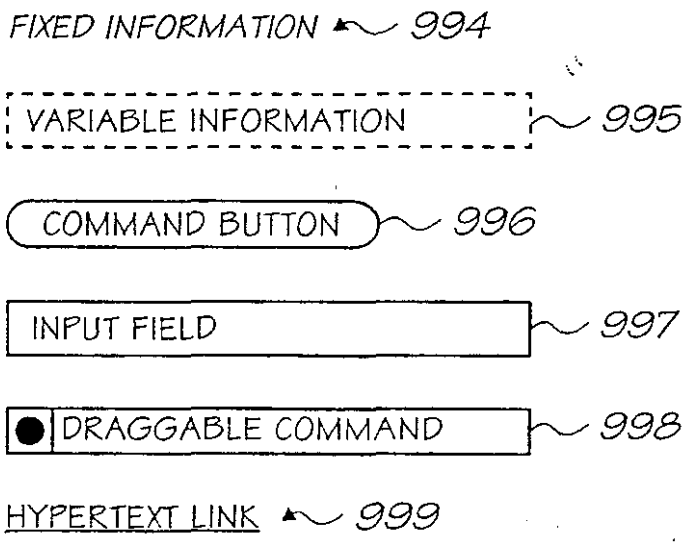

FIXED INFORMATION
994
VARIABLE INFORMATION
995
COMMAND BUTTON
996
INPUT FIELD
997
DRAGGABLE COMMAND
998
HYPERTEXT LINK
999

FIG. 45

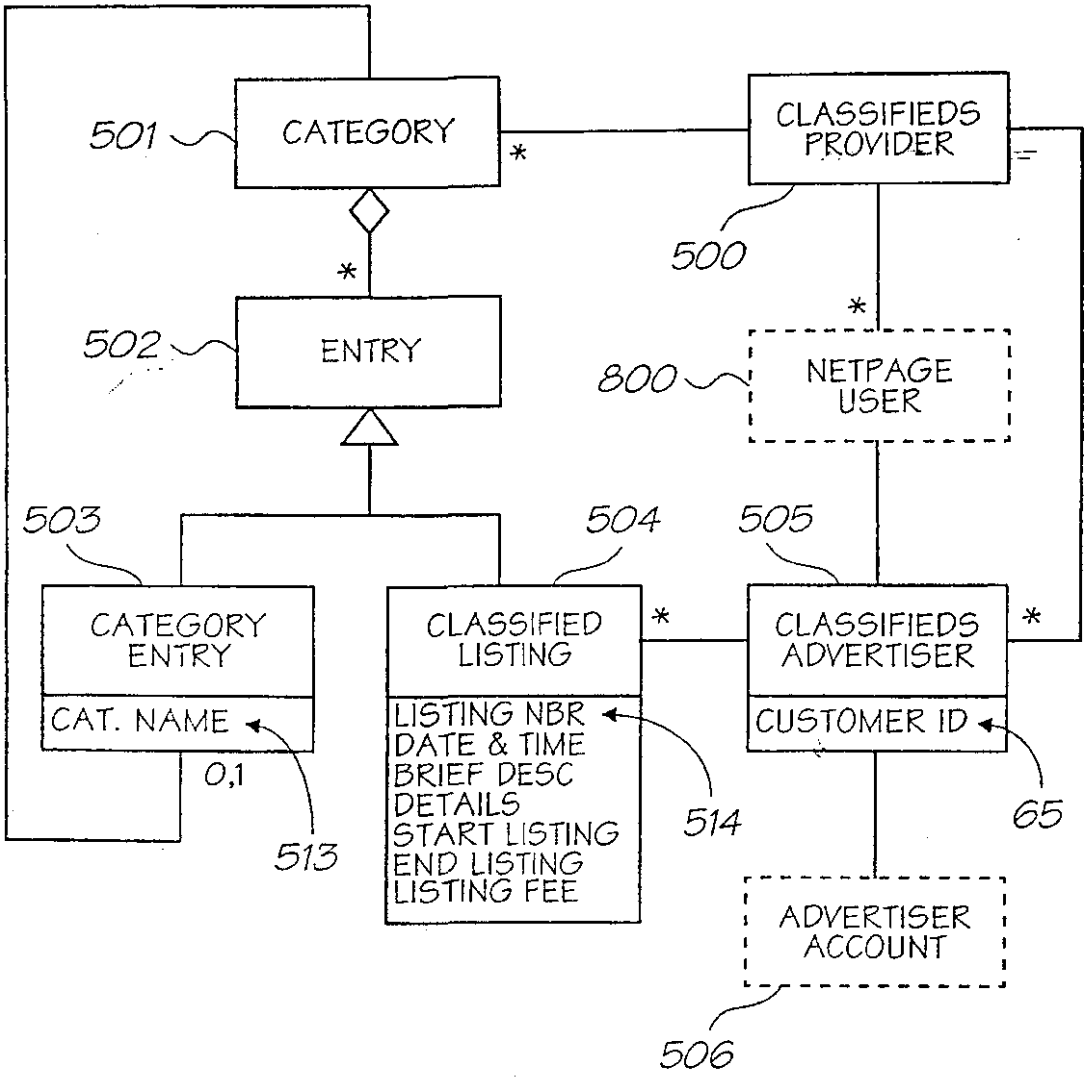

501
CATEGORY
CLASSIFIEDS PROVIDER
500
502
ENTRY
800
NETPAGE USER
503
504
505
CATEGORY ENTRY
CAT. NAME
0,1
513
CLASSIFIED LISTING
LISTING NBR
DATE & TIME
BRIEF DESC
DETAILS
START LISTING
END LISTING
LISTING FEE
514
CLASSIFIEDS ADVERTISER
CUSTOMER ID
65
ADVERTISER ACCOUNT
506

FIG. 46

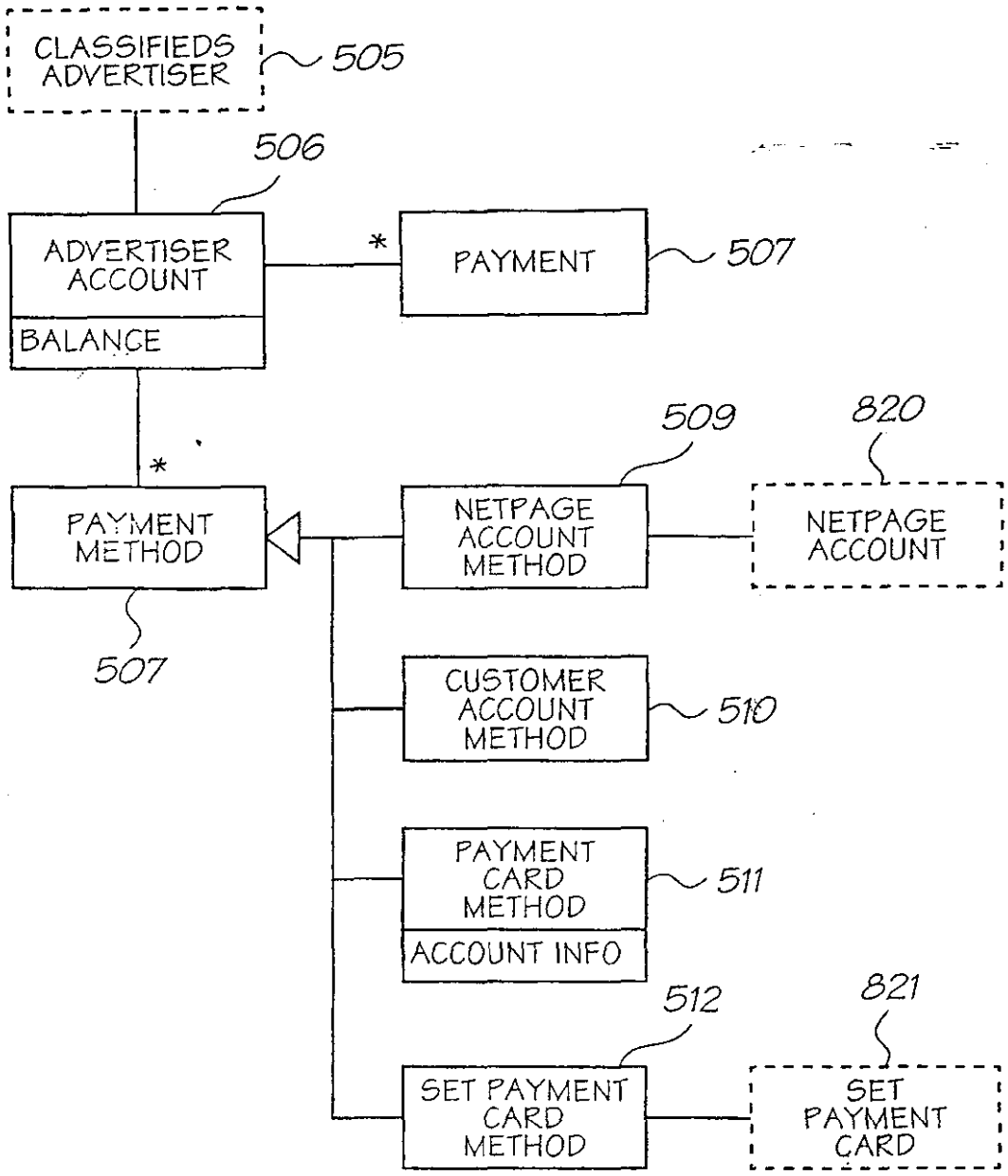

CLASSIFIEDS ADVERTISER
505
506
ADVERTISER ACCOUNT
BALANCE
*
PAYMENT
507
*
PAYMENT METHOD
507
509
NETPAGE ACCOUNT METHOD
820
NETPAGE ACCOUNT
CUSTOMER ACCOUNT METHOD
510
PAYMENT CARD METHOD
ACCOUNT INFO
511
512
SET PAYMENT CARD METHOD
821
SET PAYMENT CARD

FIG. 47

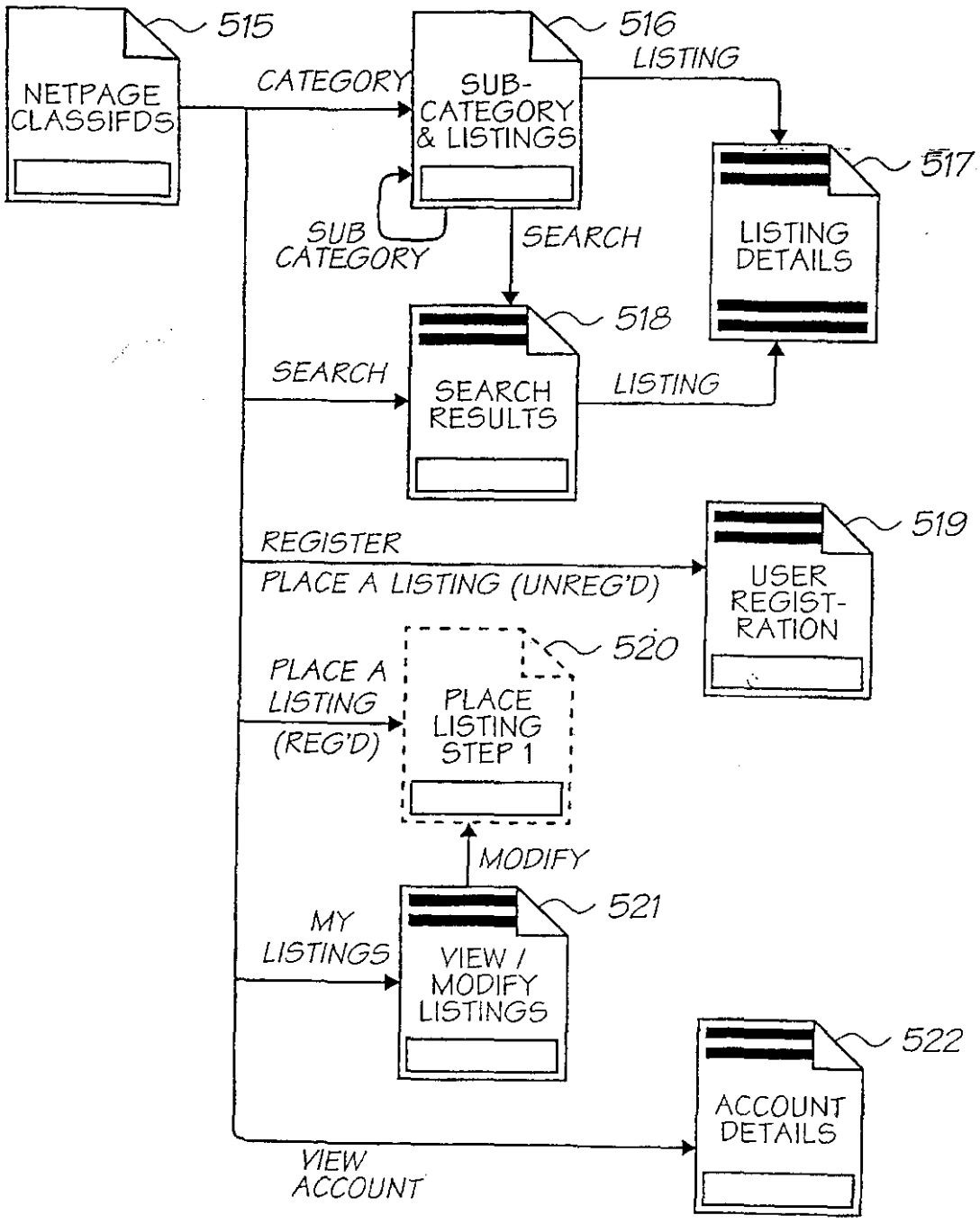

515
NETPAGE CLASSIFDS
CATEGORY
516
SUB-CATEGORY & LISTINGS
LISTING
517
LISTING DETAILS
SUB CATEGORY
SEARCH
518
SEARCH RESULTS
SEARCH
LISTING
519
USER REGIST-RATION
REGISTER
PLACE A LISTING (UNREG'D)
520
PLACE LISTING STEP 1
PLACE A LISTING (REG'D)
MODIFY
521
VIEW / MODIFY LISTINGS
MY LISTINGS
522
ACCOUNT DETAILS
VIEW ACCOUNT

FIG. 48

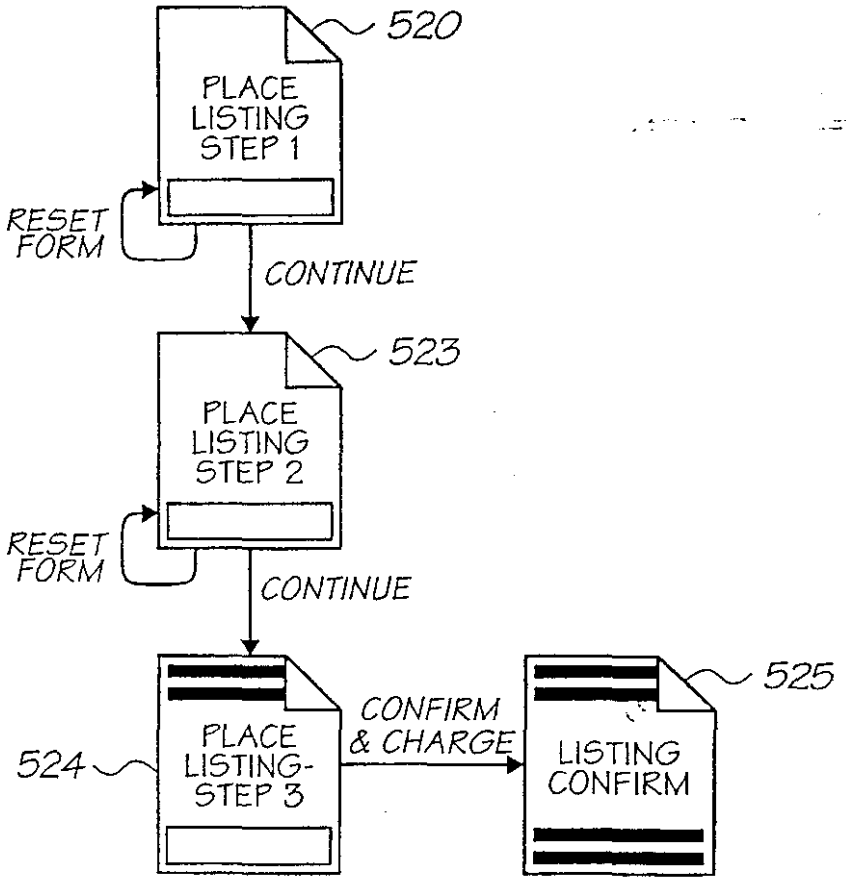

520
PLACE LISTING STEP 1
RESET FORM
CONTINUE
523
PLACE LISTING STEP 2
RESET FORM
CONTINUE
524
PLACE LISTING-STEP 3
CONFIRM & CHARGE
525
LISTING CONFIRM

FIG. 49

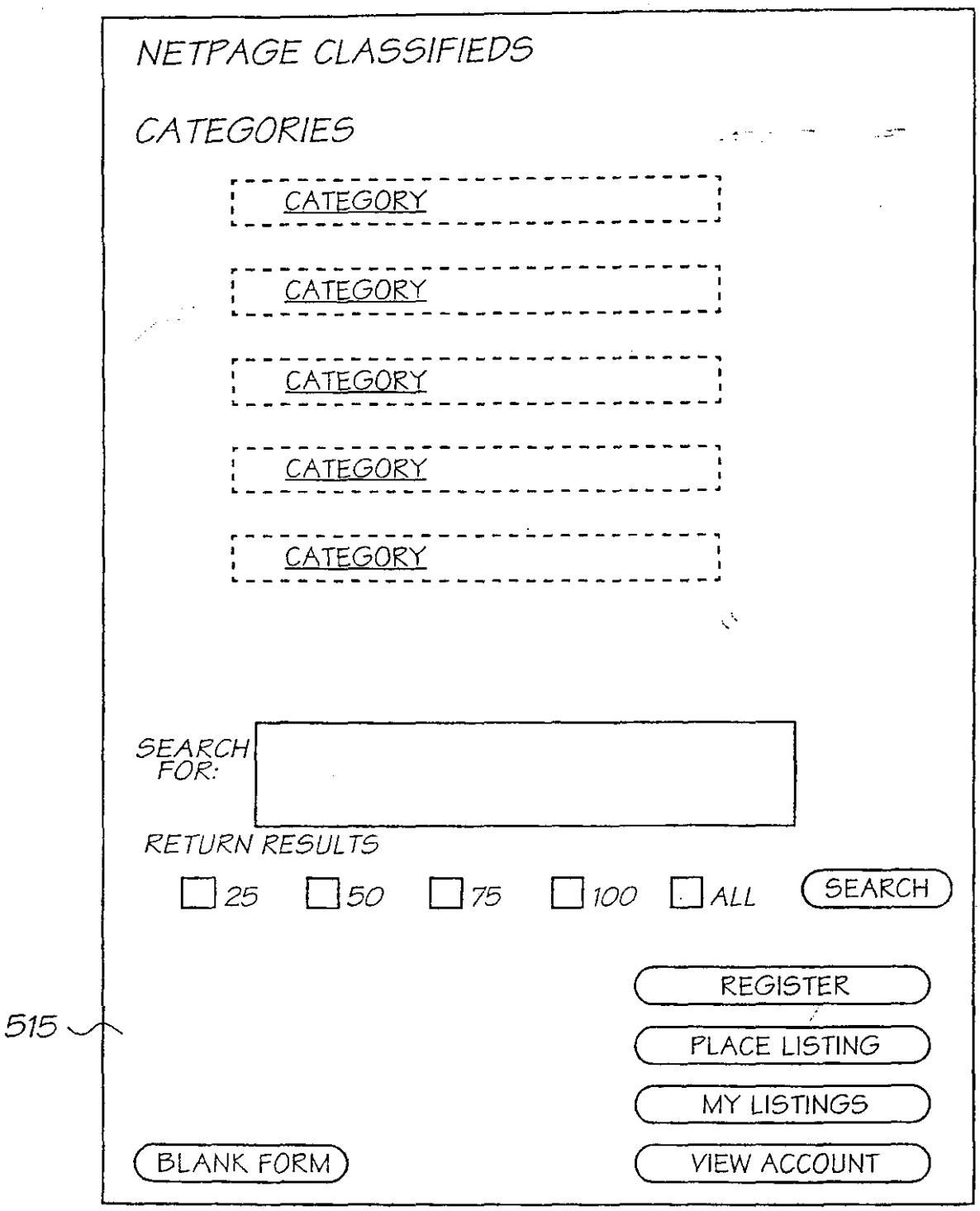

NETPAGE CLASSIFIEDS
CATEGORIES
CATEGORY
CATEGORY
CATEGORY
CATEGORY
CATEGORY
SEARCH FOR:
RETURN RESULTS
25
50
75
100
ALL
SEARCH
REGISTER
PLACE LISTING
MY LISTINGS
VIEW ACCOUNT
BLANK FORM
515

FIG. 50

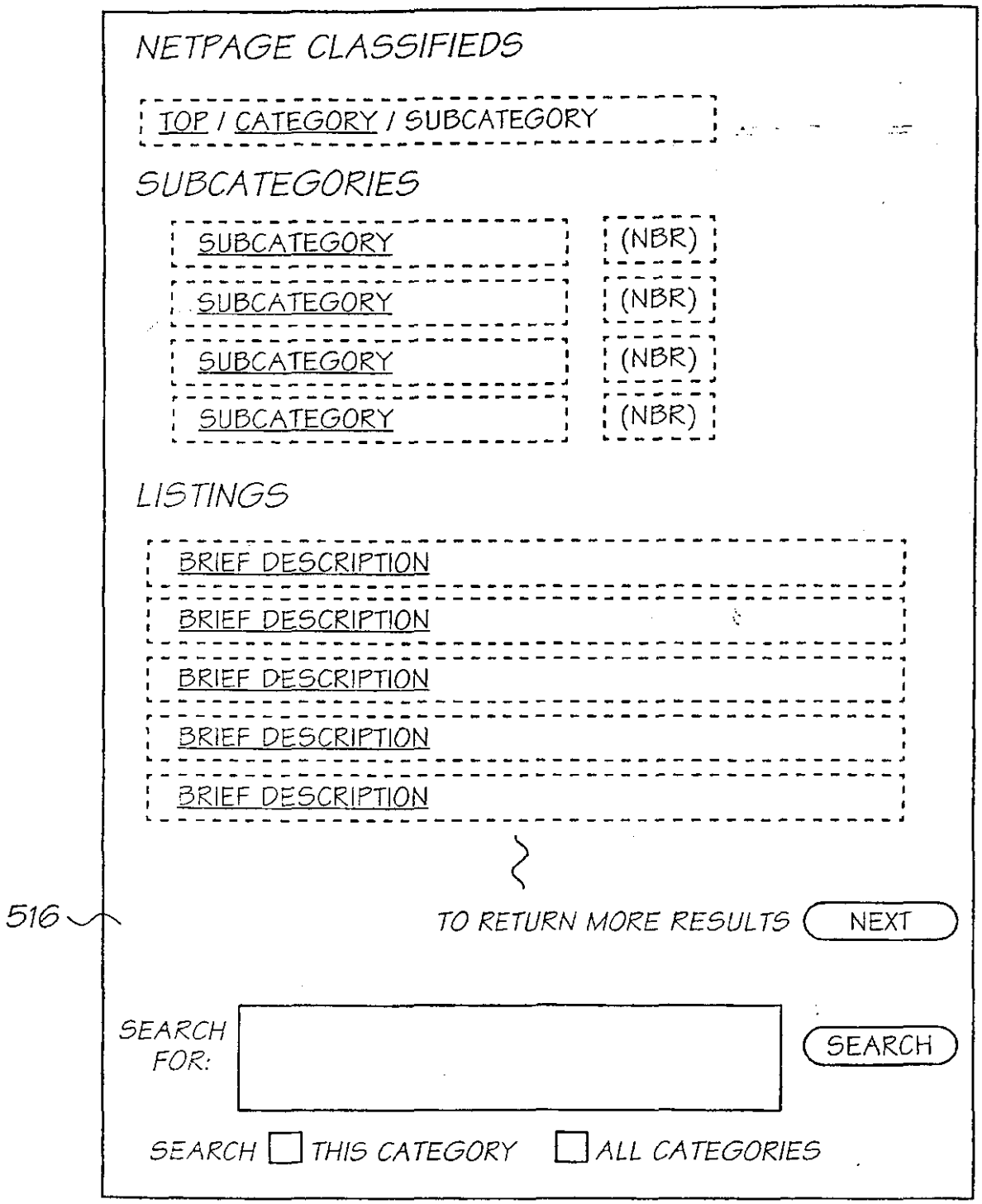

NETPAGE CLASSIFIEDS
TOP / CATEGORY / SUBCATEGORY
SUBCATEGORIES
SUBCATEGORY
(NBR)
SUBCATEGORY
(NBR)
SUBCATEGORY
(NBR)
SUBCATEGORY
(NBR)
LISTINGS
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
516
TO RETURN MORE RESULTS
NEXT
SEARCH FOR:
SEARCH
SEARCH
THIS CATEGORY
ALL CATEGORIES

FIG. 51

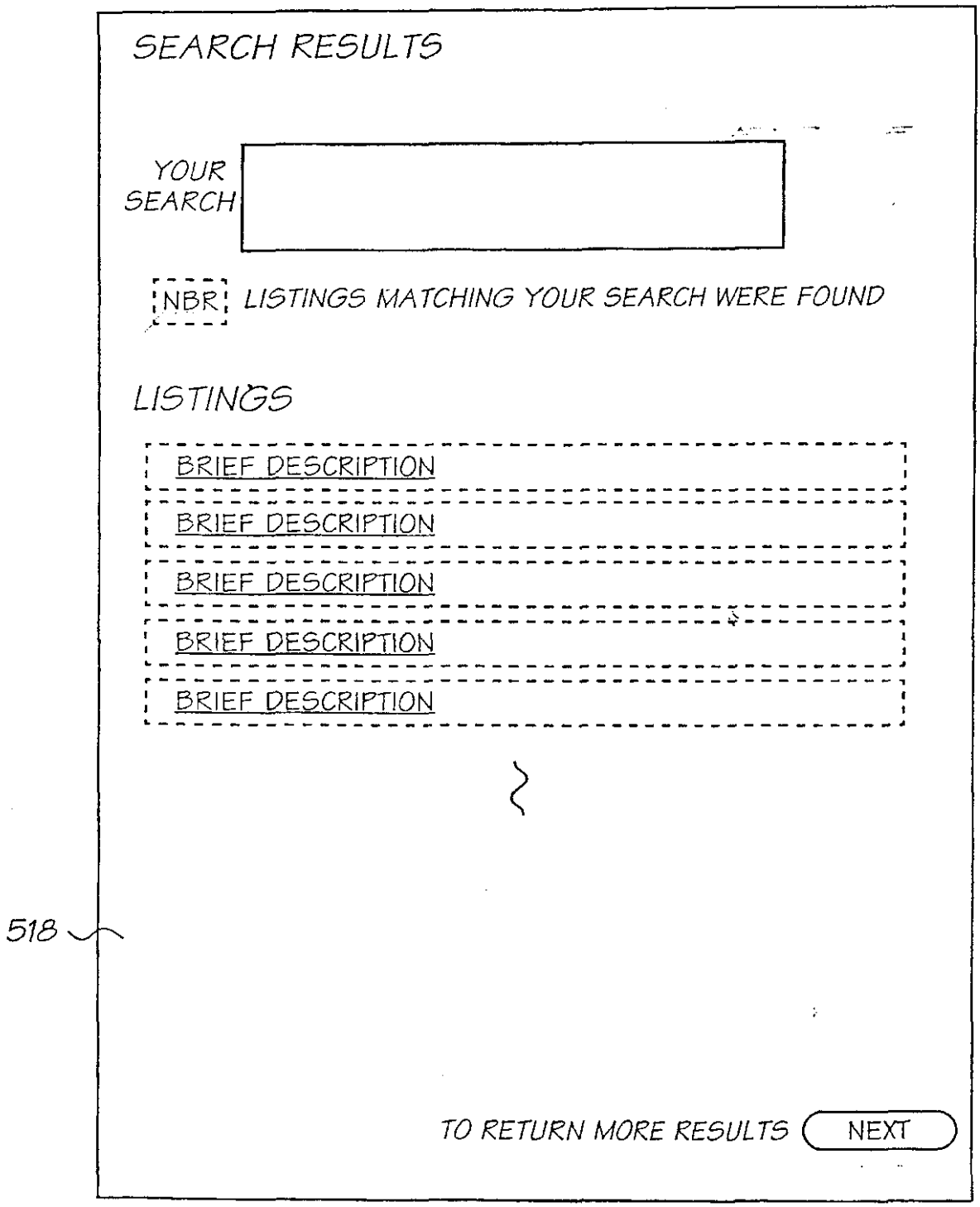

SEARCH RESULTS
YOUR SEARCH
NBR
LISTINGS MATCHING YOUR SEARCH WERE FOUND
LISTINGS
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
BRIEF DESCRIPTION
518
TO RETURN MORE RESULTS
NEXT

FIG. 52

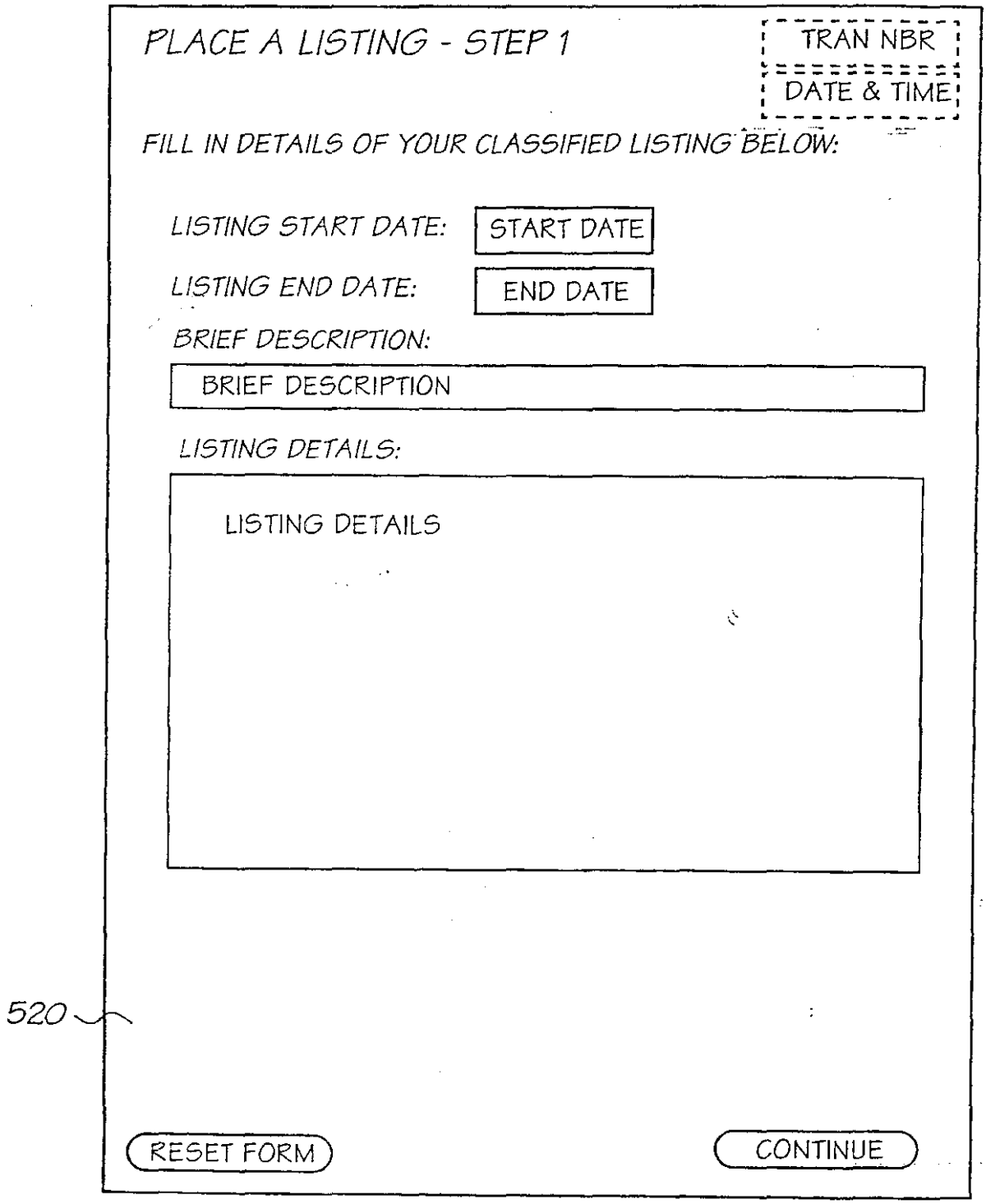

PLACE A LISTING - STEP 1
TRAN NBR
DATE & TIME
FILL IN DETAILS OF YOUR CLASSIFIED LISTING BELOW:
LISTING START DATE:
START DATE
LISTING END DATE:
END DATE
BRIEF DESCRIPTION:
BRIEF DESCRIPTION
LISTING DETAILS:
LISTING DETAILS
520
RESET FORM
CONTINUE

FIG. 53

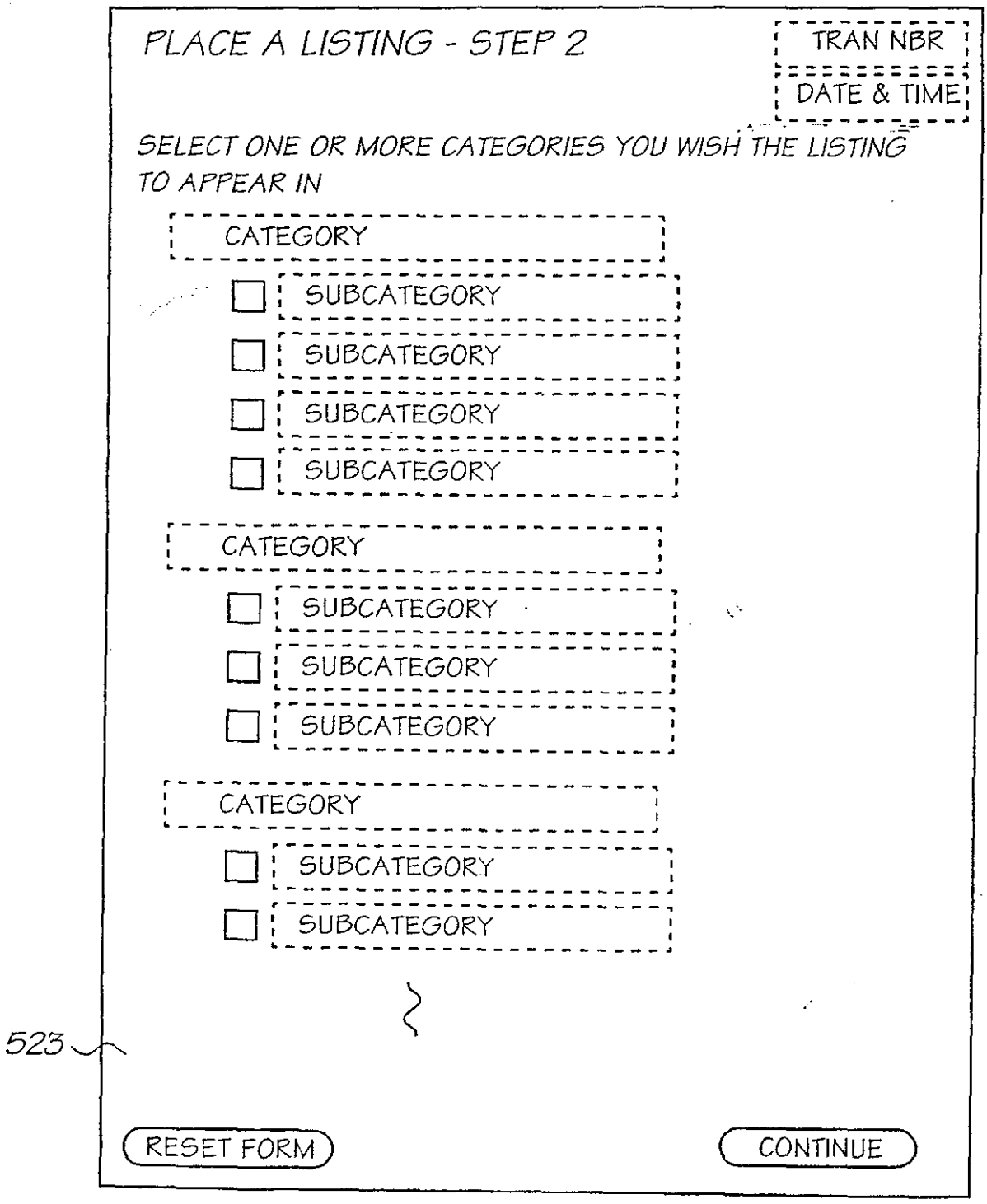

PLACE A LISTING - STEP 2
TRAN NBR
DATE & TIME
SELECT ONE OR MORE CATEGORIES YOU WISH THE LISTING TO APPEAR IN
CATEGORY
SUBCATEGORY
SUBCATEGORY
SUBCATEGORY
SUBCATEGORY
CATEGORY
SUBCATEGORY
SUBCATEGORY
SUBCATEGORY
CATEGORY
SUBCATEGORY
SUBCATEGORY
523
RESET FORM
CONTINUE

FIG. 54

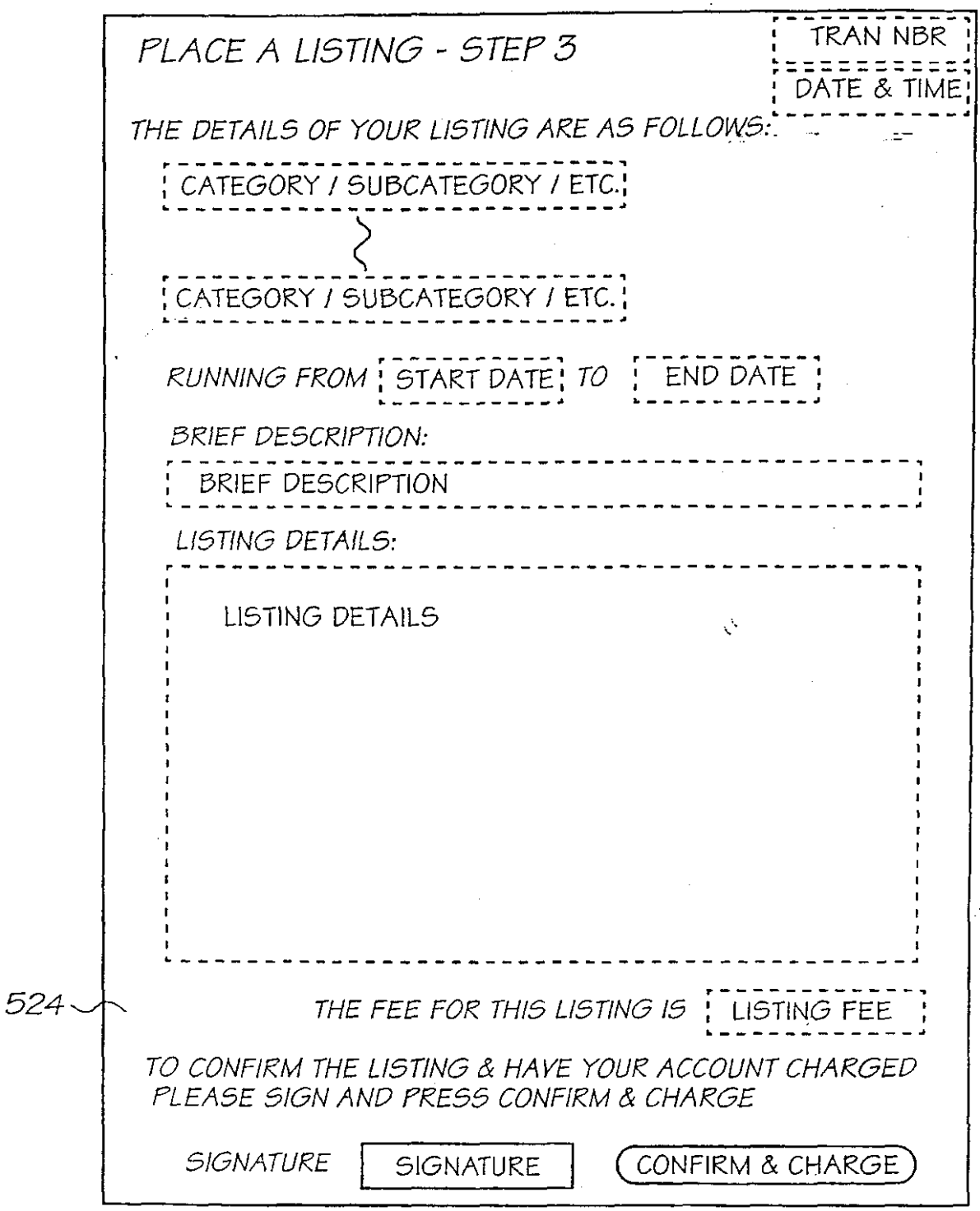

PLACE A LISTING - STEP 3
TRAN NBR
DATE & TIME
THE DETAILS OF YOUR LISTING ARE AS FOLLOWS:
CATEGORY / SUBCATEGORY / ETC.
CATEGORY / SUBCATEGORY / ETC.
RUNNING FROM
START DATE
TO
END DATE
BRIEF DESCRIPTION:
BRIEF DESCRIPTION
LISTING DETAILS:
LISTING DETAILS
524
THE FEE FOR THIS LISTING IS
LISTING FEE
TO CONFIRM THE LISTING & HAVE YOUR ACCOUNT CHARGED
PLEASE SIGN AND PRESS CONFIRM & CHARGE
SIGNATURE
SIGNATURE
CONFIRM & CHARGE

FIG. 55

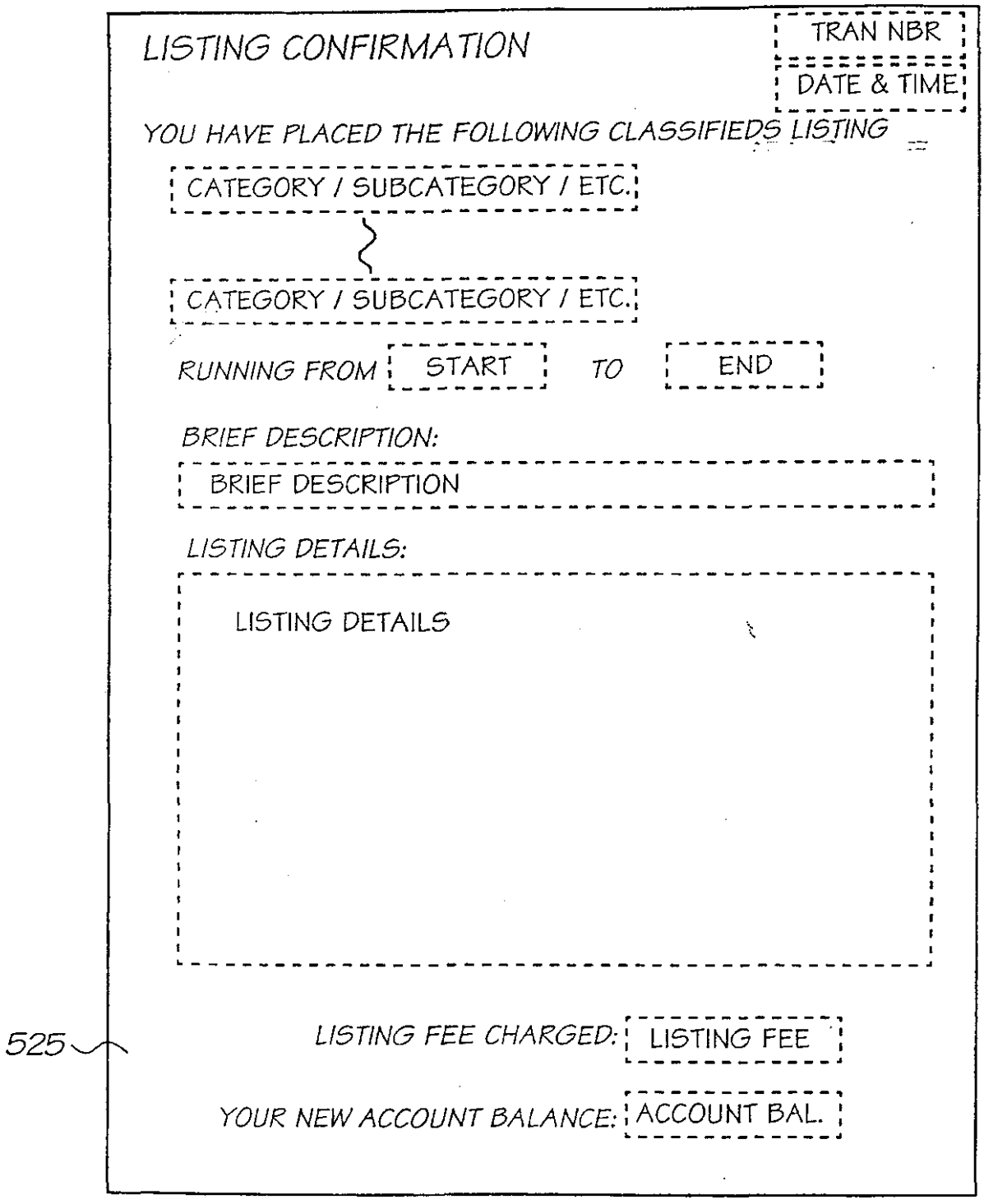

LISTING CONFIRMATION
TRAN NBR
DATE & TIME
YOU HAVE PLACED THE FOLLOWING CLASSIFIEDS LISTING
CATEGORY / SUBCATEGORY / ETC.
CATEGORY / SUBCATEGORY / ETC.
RUNNING FROM START TO END
BRIEF DESCRIPTION:
BRIEF DESCRIPTION
LISTING DETAILS:
LISTING DETAILS
525
LISTING FEE CHARGED: LISTING FEE
YOUR NEW ACCOUNT BALANCE: ACCOUNT BAL.

FIG. 56

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU00/00775

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl. [7]: G06F 16/30, G06F 17/60, G06K 11/18

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC7: G06F --/--

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	GB 2306669 (RICOH COMPANY LIMITED) 7 May 1997 See whole document but in particular lines 10-14	1-48
Y	US 5745882 (US WEST Marketing Resources Group, Inc.) 28 April 1998 See whole document but in particular column 4 lines 1-5	1-48

☐ Further documents are listed in the continuation of Box C ☒ See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 September 2000	12 SEP 2000
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized officer MICHAEL C. LANDER Telephone No : (02) 6283 2494

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU00/00775

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
GB	5306669	DE	19644109	GB	9622632	JP	9128137
		US	6081261				
US	5745882	US	5909670				

END OF ANNEX

[19]中华人民共和国国家知识产权局

[51]Int. Cl[7]
G06F 17/60
G06K 11/18

[12]发明专利申请公开说明书

[21]申请号 00811162.6

[43]公开日 2002年9月4日

[11]公开号 CN 1367904A

[22]申请日 2000.6.30 [21]申请号 00811162.6
[30]优先权
[32]1999.6.30 [33]AU [31]PQ1313
[86]国际申请 PCT/AU00/00775 2000.6.30
[87]国际公布 WO01/02977 英 2001.1.11
[85]进入国家阶段日期 2002.1.31
[71]申请人 西尔弗布鲁克研究股份有限公司
地址 澳大利亚新南威尔士
[72]发明人 保罗·拉普斯顿 杰奎琳·A·拉普斯顿
卡·西尔弗布鲁克

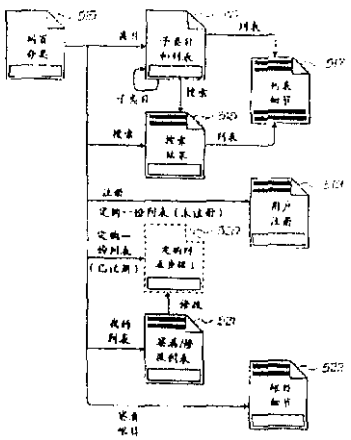
[74]专利代理机构 中国国际贸易促进委员会专利商标事务所
代理人 吴丽丽

权利要求书7页 说明书75页 附图页数48页

[54]发明名称 用于搜索分类广告的方法与系统

[57]摘要

公开了一些方法和系统,它们涉及经由打印有信息和编码数据的界 面表面列出分类广告。可以通过适当的传感装置来查询以可见方式或不 可见方式进行编码的已编码数据。传感装置跟计算机系统进行通信。这个界面表面,传感装置和计算机系统一起,能够通过网络实现分类列表 搜索事务。



ISSN1008-4274

知识产权出版社出版

权 利 要 求 书

1. 一种用于搜索分类广告的方法，本方法包括下列各步骤：

向用户提供一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示该表格的一种标识，以及该表格的至少一个参考点；

在计算机系统中，接收来自一个传感装置的指示数据，该指示数据涉及该表格的标识以及传感装置相对于该表格的位置，当将传感装置定购在相对于该表格的一个操作位置上时，该传感装置使用至少某些编码数据来感知指示数据；以及

在计算机系统以及从指示数据中，识别涉及列表搜索事务的至少一项参数。

2. 根据权利要求 1 所述的方法，其中，所述涉及列表搜索事务的至少一项参数跟表格中的至少一个区域有关，并且其中，本方法包括在计算机系统以及从与传感装置的定位有关的区域中，识别所述至少一项参数。

3. 根据权利要求 2 所述的方法包括，在计算机系统中，接收涉及传感装置相对于该表格的移动的数据，传感装置使用至少某些编码数据来感知它相对于表格的移动；以及

在计算机系统以及从至少部分地处于所述至少一个区域内的所述移动中，识别列表搜索事务的所述至少一项参数。

4. 一种用于搜索分类广告的方法，本方法包括下列各步骤：

向用户提供一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示列表搜索事务的至少一项参数；

在计算机系统中，接收来自一个传感装置的数据，该数据涉及所述至少一项参数，并涉及传感装置相对于该表格的移动，当传感装置相对于该表格移动时，使用至少某些编码数据来感知涉及所述至少一项参数的数据，并产生涉及它本身相对于该表格的移动的数据；以及

在计算机系统中，解释传感装置在与所述至少一项参数相关时的

所述移动。

5. 一种用于搜索分类广告的方法，本方法包括下列各步骤:

向用户提供一份表格，其中含有编码数据，表示该表格的一种标识;

在计算机系统中，接收来自一个传感装置的数据，该数据涉及用户的标识，并涉及表格的标识，传感装置含有涉及用户标识的数据，并使用至少某些编码数据来感知涉及表格标识的数据；以及

在计算机系统以及从涉及用户标识和表格标识的数据中，识别一种列表搜索事务。

6. 根据权利要求 5 所述的方法，其中，编码数据也表示列表搜索事务的至少一项参数，并且本方法包括，在计算机系统中，接收来自传感装置的、涉及列表搜索事务的至少一项参数的指示数据，传感装置使用至少某些编码数据来感知指示数据。

7. 根据权利要求 6 所述的方法，其中包括，在计算机系统中，接收来自传感装置的、涉及传感装置相对于表格的移动的数据，传感装置产生涉及它本身相对于该表格的移动的数据.

8. 根据权利要求 2、4 或 6 中任何一项所述的方法，其中，该参数是列表搜索事务的一项动作参数，本方法包括，在计算机系统中，实现一种相对于该动作参数的涉及操作。

9. 根据权利要求 8 所述的方法，其中，列表搜索事务的一个动作参数是从包括下列各项的组中选出的:

一个类目，

一项搜索请求，以及

对于更多的搜索结果的一项请求。

10. 根据权利要求 3、4 或 7 中任何一项所述的方法，其中，该参数是列表搜索事务的一项选项参数，本方法包括，在计算机系统中，识别该用户已借助于传感装置输入了一个手画的标记，并且在计算机系统中，实现一种与该选项参数相关的操作。

11. 根据权利要求 10 所述的方法，其中，该选项参数跟下列各项

中的至少一项有关:

一个类目,

一项搜索请求,

对于更多的搜索结果的一项请求,以及

待返回的搜索结果的数目。

12. 根据权利要求 3、4 或 7 中任何一项所述的方法,其中,该参数是列表搜索事务的一项文本参数,本方法包括,在计算机系统中,识别该用户已经借助于传感装置输入了手写文本数据,并且在计算机系统中,实现一种与该文本参数相关的操作。

13. 根据权利要求 12 所述的方法,其中包括,在计算机系统中,将手写文本数据转换为计算机文本。

14. 根据权利要求 13 所述的方法,其中,文本参数跟至少一个搜索项有关。

15. 根据权利要求 3、4 或 7 中任何一项所述的方法,其中,该参数是列表搜索事务的一项授权参数,本方法包括,在计算机系统中,识别该用户已经借助于传感装置输入了一个手写的签名,并且在计算机系统中,实现一种与该授权参数相关的操作。

16. 根据权利要求 15 所述的方法,其中包括,在计算机系统中,验证该签名是该用户的签名。

17. 根据权利要求 16 所述的方法,其中,该授权参数跟针对下列各项中至少一项的授权有关:

对帐目信息的访问,以及

帐目支付。

18. 根据权利要求 3、4 或 7 中任何一项所述的方法,其中,该参数是列表搜索事务的一项图画参数,本方法包括,在计算机系统中,识别该用户已经借助于传感装置输入了一幅手画的图画,并且在计算机系统中,实现一种与该图画参数相关的操作。

19. 根据权利要求 18 所述的方法,其中,该图画参数跟正在发布广告的项目的一幅图画有关。

20. 根据权利要求 1、4 或 5 中任何一项所述的方法，其中，该表格含有涉及下列各项中至少一项的信息:

列表类目，

列表搜索，

列表搜索结果，以及

列表细节。

21. 根据权利要求 1、4 或 5 中任何一项所述的方法，其中包括按需打印该表格。

22. 根据权利要求 21 所述的方法，其中包括在一个表面限定装置的表面上打印该表格，并且，在打印表格的同时，在该表面上打印编码数据。

23. 根据权利要求 22 所述的方法，其中包括，所打印的编码数据在可见光谱中基本上是不可见的。

24. 根据权利要求 1 或 5 所述的方法，其中包括，为每一份已产生的表格保留一份可搜索的记录，可以使用被包含在其编码数据之中的该表格的标识来搜索该表格。

25. 根据权利要求 1、4 或 5 中任何一项所述的方法，其中包括，混合使用多点和定点传播通信协议来分发多个表格。

26. 根据权利要求 1 或 4 所述的方法，其中，传感装置含有一个标识装置，它向传感装置赋予一个唯一的标识，并且将它标识为跟一个特定用户有关，并且其中，本方法包括在计算机系统中，对所述标识进行监控。

27. 根据权利要求 1、4 或 5 中任何一项所述的方法，其中包括，在表格中提供涉及列表搜索事务的所有必需的信息，以消除对一个单独的显示装置的需求。

28. 根据权利要求 1、4 或 5 中任何一项所述的方法，其中，该表格被打印在许多页面上，并且其中，本方法包括对各页面进行装订。

29. 一个用于搜索分类广告的系统，本系统包括:

一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示该表格的一个标识以及该表格的至少一个参考点；以及

一个计算机系统，用于接收来自一个传感装置的指示数据，该指示数据用于识别涉及列表搜索事务的至少一项参数，该指示数据还表示该表格的标识以及传感装置相对于该表格的位置，该传感装置使用至少某些编码数据来感知该指示数据。

30. 根据权利要求 29 所述的系统，其中，所述涉及列表搜索事务的的至少一项参数跟该表格的至少一个区域有关。

31. 根据权利要求 29 所述的系统，其中包括传感装置，该传感装置使用至少某些编码数据来感知它相对于该表格的移动。

32. 一个用于搜索分类广告的系统，本系统包括:

一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示列表搜索事务的至少一项参数；以及

一个计算机系统，用于接收来自一个传感装置的数据，该数据涉及所述至少一项参数，还涉及传感装置相对于该表格的移动，并且用于解释传感装置在与所述至少一项参数相关时的所述移动，当传感装置相对于该表格移动时，使用至少某些编码数据来感知涉及所述至少一项参数的数据，并产生涉及它本身相对于该表格的移动的数据。

33. 一个用于搜索分类广告的系统，本系统包括:

一份表格，其中含有编码数据，表示该表格的一个标识;以及

一个计算机系统，用于接收来自一个传感装置的数据，该数据涉及用户标识以及表格标识，并且用于从所述接收数据中识别一项列表搜索事务，该传感装置含有涉及用户标识的数据，并且使用至少某些编码数据来感知涉及表格标识的数据。

34. 根据权利要求 33 所述的系统，其中，编码数据也表示列表搜索事务的至少一项参数，计算机系统接收来自传感装置的、涉及列表搜索事务的至少一项参数的指示数据，并且传感装置使用至少某些编码数据来感知该指示数据。

35. 根据权利要求 33 所述的系统，其中包括传感装置，该传感装置感

知它相对于表格的移动。

36. 根据权利要求 29、32 或 34 中任何一项所述的系统，其中所述列表搜索事务的至少一项参数是从含有下列各项的组中选出的：列表搜索事务的一项动作参数，列表搜索事务的一项选项参数，列表搜索事务的一项文本参数，列表搜索事务的一项授权参数，以及列表搜索事务的一项图画参数。

37. 根据权利要求 36 所述的系统，其中，列表搜索事务的动作参数是从含有下列各项的组中选出的：

一个类目，

一项搜索请求，以及

对于更多的搜索结果的一项请求。

38. 根据权利要求 36 所述的系统，其中，选项参数跟下列各项中至少一项有关：

一个类目，

一项搜索请求，

对于更多的搜索结果的一项请求，以及

待返回的搜索结果的数目。

39. 根据权利要求 36 所述的系统，其中，文本参数跟至少一个搜索项有关。

40. 根据权利要求 36 所述的系统，其中，授权参数跟针对下列各项中至少一项的授权有关：

对帐目信息的访问，以及

帐目支付。

41. 根据权利要求 36 所述的系统，其中，图画参数跟正在发布广告的项目的一幅图画有关。

42. 根据权利要求 31、32 或 35 中任何一项所述的系统，其中，传感装置包括一个标记笔尖。

43. 根据权利要求 31 或 32 所述的系统，其中，传感装置包括一个标识装置，它向传感装置赋予一个唯一的标识，并且将它标识为属

于一个特定的用户。

44. 根据权利要求 29、32 或 33 所述的系统，其中，在一个表面限定装置的表面上打印该表格，并且其中，本系统包括一部打印机，用于按需打印表格。

45. 根据权利要求 44 所述的系统，其中，打印机在表面限定装置上打印表格的同时，打印编码数据。

46. 根据权利要求 29、32 或 33 所述的系统，其中，编码数据在可见光谱中基本上是不可见的。

47. 根据权利要求 29 或 33 所述的系统，其中包括一个数据库，用以为每一份已产生的表格保留一份可搜索的记录，可以使用被包含在其编码数据之中的该表格的标识来搜索每一份表格。

48. 根据权利要求 44 所述的系统，其中，为了适应一份表格被打印在许多页面上的情形，打印机包括一个装订装置，用于对各页面进行装订。

说　　明　　书

用于搜索分类广告的方法与系统

技术领域

本发明一般涉及用于与计算机进行交互的方法，系统和装置。更特别地，本发明涉及使用这样的方法，系统和装置来搜索分类广告。

本发明的主要开发目的是允许大量的分布于各处的用户能够通过印刷品和光学传感器跟网络信息进行交互作用，由此通过高速网络打印机按需获得交互式印刷品。虽然这里主要地参照这个用途来描述本发明，但是应当理解，本发明并不局限于在这个领域内的应用。

共同待审专利申请

在下面共同待审的专利申请中公开了与本发明相关的各种方法，系统与装置，这些共同待审的专利申请是本发明的申请人或者受让人在提交本发明申请的同时提交的:

PCT/AU00/00762,	PCT/AU00/00763,	PCT/AU00/00761,
PCT/AU00/00760,	PCT/AU00/00759,	PCT/AU00/00758,
PCT/AU00/00764,	PCT/AU00/00765,	PCT/AU00/00766,
PCT/AU00/00767,	PCT/AU00/00768,	PCT/AU00/00773,
PCT/AU00/00774,	PCT/AU00/00776,	PCT/AU00/00777,
PCT/AU00/00770,	PCT/AU00/00769,	PCT/AU00/00771,
PCT/AU00/00772,	PCT/AU00/00754,	PCT/AU00/00755,
PCT/AU00/00756,	PCT/AU00/00757	

这些共同待审的专利申请的公开内容已被收入本文作为交叉参考。

在由本发明的申请人或者受让人于 2000 年 5 月 24 日提交的下列待审专利申请中，公开了涉及本发明的各种方法，系统与装置:

PCT/AU00/00518,	PCT/AU00/00519,	PCT/AU00/00520,
PCT/AU00/00521,	PCT/AU00/00523,	PCT/AU00/00524,

PCT/AU00/00525, PCT/AU00/00526, PCT/AU00/00527,
PCT/AU00/00528, PCT/AU00/00529, PCT/AU00/00530,
PCT/AU00/00531, PCT/AU00/00532, PCT/AU00/00533,
PCT/AU00/00534, PCT/AU00/00535, PCT/AU00/00536,
PCT/AU00/00537, PCT/AU00/00538, PCT/AU00/00539,
PCT/AU00/00540, PCT/AU00/00541, PCT/AU00/00542,
PCT/AU00/00543, PCT/AU00/00544, PCT/AU00/00545,
PCT/AU00/00547, PCT/AU00/00546, PCT/AU00/00554,
PCT/AU00/00556, PCT/AU00/00557, PCT/AU00/00558,
PCT/AU00/00559, PCT/AU00/00560, PCT/AU00/00561,
PCT/AU00/00562, PCT/AU00/00563, PCT/AU00/00564,
PCT/AU00/00566, PCT/AU00/00567, PCT/AU00/00568,
PCT/AU00/00569, PCT/AU00/00570, PCT/AU00/00571,
PCT/AU00/00572, PCT/AU00/00573, PCT/AU00/00574,
PCT/AU00/00575, PCT/AU00/00576, PCT/AU00/00577,
PCT/AU00/00578, PCT/AU00/00579, PCT/AU00/00581,
PCT/AU00/00580, PCT/AU00/00582, PCT/AU00/00587,
PCT/AU00/00588, PCT/AU00/00589, PCT/AU00/00583,
PCT/AU00/00593, PCT/AU00/00590, PCT/AU00/00591,
PCT/AU00/00592, PCT/AU00/00594, PCT/AU00/00595,
PCT/AU00/00596, PCT/AU00/00597, PCT/AU00/00598,
PCT/AU00/00516, PCT/AU00/00517 和 PCT/AU00/00511

这些共同待审的专利申请的公开内容已被收入本文作为交叉参考。

技术背景

分类广告是人们所熟知的，它让各种商品或服务的经营者在报纸、杂志和其他印好的出版物上刊登提供这些商品或服务的广告。潜在的购买者可以搜索这些分类广告，以便寻找感兴趣的项目。在因特网上，日益增长地提供分类广告，以在线搜索的方式提供附加的便利条件。

发明目的

本发明的一个目标就是提供用于搜索分类广告的新方法与系统。

本发明的概要

根据一个第 1 方面，本发明提供了一种用于搜索分类广告的方法，本方法包括下列各步骤:

向用户提供一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示该表格的一种标识，以及该表格的至少一个参考点;

在计算机系统中，接收来自一个传感装置的指示数据，该指示数据涉及该表格的标识以及传感装置相对于该表格的位置，当将传感装置定购在相对于该表格的一个操作位置上时，该传感装置能通过使用至少某些编码数据来感知指示数据；以及

在计算机系统以及从指示数据中，识别涉及列表搜索事务的至少一项参数。

最好是，涉及列表搜索事务的至少一种参数跟表格中的至少一个区域有关，并且，本方法包括在计算机系统以及从与传感装置的定位有关的区域中，识别所述至少一项参数。

同样，最好是，本方法包括:

在计算机系统中，接收涉及传感装置相对于该表格的移动的移动数据，传感装置使用至少某些编码数据来感知它相对于表格的移动；以及

在计算机系统以及从至少部分地处于所述至少一个区域内的移动中，识别列表搜索事务的所述至少一项参数。

根据一个第 2 方面，本发明提供了一种用于搜索分类广告的方法，本方法包括下列各步骤:

向用户提供一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示列表搜索事务的至少一项参数;

在计算机系统中，接收来自一个传感装置的数据，该数据涉及所述

至少一项参数，并且涉及传感装置相对于该表格的移动，当传感装置相对于该表格移动时，使用至少某些编码数据来感知涉及所述至少一项参数的数据，并产生涉及它本身相对于该表格的移动的数据；以及

在计算机系统中，解释传感装置在与所述至少一项参数相关时的所述移动。

根据一个第 3 方面，本发明提供了一种用于搜索分类广告的方法，本方法包括下列各步骤:

向用户提供一份表格，其中含有编码数据，表示该表格的一种标识;

在计算机系统中，接收来自一个传感装置的数据，该数据涉及用户的一个标识，并涉及表格的标识，传感装置含有涉及用户标识的数据，并使用至少某些编码数据来感知涉及表格标识的数据；以及

在计算机系统以及从涉及用户标识和表格标识的数据中，识别一种列表搜索事务。

最好是，编码数据也表示列表搜索事务的至少一种参数，并且本方法包括在计算机系统中，接收来自传感装置的、涉及列表搜索事务的至少一项参数的指示数据，传感装置使用至少某些编码数据来感知指示数据。

根据一个第 4 方面，本发明提供了一个用于搜索分类广告的系统，本系统包括:

一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示该表格的一个标识以及该表格的至少一个参考点；以及

一个计算机系统，用于接收来自一个传感装置的指示数据，该指示数据用于识别涉及列表搜索事务的至少一种参数，该指示数据还表示该表格的标识以及传感装置相对于该表格的位置，该传感装置使用至少某些编码数据来感知该指示数据。

最好是，涉及列表搜索事务的参数跟该表格的至少一个区域有关。

同样，最好是，本系统包括传感装置，该传感装置使用至少某些编码数据来感知它相对于该表格的移动。

根据一个第 5 方面，本发明提供了一个用于搜索分类广告的系统，

本系统包括:

一份表格，其中含有涉及列表搜索事务的信息，该表格含有编码数据，表示列表搜索事务的至少一项参数；以及

一个计算机系统，用于接收来自一个传感装置的数据，该数据涉及所述至少一项参数，并涉及传感装置相对于该表格的移动，并且用于解释传感装置在与所述至少一项参数相关时的所述移动，当传感装置相对于该表格移动时，使用至少某些编码数据来感知涉及所述至少一种参数的数据，并产生涉及它本身相对于该表格的移动的数据。

根据一个第 6 方面，本发明提供了一个用于搜索分类广告的系统，本系统包括:

一份表格，其中含有编码数据，表示该表格的一个标识；以及

一个计算机系统，用于接收来自一个传感装置的数据，该数据涉及用户标识以及表格标识，并且用于从所述接收数据中识别一项列表搜索事务，该传感装置含有涉及用户标识的数据，并且使用某些编码数据来感知涉及表格标识的数据。

最好是，编码数据也表示列表搜索事务的至少一项参数，计算机系统接收来自传感装置的、涉及至少一项参数的指示数据，并且传感装置使用至少某些编码数据来感知该指示数据。

相应地，本发明提供了一个系统和一种方法，它们利用能够跟计算机系统进行交互的一份或多份表格。虽然本发明的新颖的系统与方法可以跟一个单独的计算机系统配合使用，但是在一个特别优选的实施方式中，它被设计为在计算机网络（例如因特网）中运行。

从物理上说，这个表格可以被定购在任何合适结构的一个表面媒质上。但是，在一个优选的实施方式中，这个表格被定购在片状的材料上，例如纸张或者类似的材料，它们的上面打印了编码数据并且也允许与计算机系统进行交互。优选地，但并不是唯一地，这个编码数据是可以在可见光的光谱范围以外被检测的，由此这个编码数据可以被机器读取，但是基本上不能够被人眼所看见。这个表格也可以包括可见材料，以便向用户提供信息，例如表格的用途或者目的，这个可见信息可以是被登

记的，或者在位置上与有关的被隐藏编码数据相关。

这个系统也包括一个传感装置，以便将来自表格的数据传送到计算机系统，并且在某些情形下，将产生附加的数据。另外，这个传感装置也可以有多种形式，但最好是体积小巧，并且容易携带。在一个特别地优选的实施例中，传感装置的结构被设计为一支笔的形式，它被设计成能够在物理上对这个表格作出标记，并且也能够选择性地读取这个表格上的编码数据，并将其发送到计算机系统。然后，这个编码数据提供控制信息，控制信息被这样配置，使得用户在其上所作出的指定将导致一些指令被施加到运行于这个计算机系统或者网络之上的软件中去。

介于表格和传感装置之间的交互作用的性质，以及表格和传感装置提供给计算机系统的数据可以各不相同。在一种设计安排中，在表格上的编码数据表示了这个表格的标识并且表示了这个表格上的至少一个参考点。在另一个实施例中，这个表格包括表示这个表格的一项参数的编码数据，而这个传感装置通过操作，将关于其本身相对于表格的移动的数据，连同来自这个表格的编码数据一起提供给计算机系统。在又一种设计安排中，这个表格包括至少能标识这个表格的编码数据，并且传感装置被设计成基于表格编码数据，并且也基于标识这个装置的用户的数据，来向计算机系统提供数据。

在一个优选的设计安排中，本系统和方法也利用了特别设计的打印机来打印这个表格。另外，这些打印机构成或者形成了计算机系统的一部分，并且被设计成从传感装置接收数据。如上面所指出的，本发明的系统和方法理想地是适于在一个网络上进行工作的。在这种设计安排中，这些打印机被完全地集成到这个网络之中，并且允许按需打印这些表格，同时也允许混合使用多播和单播通信协议来分发这些表格。

相应地，在一个优选实施方式中，本发明提供了方法和系统，它们为计算机系统使用了基于纸张和笔的接口。这与传统的计算机系统相比，提供了许多显著的好处。纸张的优点在于它被广泛地用于显示和记录信息。另外，与被显示在计算机屏幕上的信息相比，打印出来的信息更便于阅读。另外，纸张不需要使用电池，可以在亮光下进行阅读，或者可

以很结实，即使上面溅有咖啡之类也没有关系，并且是便携式的和可以随意处理的。而且，这个系统允许识别手画或者手写，这与通过计算机键盘或者鼠标进行输入相比，提供更丰富的表达能力。

所以，本发明提供了一个新颖的系统和方法，它们利用新颖的交互式表面介质，来进行分类广告的搜索。

附图说明

下面仅通过非限制性的示例，并且参考附图来描述本发明的优选和其它实施方式，其中：

图 1 是在一个打印网页样板和其在线页面描述之间的一个关系的一个示意图；

图 2 是关于在一个网页笔，一个网页打印机，一个网页页面服务器，和一个网页应用服务器之间的交互式通信的一个示意图；

图 3 显示了通过一个网络而连接在一起的网页服务器和打印机的一个集合；

图 4 是关于一个打印出来的网页和其在线页面描述之间的一个高层结构的一个示意图；

图 5 是显示一个网页标记的结构的一个平面视图；

图 6 是一个平面视图，显示了图 5 中所显示的一组标记和其形式是一个网页笔的一个网页传感器设备的一个视场之间的关系；

图 7 是一个标记图象处理和解码算法的一个流图；

图 8 是一个网页笔和其相关的、探测标记的视场锥图的一个透视图；

图 9 是图 8 中所显示的网页笔的透视解剖视图；

图 10 是用于图 8 和图 9 中所显示的网页笔的一个笔控制器的一个示意性框图；

图 11 是一个可以被安装在墙壁上的一个网页打印机的一个透视图；

图 12 是图 11 的这个网页打印机的长度方向上的剖视图；

图 12a 是图 12 的一个放大图，它显示了两个方向移动的打印机引擎和胶轮组装的剖视图；

图 13 是图 11 和图 12 中的这个网页打印机的墨盒，墨，空气和胶路径，和打印机引擎的详细视图；

图 14 是用于图 11 和图 12 中所显示的这个网页打印机的一个打印机控制器的一个示意性框图；

图 15 是与图 14 中所显示的这个打印机控制器相关的双向打印机引擎控制器和 Memjet™ 打印机头的一个示意框图；

图 16 是图 14 和 15 中所显示的这个打印机引擎控制器的一个示意图框图；

图 17 是如在例如图 10 到 12 中的网页打印机中所使用的一单个 Memjet™ 打印部件的一个透视图；

图 18 是一个 Memjet™ 打印部件阵列的一小部分的一个透视图；

图 19 是显示在图 13 中所显示的 Memjet™ 打印部件的工作周期的一系列透视图；

图 20 是一个页面宽度的 Memjet™ 打印头的一个短段的一个透视头；

图 21 是一个用户类图的一个示意图；

图 22 是一个打印机类图的一个示意图；

图 23 是一个笔类图的一个示意图；

图 24 是一个应用类图 的一个示意图；

图 25 是一个文档和页面描述类图的一个示意图；

图 26 是一个文档和页面所有者类图的一个示意图；

图 27 是一个终端部件特殊化类图的一个示意图；

图 28 是一个静态部件特殊化类图的一个示意图；

图 29 是一个超级链接部件类图的一个示意图；

图 30 是一个超级链接部件特殊化类图的一个示意图；

图 31 是一个超级链接组类图的一个示意图；

图 32 是一个表格类图的一个示意图；

图 33 是一个数字墨水类图的一个示意图；

图 34 是一个字段部件特殊化类图的一个示意图；

图 35 是一个选择框字段类图的一个示意图；

图 36 是一个文本字段类图的一个示意图；

图 37 是一个签名字段类图的一个示意图;
图 38 是一个输入处理算法的一个流图;
图 38a 是图 38 中流图的一个步骤的一个详细流图;
图 39 是一个页面服务器命令部件类图的一个示意图;
图 40 是一个订阅发送协议的一个示意图;
图 41 是一个超级链接请求类图的一个示意图;
图 42 是一个超级链接激活协议的一个示意图;
图 43 是一个表格提交协议的一个示意图;
图 44 是一组用户接口流图文档图标的一个示意图;
图 45 是一组用户接口页面布局部件图标的一个示意图;
图 46 是一份分类类目图的示意图;
图 47 是一份支付类目图的示意图;
图 48 是一份已分类的用户界面流程图的示意图;
图 49 是一份定购分类列表用户界面流程图的示意图;
图 50 是一份分类主页的示意图;
图 51 是一份已分类的子类目和列表页面的示意图;
图 52 是一份搜索结果页面的示意图;
图 53 是定购一份列表一步骤 1 表格的示意图;
图 54 是定购一份列表一步骤 2 表格的示意图;
图 55 是定购一份列表一步骤 3 表格的示意图; 以及
图 56 是一份列表确认页面的示意图。

具体实施方式

注意: Memjet™是澳大利亚的 Silverbrook Research Pty Ltd 的商标。

在这个优选实施方式中，本发明被构造成使用一个基于网络网页的计算机系统进行工作，在后面对它进行了详细的描述。应理解，就基本系统来说，不是每一个实施方式均必须实现下面所讨论的全部甚至大部分具体的细节和延伸内容。但是，以最完全的形式描述 了这个系统，以减少当希望理解本发明的优选实施方式和方面进行工作的上下文时，对外

部参考资料的需要。

简单地说，这个网页系统的优选形式利用了形式为一个映射表面的一个计算机接口，即，包括指向在一个计算机系统中被维持的表面映射的参考的一个物理表面。这个映射参考可以被一个合适的传感器设备进行查询。取决于具体的实施方式，这个映射参考可以被进行可见地编码或者不可见编码，并且以这样一个方法来定义，以使对这个映射编码进行的一个本地查询可以获得一个明确的在这个映射内和在不同映射之间的映射参考。这个计算机系统可以包括关于这个映射表面的特征的信息，并且这样的信息可以根据一个传感器设备和映射表面一起提供的映射参考被进行检索。这样被检索的信息可以对这个操作员与表面特征进行的交互式通信作出响应，代表这个操作员执行由计算机系统所发起的动作。

在其优选的形式中，这个网页系统依赖于网页的产生以及人与这个网页的交互。这些网页是关于文本的网页，关于图象和打印在普通纸张上的图形的页面，但是它们工作起来就象交互式万维网页面。使用墨水在每一张纸上对信息进行编码，这墨水基本上不能够被普通的、不使用特殊仪器的人所看见。但是，这个墨水，及由此产生的编码数据可以被一个光学成象笔所探测并且被发送到这个网页系统。

在这个优选的形式中，在每一个页面上的每一个按钮和超级链接可以用这个笔来进行点击，以从这个网络请求信息或者向一个网络服务器发送优选项的信号。在一个实施方式中，在一个网页上用手写的文本在这个网页系统中被自动地识别和转换到计算机文本，并且允许对表格进行填充。在其它的实施方式中，被记录在一个网页上的签名被自动地进行证实，这允许电子商务的交易可以被安全地授权。

如图 1 中所显示的，一个打印出来的网页 1 可以表示一个交互式表格，这个表格可以被用户在打印出来的页面上进行物理地填充，并且也可以被用户进行“电子”填充，这是通过在笔和网页系统之间的通信来进行的。这个示例显示了包括名字和地址字段的一个“请求”表格和一个提交按钮。这个网页包括使用可见墨水打印出来的图形数据 2，和使用不可见墨水打印的、作为一个标记集合 4 的编码数据 3。被保存在这个网页网

络上的相应页面描述 5 描述了这个网页的独立部件。特别地，它描述了每一个交互式部件（即，在这个示例中的文本字段或者按钮）的类型和空间范围（区域），以允许这个网页系统能够正确地理解通过网页进行的输入。例如，提交按钮 6 具有一个区域 7，这个区域与相应图形 8 的空间范围相应。

如图 2 中所显示的，网页笔 101 与一个网页打印机 601，一个用互联网连接的、用于家庭、办公室或者移动使用的打印工具一起进行工作，这个网页笔 101 的一个优选形式被显示在图 8 和 9 中，并且在下面被进行更详细的描述。这个笔是无线的，并且通过一个短距离无线链路 9 与这个网页打印机进行安全的通信。

这个网页打印机 601 的优选形式被显示在图 11 到图 13 中，并且在下面被进行详细地描述，这个网页打印机 601 能够根据需要或者周期性地发送个性化的新闻报纸，杂志，商品目录，小册子和其它出版物，所有这些出版物均以高质量进行打印，并且被用作交互式网页。与一个个人计算机不同，这个网页打印机是一个应用工具，例如，它可以被安装在与早间新闻首先被阅读的区域相邻的墙壁上，例如一个用户的厨房，靠近早餐桌的旁边，或者在靠近这天离开家的位置上。它也可以是桌面，台面，便携式的或者缩微的形式。

在消费点被打印的网页综合了纸张使用的方便性和一个交互式媒质的及时性与交互性。

如图 2 中所显示的，这个网页笔 101 与一个打印网页 1 上的编码数据进行交互式通信，并且通过一个短距离无线链路 9 与一个网页打印机进行交互式通信。这个打印机 601 将这个交互式通信发送到相关的网页页面服务器 10，以进行理解。在合适的环境下，这个页面服务器发送一个相应的消息到在一个网页应用服务器 13 上运行的应用计算机软件。这个应用服务器反过来可以发送一个响应，这个响应将被打印在这个发起打印机上。

通过与基于高速微机械系统(MEMS)的喷墨 (Memjet^{TM})打印机一起进行使用，在这个优选实施方式中，可以使这个网页系统更方便。在这个

技术的优选实施方式中，相对高速度和高质量的打印已经降低到可以为更多的用户所使用的程度。在其优选形式中，一个网页出版具有一个传统的新闻杂志的物理特征，例如一组信纸大小的、两面使用全彩色进行打印的光滑页面，并且被装订在一起以更方便地进行导航和进行舒适的处理。

这个网页打印机利用了日益增多的宽带互联网接入。对美国的家庭用户来说，有 95% 的用户可以使用有线电视电缆业务，并且其中 22% 的家庭用户已经可以使用有线电视电缆调制解调器所提供的宽带互联网接入业务了。这个网页打印机也可以在低速度连接上进行工作，但是其发送时间变长了，其图象质量变差了。实际上，使用已有的、消费者所使用的喷墨打印机和激光打印机，就可以实现这个网页系统，虽然这个系统的工作速度较慢，由此从一个消费者的角度来看是比较难以接受的。在其它的实施方式中，这个网页系统驻留在一个私有的内部网络中。在另外其它的实施方式中，这个网页系统驻留在一单个计算机或者用计算机来工作的设备上，例如一个打印机上。

在这个网页网络上的网页出版服务器 14 被配置成将打印质量的出版内容发送到网页打印机。通过单播和多播互联网协议，周期性的出版物被自动地发送到进行订阅的网页打印机。个性化的出版物被根据每一个用户的要求而进行滤波与进行格式化。

一个网页打印机可以被配置成支持任何数量的笔，并且一个笔可以与任何数量的网页打印机一起进行工作。在这个优选实施方式中，每一个网页笔具有一个唯一的标识符。一个家庭可以有很多彩色网页笔的集合，其中一个笔被分配到这个家庭的每一个成员。这允许每一个用户可以对一个网页出版服务器或者应用服务器保留不同服务要求。

一个网页笔也可以登记到一个网页登记服务器 11 上，并且被连接到一个或者多个付费卡帐号。这允许使用这个网页笔来对电子商务付费进行安全的授权。这个网页登记服务器将这个网页笔所捕获的签名与前一个登记注册的签名进行比较，这允许它能够对一个电子商务服务器的一个用户的身份进行认证。也可以使用其它生物统计学来证实身份。这个

网页笔的一个版本包括指纹扫描，其证实方法与这个网页登记服务器的证实方法类似。

虽然一个网页打印机可以发送期刊，例如早间新闻报纸，而不需要用户进行干预，但是它也可以被配置成决不发送未经请求的垃圾邮件。在其优选形式中，它仅发送来自被订阅的或者是被授权的源的周期性杂志。从这个角度来说，这个网页打印机与一个传真机或者电子邮件帐号是不同的，传真机或者电子邮件帐号对任何垃圾邮件发送者是可见的，并且垃圾邮件发送者知道这个电话号码或者电子邮件地址。

1 网页系统结构

使用一个统一的模型语言（UML）类图来描述每一个对象模型。一个类图包括通过关系而连接在一起的一组对象类，这里对两类关系感兴趣：相关和一般化。一个相关表示在对象之间的某种关系，即在类的实例之间的关系。一个一般化涉及实际的类，并且可以使用下面的方法来进行理解：如果一个类被认为是这个类所有对象的集合，并且类 A 是类 B 的一个一般化，然后，简单地说，B 就是 A 的一个子集。这个 UML 不直接支持第二级模型 - 即，关于类的类。

每一个类被表示为一个标有该类的名字的矩形。它包括一个该类的属性的列表，与名字之间是用水平线分开的，并且包括一个类的操作列表，与这个属性列表之间是用一个水平线分开的。但是在随后的类图中，操作决不进行模型化。

一个相关被表示为连接了两个类的一条线，可选地，可以在任何一端标上相关的多重性。这个缺省的多重性是 1。一个星号表示多重性为“很多”，即，零或者更多。每一个相关被可选地标上其名字，并且可选地，在其任何一端标上相应类的角色。一个中心为空的菱形表示一个聚合相关（“是其一部分”），并且被画在这个相关线的聚合者端。

一个一般化的关系（“是一个”）被表示连接两个类的一条实线，在其一般化端有一个箭头（中心为空的三角形）。

当一个类图被分为多个图时，被复制的任何一个类被用一个虚线来进

行显示，除了定义这个类的主图外。仅在其定义的位置显示了类的属性。

1.1 网页

网页是在其上建立一个网页网络的基础。它们提供了一个基于纸张的、面向出版信息和交互式业务的用户接口。

一个网页包括一个打印页面（或者其它表面区域），并且附带着对这个页面的在线描述的不可见的索引。这个在线页面描述被一个网页页面服务器进行永久的维护。这个页面描述描述了这个页面的可见布局和内容，包括文本的，图形和图象的。它也描述这个页面上的输入部件，包括按钮，超级链接，和输入字段。一个网页允许使用一个网页笔在其表面上进行标记，而同时被这个网页系统所捕获与处理。

多个网页可以共享相同的页面描述。但是，为了允许能够将通过相同页面而进行的输入区别开来，每一个网页被分配了一个唯一的页面标识符。这个页面 ID 具有足够多的精度来区别数量很多的网页。

到这个页面描述的每一个索引在一个打印的标记中被进行编码。这个标记标识了其上出现了这个标记的这个唯一页面，由此间接地识别了这个页面描述。这个标记也标识其自己在这个页面上的位置。下面更详细地描述了这些标记的特征。

标记被使用对红外线能够进行吸收的墨水打印在任何能够反射红外线的衬底上，例如普通的纸张上。近红外线波长对人眼是不可见的，但是很容易被具有一个合适滤波器的一个固态图象传感器所探测到。

一个标记被在这个网页笔中的一个区域图象传感器所探测，并且这个标记数据被通过最近的网页打印机发送到这个网页系统。这个笔通过一个短距离无线链路与这个网页打印机进行通信，并且通信是无线的。标记是足够地小，并且被足够密集地排列，以致即使在页面上进行一单个点击，这个笔也能够可靠地对至少一个标记进行成象。重要的是，每一次与这个页面进行交互式通信时，这个笔能够识别出这个页面 ID 和位置，因为交互式通信是无状态的(stateless)。这些标记被进行了能够纠正错误的编码，以使它们能够部分地容忍对表面的损害。

这个网页页面服务器为每一个打印网页维持一个唯一的页面实例，这

允许它能够为每一个打印网页的页面描述的输入字段维持不同的、用户所提供的值。

介于网页描述、页面实例以及已打印的网页之间的关系示于图 4。已打印的网页可以是已打印的网页文档 45 的一部分。页面实例跟把它打印出来的网页打印机以及请求打印的网页用户（如果知道的话）二者相关联。

1.2 网页标记

1.2.1 标记数据内容

在一个优选的形式中，每一个标记标识它所出现的区域，和该标记在这个区域中出现的位置。一个标记也包括与整个区域或者与这个标记相关的一个标识。一个或者多个标识比特可以，例如，向一个标记探测设备发送信号来提供表示与这个标记的近邻区域相关的一个功能的反馈，而不需要这个探测设备参考这个区域的一个描述。一个网页笔，例如，可以让一个“激活区域”LED 发光，当其在一个超级链接的区域中时。

如下面将更清楚地解释的，在一个优选实施方式中，每一个标记包括一个容易被识别的固定不变的结构，它有助于初始时的检测，并且可以帮助使这个表面或者这个探测过程所引入的任何弯曲所造成的影响减少到最小。优选地，这些标记平铺在整个页面中，并且足够地小和足够密集地被排列，以致即使在页面上进行一单个点击，这个笔也能够可靠地对至少一个标记进行成象。重要的是，每一次与这个页面进行交互式通信时，这个笔能够识别出这个页面 ID 和位置，因为交互式通信是无状态的。

在一个优选的实施方式中，一个标记所指向的这个区域与整个页面一致，并且所以，在这个标记中被进行编码的这个区域 ID 与这个标记出现在其中的这个页面的页面 ID 是同义的。在其它的实施方式中，一个标记所指向的这个区域可以是一个页面或者其它表面的一个任意子区域。例如，它可以与一个交互式部件的区域一致，在这个情形下，这个区域 ID 可以直接地标识出这个交互式通信部件。

表 1 - 标记数据

字段	精度（比特）
区域 ID	100
标记 ID	16
标识	4
总数	120

每一个标记包括 120 个比特的信息，典型的分配如表 1 中所显示的。假设一个最大的标记密度是每平方英寸是 64 个标记，一个 16 比特的标记 ID 支持的区域大小可以达到 1024 平方英寸。更大的区域可以进行连续的映射，而不需要增加标记 ID 的精度，而是简单地使用相邻区域和地图。100 比特的区域 ID 允许可以唯一识别 2^{100} 个（~10^{30} 或者一百万兆万兆万）不同的区域。

1.2.2 标记数据编码

这个 120 比特的标记数据可以被使用一个（15，5）的里得索罗门码进行冗余编码。这实现了 360 个编码比特，包括 6 个码字，每个码字是 15 个 4 比特的符号。这个（15，5）码允许在每一个码字中可以有 5 个符号错误可以被纠正，即，它能够容忍的符号错误速率为每一个码字 33%。

每一个 4 比特符号以一个空间相关的方式被表示在这个标记中，并且这 6 个码字的符号在这个标记中被进行空间交织。这可以确保一个突发错误（能够对多个空间上相邻的比特产生影响的一个错误）对整个符号的破坏符号数目最小，并且在任何一个码字中的符号数目最小，这样可以使突发错误被完全纠正的可能性达到最大。

1.2.3 物理标记结构

这个标记的物理结构表示被显示在图 5 中，其物理结构包括固定的目标结构 15，16，17 和可变的数据区域 18。固定的目标结构允许一个探测设备，例如这个网页笔能够检测到这个标记，并且推断出它相对于这个传感器的 3 维方向。这个数据区域包括这个被编码标记数据的独立比特

的表示。

为了实现正确的标记再生，这个标记被再现为 256 × 256 点的分辨率。当以每英寸 1600 个点的精度进行打印时，这实现了一个直径为 4 毫米的一个标记。使用这个分辨率，这个标记被设计成被其半径为 16 点的一个“安静区域”所围绕。因为这个安静区域也是由相邻标记作贡献的。所以它仅给这个标记的有效直径增加了 16 点。

这个标记包括 6 个目标结构。一个检测环 15 允许这个探测设备能够在开始就检测到这个标记。这个环是很容易被检测的，因为它是圓型的并且是固定不变的，并且对其长宽比进行一个简单的纠正就去除了大部分透视畸变的影响。一个方向轴 16 允许这个探测设备能够确定这个标记的大致水平方向，因为这个传感器的偏转。这个方向角是不对称的，以实现一个唯一的方向。4 个透视目标 17 允许这个探测设备推断出这个标记的一个准确的 2 维透视变换，因此可以推断出这个标记相对于这个传感器的一个准确的 3 维位置和方向。

所有的目标结构均是足够冗余的和足够大的，以改进它们的抗噪声的能力。

整个标记的形状是圓形的。除了其它方面，这在一个不规则的三角格栅中支持了最佳的标记包装。与这个圓形的检测环一起，这使 在这个标记中的一个圓形数据比特结构为最佳结构。为了使其尺寸最大化，每一个数据比特被用一个径向的楔表示，这个楔的形式是被两个径向线和两个同心圓弧所围绕而成的一个区域。每一个楔的最小尺寸在 1600dpi 时是 8 个点，并且被设计成以使其基点（其内圓弧）至少与最小尺寸相等。这个楔在径向上的高度总是等于最小尺寸。每一个 4 比特数据符号用一个 2 × 2 楔的阵列来表示。

6 个码字中每一个码字的这 15 个 4 比特数据符号被分配到 4 个同心符号环 18a 到 18d 中，并且分配方式是交织的。符号被交替地、围绕这个标记以圓形前进的方式而进行分配。

设计交织的目的使在相同码字的任何两个符号之间的平均空间距离最大。

为了支持通过一个探测设备与一个被标记区域进行的“单点击”交互式作用，这个探测设备必须能够在其视场中看到至少一个完整的标记，不管在这个区域的哪一个位置或者位于哪一个方向上。所以，这个探测设备的视场的所需要直径是这些标记的尺寸和距离的函数。

假设这个视场是一个圆形的，当这些标记被排列在一个等边三角形格栅上时，这个传感器的视场的最小直径就可以获得了，如图 6 中所显示的。

1.2.4 标记图象处理和解码

这个标记图象处理和解码是被一个探测设备，例如图 7 中所显示的网页笔，执行的。当一个被捕获图象可以被这个图象传感器中获得，就确定了这个图象的动态范围（在 20）。然后，这个范围的中心被选择作为这个图象的二进制阈值 21。然后，这个图象被进行阈值处理并且被分段成连接的点区域（即，形状 23）（在 22）。尺寸太小以致不能够表示标记目标结构的形状被丢弃。每一个形状的尺寸和质心也被计算出来。

然后，对每一个形状计算出（在 24）二进制形状矩(shape moment)25，并且这些提供了随后对目标结构进行定位的基础。从本质上说，中心形状矩是与位置无关的，并且可以很容易地被做成与尺寸大小，长宽比和旋转无关。

环的目标结构 15 被首先定位出来（在 26）。一个环的优点在于当发生了透视畸变时，可以很好地进行工作。在进行匹配以前，对每一个形状的矩进行长宽比的归一化和旋转归一化。一旦其二阶矩被归一化，这个环就很容易被识别出来，即使透视畸变非常严重。环的初始长宽比和旋转 27 一起提供了对这个透视变换的一个有用近似。

下面对轴向目标结构 16 进行定位（在 28）。在进行匹配以前，对每一个形状的矩进行环的归一化，并且对所产生的矩进行旋转归一化。一旦其二阶矩已经被归一化了，其轴向目标结构就可以很容易地被识别。注意，在区分轴方向为两个可能方向中哪一个方向时就需要使用 3 阶矩。这个形状被故意地朝一侧倾斜以使可能区别出方向。另外，注意，仅仅

在对它进行了环 的归一化后，才能够对轴向目标进行旋转归一化，因为透视畸变可以隐藏轴向目标的轴方向。这个轴向目标的初始旋转提供了一个有用的、对标记因为笔的偏转 29 而旋转的一个近似。

4 个透视目标结构 17 是最后一个需要被定位的（在 30）。根据它们与环和轴向目标环的方位(aspect)和旋转，以及轴向的旋转之间已知的空间关系，可以很好地估计计算位置。通过将好的归一化应用到每一个形状矩来进行匹配。一旦其二阶矩被归一化了，就很容易识别出圆形的透视目标，并且最靠近每一个估计位置的目标也被认为是匹配的。然后，4 个透视目标的初始质心被认为是在标记空间中一个已知尺寸的平方的透视畸变角 31，并且在求解了涉及 4 个标记空间和图象空间点对的已知方程后，就可以推断出（在 32）一个 8 自由度的透视变换 33（见 **Heckbert, P., Fundamentals of Texture Mapping and Image Warping, Master Thesis, Dept. Of EECS, U. Of California at Berkley, Technical Report No. UCB/CSD 89/516, June 1989,** 其内容在这里被用作参考）。

所推断出来的、从标记空间到图象空间的透视变换被用于将标记空间中的每一个已知数据比特位置投影（在 36）到图象空间中，其中实数值位置被用于双线性内插（在 36）输入图象中的 4 个相关相邻点。前面计算出来的图象阈值 21 被用于对结果进行阈值处理，而产生最终的比特值 37。

一旦已经使用这个方法获得了所有 360 个数据比特 37，6 个 60 比特里得索罗门码字中的每一个被进行解码（在 38）来获得 20 个解码比特 39，或者总共 120 个解码比特。注意，以码字的顺序来对码字符号进行采样，以使在采样过程中，就暗暗地完成了对码字的去交织。

仅在该图象的子区域中来寻找这个环目标 15，该图象区域与这个图象的关系可以确保，如果发现了该环，该环就是一个完整标记的一部分。如果没有发现一个完整的标记并且成功地解码出这个标记，然后，就不记录当前帧的笔位置。如果有足够的处理能力和理想的一个不是最小的视场 193，就可以使用一个替代的策略来在当前图象中寻找另一个标记。

所获得的标记数据表示包括该标记的区域的标识身份和标记在这个区

域中的位置。然后，就可以从对这个标记进行的透视变换 33 和在笔的物理轴与笔的光学轴之间的已知空间关系来推断（在 34）出这个笔尖在区域中的确切位置 35，以及笔的整体方向 35。

1.2.5 标记图

对一个标记进行解码就产生了一个区域 ID，一个标记 ID，和一个与标记相关的笔变换。在标记 ID 和与标记相关的笔位置被转换成在这个标记区域中的一个绝对位置以前，这个标记在该区域中的位置必须是已知的。这是通过一个标记图而给出的，这个标记图的功能是将一个标记区域中的每一个标记 ID 映射到一个相应的位置。这个标记图类图被显示在图 22 中，它作为网页打印机类图的一部分。

一个标记图反映了用标记将这个表面排列满的一个方法。并且这个排列方法可以根据表面类型的不同而不同。当多个标记区域共享了相同的排列方法和相同的标记编号方法时，它们也可以共享相同的标记图。

用于一个区域的一个标记图必须是可以通过区域 ID 进行检索的。这样，给出一个区域 ID，一个标记 ID 和一个笔变换，就可以检索这个标记图，并且这个标记 ID 可以被变换成在该区域内的一个绝对标记位置，并且与标记相关的笔位置可以被增加到这个标记位置以获得笔在该区域内的一个绝对位置。

1.2.6 进行标记的方法

两个不同的表面编码方法是比较有意思的，这两个方法均使用在这个部分中前面所描述的标记结构。优选编码方法使用“表示位置的”标记，如已经讨论的。一个替代的编码方法使用表示对象的标记。

一个表示位置的标记包括一个标记 ID，当通过与标记区域相关的标记图而进行变换时，这个标记 ID 获得了在该区域中的一个唯一的标记位置。笔的、与标记相关的位置被增加到这个标记位置以获得笔在该区域内的位置。这依次又被用于决定笔相对于在与该区域相关的页面描述中的一个用户接口部件的位置。不仅用户接口部件本身被标识，而且也标识了

相对于这个用户接口部件的一个位置。所以，表示位置的标记可以很容易地捕获在一特定用户接口部件中的区域中的一个绝对笔路径。

一个表示对象的标记包括直接标识在与该区域相关的页面描述中的一个用户接口部件。这个用户接口部件中的区域中的所有标记标识了这个用户接口部件，使它们均是一致的，并且所以也是不可区分的。所以，表示对象的标记不支持对一个绝对笔路径的捕获。但是，它们能够支持对一个相对笔路径的捕获。只要位置采样频率超过了所遇到的标记频率的两倍，在一次点击中从一个采样笔位置到下一个位置的偏移量可以被准确地确定出来。

使用任何一个进行标记的方法，这些标记的功能都是与网页上作为用户交互式通信部件的相关视觉部件进行合作，这样一个用户可以使用一个合适的探测设备与打印页面进行交互式作用，以通过这个探测设备读取标记数据并且在网页系统中产生一个合适的响应。

1.3 文档和页面描述

图 25 和 26 显示了一个文档和页面描述类图的一个优选实施方式。

在这个网页系统中，用 3 个层次来描述一个文档。在最抽象的层次上，文档 836 具有一个等级结构，其终端部件 839 与内容对象 840，例如文本对象，文本类型的对象，图象对象，等等相关。一旦这个文档在使用一个特定的页面大小的打印机上并且根据一特定用户的缩放因子优选项被打印出来，这个文档被编上页号并且也被进行格式化。格式化终端部件 835 在某些情形下将与那些不同于那些与它们相应终端部件相关的内容对象的内容对象相关，特别地，在内容对象是与风格(style)相关的地方。一个文档和页面的每一个打印实例也被分开进行描述，以允许通过一特定页面实例 830 而捕获的输入的记录可以与通过该相同页面描述的其它实例而捕获的输入的记录分开。

在这个页面服务器上的最抽象文档描述的出现允许一个用户能够请求一个文档的拷贝，而不需要被强迫接受源文档的特定格式。这个用户可以通过使用一个不同纸张大小的打印机来请求一个拷贝，例如。相反，

在这个页面服务器上的格式化文档描述的出现允许这个页面服务器能够有效地解释用户对一特定打印页面进行的动作。

一个格式化文档 834 包括一组格式化的页面描述 5，每一个页面描述 5 包括一组格式化的终端部件 835。每一个格式化终端部件在这个页面上具有一个空间的扩展或者区域 58。这定义了输入部件，例如超级链接和输入字段的激活区域。

一个文档实例 831 与一个格式化文档 834 相应。它包括一组页面实例 830，每一个页面实例 830 与这个格式化文档的一个页面描述 5 相应。每一个页面实例 830 描述了一单个唯一的打印网页 1，并且记录了该网页的页面 ID 50。一个页面实例不是一个文档实例的一部分，如果它表示一个被分开请求的页面的一个拷贝。

一个页面实例包括一组终端部件实例 832。仅当一个部件实例记录了与实例相关的信息，这个部件实例才存在。这样，对一个超级链接部件存在有一个超级链接实例，因为它记录了一个对这个页面实例特定的交易 ID55，并且对一个字段部件存在一个字段实例，因为它记录了一个对该页面实例特定的输入。但是，静态部件，例如文本流，不存在一个部件实例。

一个终端部件可以是一个静态的部件 843，一个超级链接部件 844，一个字段部件 845 或者一个页面服务器命令部件 846，如图 27 中所显示的。一个静态部件 843 可以是具有一个相关风格对象(style object)854 的一个风格部件 847，具有相关风格化文本对象 855 的一个文本流部件 848，具有一个相关图象部件 856 的一个图象部件 849，具有一个相关图形对象 857 的一个图形部件 850，具有一个相关视频剪辑对象 858 的一个视频剪辑部件 851，具有一个相关音频剪辑对象 859 的一个音频剪辑部件 852，或者具有一个相关描述对象 860 的一个描述部件 863，如图 28 中所显示的。

一个页面实例具有一个背景字段 833，它被用于记录在这个页面上所捕获的、不用于一个特定输入部件的任何数字墨水。

在本发明的这个优选实施方式中，一个标记图 811 与每一个页面实例

相关来允许这个页面上的标记被变换到这个页面上的位置。

1.4 网页网络

在一个优选实施方式中，一个网页网络包括一个分布式的、网页页面服务器 10，网页注册服务器 11，网页 ID 服务器 12，网页应用服务器 13，网页出版服务器 14，和网页打印机 601 的集合，这些服务器是通过一个网络 19，例如互联网而连接在一起的，如图 3 中所显示的。

这个网页注册服务器 11 是记录在用户，笔，打印机，应用和出版之间的关系的服务器，由此对各种网络活动进行授权。它对用户进行认证，并且在应用交易中担当代表被认证的用户的签名代理。它也提供了硬件识别服务。如上面所描述的，一个网页页面服务器 10 保存了关于页面描述和页面实例的永久信息。这个网页网络包括任何数量的页面服务器，每一个页面服务器处理页面实例的一个子集。因为一个页面服务器也维持每一个页面实例的用户输入，所以客户，例如网页打印机将网页输入直接发送到合适的页面服务器。这些页面服务器解释任何相对于相应页面的描述的这种输入。

一个网页 ID 服务器 12 根据需要分配文档 ID51，并且通过其 ID 分配方法来在页面服务器之间提供负载均衡。

一个网页打印机使用互联网分布式名字系统（DNS），或者类似的系统，来将一个网页页面 ID 50 解析为处理相应页面实例的网页页面服务器的网络地址。

一个网页应用服务器 13 是其上装有交互式网页应用的一个服务器。一个网页出版服务器 14 是将网页文档出版给网页打印机的一个应用服务器。它们在部分 2 中将被详细地描述。

网页服务器可以被安装在很多网络服务器平台上，例如 IBM，惠普公司，和 Sun 公司所生产的网络服务器平台。多个网页服务器可以同时运行在一单个主机上，并且一单个服务器也可以分布到多个主机上。网页服务器所提供的某些或者全部功能，特别是 ID 服务器和页面服务器所提供的功能，也可以被直接提供在一个网页应用工具，例如一个网页打印

机中，一个计算机工作站中，或者被提供在一个局域网上。

1.5 网页打印机

网页打印机 601 是注册到这个网页系统中的一个应用工具，并且根据需要或者根据订阅来订阅网页文档。每一个打印机具有一个唯一的打印机 ID 62，并且通过一个网络，例如互联网，理想的是一个宽带连接，被连接到这个网页网络。

除了被保存在非挥发性存储器中的、关于身份和安全设置的信息外，这个网页打印机不包括永久的保存信息。就一个用户来说，“这个网络是一个计算机”。在这个分布式网页页面服务器 10 的帮助下，网页通过空间与时间来进行交互式的通信，而与特定的网页打印机无关。

网页打印机从网页出版服务器 14 接收订阅的网页文档。每一个文档被分成两个部分：页面布局，和用来填充页面的文本和图象对象。因为有个性化，页面布局典型地是对一个特定用户而具体化的，所以通过合适的页面服务器被单播给用户的打印机。另一方面，文本和图象对象典型地是与其它用户进行共享的，所以被多播给所有用户的打印机和合适的页面服务器。

网页出版服务器对文档内容的分段进行优化，以进行单播和多播。在接收到单播的一个文档页面布局后，这个打印机就知道需要侦听哪一个多播，如果有的话。

一旦这个打印机已经接收到完整的定义了需要被打印 的这个文档的页面布局和对象，它就能够打印这个文档。

这个打印机可以进行光栅化操作，并且同时在纸张的两面打印奇数页和偶数页。它包括双向打印引擎控制器 760 和使用用于这个目的的 Memjet™ 打印机头的打印引擎。

这个打印过程包括两个分开的阶段：页面描述的光栅化，和页面图象的扩展和打印。光栅图象处理器（RIP）包括一个或者多个并行工作的标准的 DSP 757。这个双向打印引擎控制器包括定制处理器，它实时地扩展，抖动和打印页面图象，并且与打印引擎中的打印机头的操作同步。

不能够进行 IR 打印的打印机具有使用吸收 IR 的黑墨水来打印标记的选项，虽然这将标记局限在页面的其它空白区域中。虽然与用 IR 打印的页面相比，这样的页面具有更局限性的功能，但是它们仍然可以被分类为网页。

一个正常的网页打印机将网页打印在纸张上。更特殊的网页打印机可以打印更特殊的表面，例如球面。每一个打印机支持至少一个类型的表面，并且对每一个表面类型支持至少一个标记排列方法，由此可以形成一个标记图。这个标记图 811 描述了实际被使用来打印一个文档的标记排列方法，并且与该文档相关，以使这个文档的标记可以被正确地理解。

图 2 示出了网页打印机类图，反映了与打印机相关的、被网页网络上的一个注册服务器 11 所维持的信息。

在下面的部分 6 中，参考图 11 到 16 更详细地描述了这个网页打印机的一个优选实施方式。

1.5.1 Memjet™打印头

这个网页系统可以使用用各种数字打印技术制造的打印机来进行工作，包括热喷墨打印机，压电喷墨打印机，激光电子照象技术，和其它类型的打印机。但是，为了使消费者能够广泛地接受，理想的是，一个网页打印机应具有下面的特征:

照片质量的彩色打印
高质量的文本打印
高可靠性
打印机成本低
墨水成本低
纸张成本低
操作简单
打印噪声很低
打印速度高
同时能够进行双面打印

紧凑的形状因子

功率消耗低

目前还没有商用的打印机技术能够满足所有这些特征。

为了生产具有这些特性的打印机，本发明申请已经发明了一个新的打印技术，称作 Memjet™ 打印技术。Memjet™ 是根据需要而进行滴墨的喷墨打印技术，其打印头的宽度与纸张相同，并且是使用微电子机械系统（MEMS）技术来制造的。图 17 显示了用一个 Memjet™ 打印头做的一单个打印部件 300。这个网页墙壁安装打印机包括了 168960 个打印部件 300 来形成一个 1600dpi 页宽的双向打印机。这个打印机同时打印深蓝色，品红色，黄色，黑色，和红外墨水及纸张调节剂与墨水固定剂。

这个打印部件 300 大约是 110 微米长，32 微米宽。这些打印部件阵列是被形成在一个硅衬底 301 上，这个硅衬底包括 CMOS 逻辑电路，数据传送，定时，和驱动电路（没有显示）。

这个打印部件 300 的主要部件是喷嘴 302，喷嘴缘边 303，喷嘴腔 304，流体密封 305，墨水管道缘边 306，杠杠臂 307，有源传动机构梁对 308，无源传动机构梁对 309，有源传动机构固定器 310，无源传动机构固定器 311，和墨水注入口 312。

这个有源传动机构梁对 308 是通过机械的方式在连接点 319 被连接到无源传动机构梁对 309。这两个梁对均被固定在它们相应的固定点 310 和 311。部件 308，309，310，311 和 319 组合在一起形成了一个悬臂式热电弯曲传动机构 320。

图 18 显示了一个打印部件 300 阵列的一个小部分，包括一个打印部件 300 的一个横切面部分 315。这个横切面部分 315 被显示为没有墨水，以清楚地显示通过硅晶片 301 的这个墨水注入口 312。

图 19（a），19(b)，和 19(c)显示了一个 Memjet™ 打印部件 300 的工作周期。

图 19(a)显示了在打印一个墨水微滴以前，墨水弯液面 316 的静止位置。墨水被墨水弯液面 316 的表面张力维持在喷嘴腔内，并且被维持在形成在喷嘴腔 304 和墨水管道缘边 306 之间的流体密封 305 中。

在进行打印时，打印头 CMOS 电路将数据从打印引擎控制器分发到正确的打印部件，锁存这个数据，并且缓存这个数据，以驱动这个有源传动机构梁对 308 的电极 318。这促使一个电流通过这个梁对 308 并且电流的持续时间大约为 1 微秒，这就产生了焦耳热效应。焦耳热效应所产生的温度升高促使梁对 308 进行膨胀。因为这个无源传动机构梁对 309 没有被加热，所以它不会进行热膨胀，这导致在这两个梁对之间存在有应力差异。这个应力差异部分地是通过热电弯曲激励器 320 的悬臂末端朝衬底 301 进行弯曲而得到消散。这个杠杠臂 307 将这个运动传送到喷嘴腔 304。喷嘴腔 304 移动大约 2 个微米到如图 19(b)所显示的这个位置。这增加了墨水的压强，迫使墨水 321 喷出喷嘴 302，并且促使墨水的弯液面 316 凸出。喷嘴缘边 303 避免墨水弯液面 316 扩展到喷嘴腔 304 的表面。

当梁对 308 和 309 的温度相等时，激励器 320 返回到其初始位置。这有助于墨水微滴 317 与在喷嘴腔中的墨水 321 断开，如图 19(c)中所显示的。这个喷嘴腔受弯液面 316 的表面张力的作用而重新被注满。

图 20 显示了一个打印头 350 的一段。在一个网页打印机中，打印头的长度是纸张在方向 351 上的满宽度（典型地是 210mm）。所显示的段是 0.4mm 长(一个完全的打印头的大约 0.2%)。当进行打印时，这个纸张在方向 352 上进行移动并且通过固定的打印头。这个打印头具有 6 行叉指形排列的打印部件 300，打印由墨水注入口 312 所提供的 6 个颜色的或者 6 个类型的墨水。

为了在工作期间保护打印头的脆弱表面，一个喷嘴保护薄片 330 被连接到这个打印头长度 301。对每一个喷嘴 302 来说，有一个相应的喷嘴保护孔 331，通过这个孔，墨水微滴被发射出去。为了避免喷嘴保护孔 331 被纸张纤维或者其它碎片所阻塞，在进行打印期间，被过滤的空气通过空气注入口 332 被泵浦进来并且从这个保护孔被泵浦出去。为了避免墨水 321 变干，当打印机处于空闲状态时，打印防护装置被进行密封。

1.6 网页笔

这个网页系统的有源探测设备典型地是一个笔 101，它使用其中被嵌入的控制器 134 来通过一个图象传感器从一个页面捕获和解码 IR 位置标记。这个图象传感器是一个固体设备，并且具有一个合适的滤波器来允许仅探测近红外波长。如下面更详细描述的，这个系统能够探测到笔尖与表面的接触，并且这个笔能够以一足够的速率对标记进行探测来捕获人手写的字（即，为 200dpi 或者更高，和 100Hz 或者更快）。这个笔所捕获的信息被进行编码，并且被用无线的方式发送到这个打印机（或者基站），这个打印机或者基站使用（已知的）页面结构来理解这个数据。

这个网页笔的优选实施方式既可以作为一个普通的标记墨水笔使用，也可以作为一个非标记输入笔使用。然而，这个标记用途对使用作为一个浏览系统的网页系统来说不是必需的，例如当它被用作一个互联网接口时。每一个网页笔被注册到这个网页系统中，并且具有一个唯一的笔 ID 61。图 23 显示了这个网页笔类图，反映了这个网页网络上一个注册服务器 11 所维持的与笔相关的信息。

当笔尖与一个网页进行接触时，这个笔确定其相对这个页面的位置和方向。这个笔尖被连接到一个力传感器，并且这个笔尖上的力被相对表示这个笔是“抬起的”或者是“按下的”的一个阈值来进行理解。这允许通过使用笔尖来进行按压来“点击”这个页面上的一个交互式部件，以从一个网络请求，例如，信息。另外，这个力被作为一个连续值而进行捕获从而允许例如一个签名的全动态特性被证实。

该笔通过在红外谱中对笔 尖周围的页面区域 193 进行成象，来确定其笔尖在这个网页上的位置和方向。它解码最近的标记，并且根据在这个图象标记上的被观察透视畸变和这个笔的已知光学几何结构来计算这个笔尖相对标记的位置。虽然这个标记的位置分辨率可能比较低，因为页面上的标记密度与标记大小成反比，但是被调节后的位置分辨率是很高的，超过了准确手写识别所需要的最小分辨率。

笔相对网页而进行的动作是作为一系列笔画而捕获的。一个笔画包括在这个页面上的一系列标记了时间的笔位置，这是被一个笔按下的事件所触发的，并且被随后的一个抬起笔的事件所结束。无论何时这个页面 ID

改变时，在正常的情形下，页面 ID 的改变是在一个笔画的开始。一个笔画也被标记了这个网页的页面 ID 50。

每一个网页笔有与其相关的一个当前选择 826，这允许这个用户能够执行拷贝和粘贴操作，等等。这个选择被标记上了时间，以允许这个系统能够在一预定时间后丢弃这个选择。当前选择描述了一个页面实例的一个区域。它包括通过笔相对这个页面的背景区域而捕获的最近数字墨水笔画。一旦它已经被通过一个选择超级链接激活而提交到一个应用时，它就被用一个与应用相关的方式进行理解。

每一个笔具有一个当前的笔尖 824。这是笔最后一次通知给这个系统的笔尖。在上面所描述的缺省网页笔的情形下，或者是标记黑墨水笔或者非标记输入笔是当前的笔尖。每一个笔也具有一个当前的笔尖风格 825。这是一个应用最后将其与笔相关的一个笔尖风格，例如，对用户从一个调色板中选择一个颜色作出的响应。这个缺省笔尖风格是与当前笔尖相关的笔尖风格。通过一个笔而被捕获的笔画被标记上了当前的笔尖风格。当笔画随后被进行再生时，它们被用标记到其上的笔尖风格来进行再生。

无论何时笔在与其进行通信的一个打印机的范围内时，这个笔缓慢地闪烁其“联机”LED。当这个笔不能够相对这个页面对一个笔画进行解码时，它立即激活其“错误”LED。当这个笔成功地相对这个页面解码一个笔画时，它立即激活其“OK”LED。

一系列被捕获 的笔画被称作数字墨水。数字墨水形成了绘画和手写的数字交换的基础，形成了对手写进行联机识别的基础，并且形成了对签名进行联机证实的基础。

这个笔使用无线通信方式，并且通过一个短距离无线链路将数字墨水发送到这个网页打印机。被发送的数字墨水被进行加密以确保私有性和安全，并且被进行打包以进行有效的传输，但是总是在一个笔抬起的事件发生后就被清空到打印机，以确保在打印机中能够进行及时处理。

当这个笔出了一个打印机的范围时，它将数字墨水缓存在内部存储器中，内部存储器的容量能够保存 10 分钟连续的手写。当这个笔又处于一

个打印机的范围内时，它发送任何缓存的数字墨水。

一个笔可以注册到任何数目的打印机，但是因为所有的状态数据驻留在纸张的网页中和在网络的网页中，所以在任何特定时刻一个笔与哪一个打印机进行通信就不是特别重要。

下面在部分 6 中，参考图 8 到 10 来详细描述这个笔的一个优选实施方式。

1.7 网页交互

网页打印机 601 接收关于笔 101 的一个笔画的数据，当这个笔被用于与一个网页 1 进行交互式通信时。标记 4 的被编码数据 3 被这个笔所读取，当笔被用于执行一个运动，例如一个笔画时。这个数据允许特定页面的识别标记和相关的交互式部件被确定出来，并且允许获得这个笔相对该页面的相对位置的表示。这个表示数据被发送到打印机，在这个打印机中，它通过 DNS 将笔画的页面 ID 50 解析为维持了相应的页面实例 830 的网页页面服务器 10 的网络地址。然后，它将这个笔画发送到页面服务器。如果最近在前面的笔画中识别出了这个页面，然后，这个打印机已经在其缓冲器中有相关页面服务器的地址。每一个网页包括被一个网页页面服务器（见下面）所永久维持的一个紧凑页面布局。这个页面布局涉及对象，例如图象，字体文本和片段，典型地被保存在网页网络中的其它地方。

当这个页面服务器从这个笔接收到笔画时，它检索这个笔画应用到其上的一个页面描述，并且确定这个笔画与页面描述的哪一个部件相交。然后，它能够根据相关部件的上下文类型来理解该笔画。

一个“点击”是一个其中在笔放下的位置和随后笔抬起的位置之间的距离与时间均比某个小的最大值小的笔画。被一个点击所激活的一个对象典型地需要激活一个点击，所以，就忽略了一个长的点击。一个笔动作，例如一个“草率”的点击不能够进行注册可以通过缺乏笔的“OK” LED 的响应而表示出来。

在一个网页页面描述中有两类输入部件：超级链接和表格字段。通过

一个表格字段而进行的输入也可以触发对一个相关超级链接的激活。

1.7.1 超级链接

一个超级链接是向一个远程应用发送消息的工具，典型地在网页系统中引出一个打印响应。

一个超级链接部件 844 标识出处理超级链接的激活的应用 71，标识到这个应用的超级链接的一个链路 ID 54，要求该系统在超级链接激活中包括用户的应用别名 ID 65 的一个“所需要别名”标记，和当超级链接被作为一个优选项而记录或者出现在用户的历史记录中时被使用的一个描述。这个超级链接部件类被显示在图 29 中。

当一个超级链接被激活时，这个页面服务器发送一个请求到这个网络中某个地方上的一个应用。这个应用用一个应用 ID64 来进行标识，并且这个应用 ID 被通过 DNS，使用一个正常的方法来进行解析。有 3 类超级链接：一般的超级链接 863，表格超级链接 865，和选择超级链接 864，如图 30 中所显示的。一个一般超级链接可以实现关于一个被链接文档的请求，或者可以简单地向一个服务器发送一个优选项。一个表格超级链接将相应的表格提交给这个应用。一个选择超级链接将当前的选择提交给这个应用。如果当前的选择包括一单个词的文本，例如，这个应用可能会返回一单个页面的文档，以给出这个词所出现的上下文中这个词所表示的意思，或者将它翻译成为一个不同的语言。每一个超级链接类型的特征在于它所提交给这个应用的信息。

相应的超级链接实例 862 记录了一个交易 ID 55，这个交易 ID 55 专用于这个超级链接实例所在的页面实例。这个交易 ID 可以标识出对这个应用的、与用户相关的数据，例如由一个购物应用为这个用户的所维持的存放待处理购买的“购物车”。

这个系统在一个选择超级链接激活中包括笔的当前选择 826。这个系统在一个表格超级链接激活中包括相关表格实例 868 的内容，虽然如果这个超级链接具有其“增量提交”属性集合，仅最后一次表格提交之后的输入被包括。这个系统在所有的超级链接激活中包括一个有效的返回

路径。

一个超级链接组 866 是具有一相关超级链接的一组部件 838，如图 31 所显示的。当通过这个组中的任何字段部件进行输入时，与这个组相关的超级链接 844 被激活。一个超级链接组可以被用于将超级链接行为与一个字段，例如一个选择框进行相关。它也可以与一个表格超级链接的“增量提交”属性一起，用于向一个应用提供连续的输入。所以，它也可以被用于支持一个“黑板式”交互式模型，即，输入被捕获的地方并且所以只要它一发生就可以被共享。

1.7.2 表格

一个表格定义了用于通过一个打印网页来捕获一个相关输入集合的相关输入字段集合。一个表格允许一个用户向在一个服务器上运行的一个应用软件程序提交一个或者多个参数。

一个表格 867 是在文档层次结构中的一组部件 838。它最终包括一组终端字段部件 839。一个表格实例 868 表示了一个表格的一个打印实例。它包括与这个表格的字段部件 845 相应的一组字段实例 870。每一个字段实例具有一个相关值 871，该相关值的类型取决于相应字段部件的类型。每一个字段值记录了通过一特定打印表格实例的输入，即，通过一个或者多个打印网页的输入。这个表格类图被显示在图 32 中。

每一个表格实例都有一个状态 872，该状态 872 表示这个表格是不是激活的，冻结的，已提交的，无效的或者过期的。当表格被首次打印时，它是激活的。一旦这个表格被签名于其上，或者一旦到达它的冻结时间，这个表格就被冻结了。一旦表格的一个提交超级链接已经被激活，这个表格就变为已提交的，除非这个超级链接的“增量提交”属性已被激活。当用户调用了一个无效表格、重置表格或者复制表格页面命令时，这个表格就变为无效的。当这个表格已到达指定的有效期限，即，当表格被激活的时间已经超过了这个表格的规定寿命时间时，这个表格就变为过期的。当这个表格处于激活状态时，允许对这个表格进行输入。通过尚未激活的一个表格而进行的输入将改为在相关页面实例的背景字段 833

中被捕获。当这个表格处于激活或者冻结状态时，允许提交表格。当这个表格处于尚未激活或者冻结状态时，任何提交表格的尝试将被拒绝，取而代之的是引出一份表格状态报告。

每一个表格实例与从其推断出的任何表格实例相关（在 59），这样，提供了一个版本历史。这允许除了最新的一个表格版本外的所有表格版本在一特定时间内可以被从搜寻中排除出来。

所有输入是作为数字墨水而被捕获的。数字墨水 873 包括一组有时间标记的笔画组 872，每一个笔画组包括一组所做的笔画 875。每一个笔画包括一组带时间标记的笔位置 876，每一个笔位置 876 也包括笔方向和笔尖的力。这个数字墨水类图被显示在图 33 中。

一个字段部件 845 可以是一个选择框字段 877，一个文本字段 878，一个绘画字段 879，或者一个签名字段 880。这个字段部件类图被显示在图 34 中。在一个字段区域 58 中被捕获的任何数字墨水被分配到这个字段。

一个选择框字段具有一个相关的布尔值 881，如图 35 中所显示的。在一个选择框字段区域中被捕获的任何标记（一个勾号，一个叉，一个斜杠，一个之字形，等等）可以促使一个真值被分配到这个字段的值。

一个文本字段具有一个相关的文本值 882，如图 36 中所显示的。在一个文本字段区域中被捕获的任何数字墨水被通过联机手写识别自动转换为文本，并且这个文本被分配到这个字段的值。联机手写识别已经被广泛理解了（见，例如，Tappert, C., C. Y., Suen 和 T. Wakahara 写的 "The state of the Art in On-line Handwriting Recognition", IEEE Transactions on Pattern Analysis and Machine Intelligence,Vol. 12, No.8, 1990 年 8 月，其内容在这里被用作交叉参考）。

一个签名字段具有一个相关的数字签名值 883，如图 37 中所显示的。在一个签名字段的区域中被捕获的任何数字墨水被根据笔的拥有者的身份而进行证实，并且包括该字段的表格的内容的一个数字签名被产生并且被分配到这个字段的值。使用这个笔用户专用于拥有这个表格的应用的私有签名密钥来产生这个数字签名。联机签名证实是被广泛地理解的

（见，例如，Plamondon, R. 和 G. Lorette 写的 “Automatic Signature Verification and Writer Identification-The State of the Art”, Pattern Recognition, Vol.22, No.2, 1989，其内容在这里被用作交叉参考）。

一个字段部件被隐藏，如果其“隐藏”属性被设置。一个被隐藏的字段部件在页面上不具有一个输入区域，并且不接收输入。它可以具有一个相关字段值，并且当包括这个字段的表格被提交时，这个值可以被包括在表格数据中。

“编辑”命令，例如表示删除的删除线，也可以在表格字段中被识别出来。

因为手写识别算法是联机工作的（即，使用了笔移动的动态特性），而不是“离线”的（即，仅使用笔标记的位图），所以它可以使用相对较高的准确度识别出连续写的、分开写的字符，而不需要与书写者相关的一个训练阶段。但是在经过一段时间后，自动产生与一个书写者相关的手写模型，并且如果必要的话，可以预先产生它。

如已经描述的数字墨水，包括一系列笔画。任何在一特定部件 的区域开始的笔画被附加到这个部件的数字墨水流，并且以用于理解。任何没有被附加到一个对象的数字墨水流的笔画可以被附加到这个背景字段的数字墨水流。

在背景字段中被捕获的数字墨水可以被理解为一个选择动作。用范围线将一个或者多个对象界定在一起通常被理解为选择了这些被用线界定的对象，虽然实际的理解是与应用相关的。

表 2 概述了与一个网页进行的各种笔交互式通信。

表 2　　与一个网页进行交互式通信的笔的概述

对象	类型	笔输入	动作
超级链接	一般	点击	将动作提交给应用
	表格	点击	将表格提交给应用
	选择	点击	将选择提交给应用
表格字段	选择框	任何标记	分配真值给字段
	文本	手写	将数字墨水转换为文本；分配文本到字段
	图画	数字墨水	分配数字墨水到字段
	签名	签名	证实数字墨水签名；产生表格的数字签名；分配数字签名到字段
无	-	界限	分配数字墨水到当前的选择

这个系统维持每一个笔的一个当前选择。这个选择简单地包括在背景字段中最近被捕获的笔画。在一个非激活时间后，这个选择被清除，以确保可预测的行为。

在每一个字段中被捕获的原始数字墨水被保留在这个网页服务器上，并且当这个表格被提交给应用时被与表格数据一起可选地进行传送。这允许这个应用能够询问原始数字墨水，当它对这个初始的转换有怀疑时，例如手写文本的转换。例如，这可以包括在应用层上对没有通过特定的、与应用相关的一致性检查的表格进行人为干预。作为这个的一个扩展是，一个表格的整个背景区域可以被指定为一个绘画字段。然后，这个应用可以根据在表格的明确字段外出现的数字墨水来决定将这个表格路由到一个人工操作员，假设这个用户可能已经在这些字段外指出了对已经填充的字段的修改。

图 38 显示了处理相对一个网页的笔输入的过程的一个流图。这个过程包括从这个笔接收（在 884）一个笔画；标识（在 885）笔画中的这个页面 ID 50 所涉及的页面实例 830；检索（在 886）这个页面描述 5；标识（在 887）这个笔画与其区域 58 有交叉的一个格式化部件 839；判断（在 888）这个格式化部件是否与一个字段部件相应，并且如果是就将所

接收的笔画附加（在 892）到这个字段值 871 的数字墨水上，理解（在 893）所收集的这个字段的数字墨水，并且判断（在 894）这个字段是否是一个超级链接组 866 的一部分，并且如果是，就激活（在 895）相关的超级链接；替代地，判断（在 889）这个格式化部件是否与一个超级链接部件相应，如果是，就激活（在 895）相应的超级链接；替代地，在无一个输入字段或者超级链接的情形下，将所接收的笔画附加（在 890）到背景字段 833 的数字墨水上；和将所接收的笔画拷贝（在 891）到当前笔的当前选择 826，这将被注册服务器所维持。

图 38a 显示了在图 38 所显示的过程中步骤 893 的一个详细流图，其中一个字段的被收集数字墨水被根据这个字段的类型而进行理解。这个过程包括判断（在 896）这个字段是否是一个选择框和（在 897）这个数字墨水是否表示一个选择记号，并且如果是，就将一个真值分配（在 898）到这个字段值；替代地，判断（在 899）这个字段是否是一个文本字段，并且如果是，就借助合适的注册服务器将这个数字墨水转换（在 900）为计算机文本，并且将这个被转换的计算机文本分配（在 901）到这个字段值；替代地，判断（在 902）这个字段是否是一个签名字段，如果是，就借助合适的注册服务器证实（在 903）作为这个笔拥有者的签名的数字墨水，同时也借助这个注册服务器并且使用这个笔拥有者关于这个相应应用的私有签名密钥，来产生（在 904）关于相应表格的内容的一个数字签名，并且将这个数字签名分配（在 905）到这个字段值。

1.7.3 页面服务器命令

一个页面服务器命令是被这个页面服务器进行本地处理的一个命令。它直接对表格，页面，和文档实例进行操作。

一个页面服务器命令 907 可以是一个无效的表格命令 908，一个复制的表格命令 909，一个复位表格命令 910，一个获得表格状态的命令 911，一个复制页面命令 912，一个复位页面命令 913，一个获取页面状态的命令 914，一个复制文档命令 915，一个复位文档命令 916，或者一个获得文档状态的命令 917，如图 39 中所显示的。

一个无效的表格命令使相应的表格实例无效。一个复制表格命令使相应的表格实例无效，并且然后使用保存的字段值来产生当前表格实例的一个激活打印拷贝。这个拷贝包括与原始表格相同的超级链接交易 ID，并且对一个应用来说，是不能够与原始表格有区别的。一个复位表格命令使相应的表格实例无效，并且产生这个表格实例的一个激活的打印拷贝，而放弃字段值。一个获得表格状态命令产生关于这个相应表格实例的状态的一个打印报告，包括谁出版了它，何时被打印的，是为谁打印的，和这个表格实例的表格状态。

因为一个表格超级链接实例包括一个交易 ID，这个应用就不得不产生一个新的表格实例。所以，请求一个新的表格实例的一个按钮典型地是作为一个超级链接而被实现的。

一个复制页面命令使用保存的背景字段值来产生相应页面实例的一个打印拷贝。如果这个页面包括一个表格或者一个表格的一部分，然后，这个复制页面命令就被理解为一个复制表格命令。一个复位页面命令产生相应页面实例的一个打印拷贝，而其背景字段值被丢弃。如果这个页面包括一个表格或者一个表格的一部分，然后，这个复位页面命令就被理解为一个复位表格命令。一个获得页面状态的命令产生关于这个相应页面实例的状态的一个打印报告，包括谁出版了它，何时被打印的，是为谁打印的，和它包括的任何表格或者其部分表格的状态。

出现在每一个网页上的这个网页图标通常与一个复制页面部件相关。

当一个页面实例被复制并且字段值被保存时，字段值被以它们原本的形式被打印，即，一个选择记号作为一个标准的选择记号图形而出现，并且文本作为排版文本出现。仅图和签名是以其原始形式而出现的，并且一个签名伴随有一个标准的、表示成功地通过了签名证实的图形。

一个复制文档命令使用被保存的背景字段值产生了相应的文档实例的一个打印拷贝。如果这个文档包括任何表格，然后，这个复制文档命令就使用与一个复制表格命令相同的方法来复制表格。一个复位文档命令产生相应文档实例的一个打印拷贝，而其背景字段值被丢弃。如果这个文档包括任何表格，然后，这个复位文档命令就使用与一个复位表格命

令相同的方法来复位表格。一个获得文档状态的命令产生关于这个相应文档实例的状态的一个打印报告，包括谁出版了它，何时被打印的，是为谁打印的，和它包括的任何表格的状态。

如果这个页面服务器命令的“在被选中后”属性被设置了，然后，这个命令对被笔的当前选择所标识的页面进行操作，而不是对包括这个命令的页面进行操作。这允许一个页面服务器命令的菜单能够被打印。如果这个目标页面不包括关于这个指定页面服务器命令的一个页面服务器命令部件，然后，这个命令被忽略。

通过将相关的页面服务器命令部件嵌入在一个超级链接组中，一个应用可以提供与应用相关的处理。这个页面服务器将激活与这个超级链接组相关的超级链接而不是执行这个页面服务器命令。

一个页面服务器命令部件被隐藏，如果其“隐藏”属性被设置了。一个被隐藏的命令部件在这个页面上没有一个输入区域，所以不能够直接被一个用户所激活。但是，它可以通过嵌入在一个不同页面中的一个页面服务器命令而被激活，如果这个页面服务器命令的“在被选中后”属性被设置了。

1.8 网页的标准特征

在这个优选的方式中，每一个网页的底部均打印了这个网页图标，以表示它是一个网页并且所以具有交互式通信的特性。这个图标也用作一个拷贝按钮。在大多数情形下，按下这个图标就产生了这个页面的一个拷贝。在一个表格的情形下，这个按钮产生整个表格的一个拷贝。并且在一个安全文档的情形下，例如一个票或者赠券，这个按钮引出一个说明条或者广告页面。

这个缺省单页面拷贝能够直接被相关的网页页面服务器进行处理。特殊的拷贝功能通过将这个图标按钮链接到一个应用而进行处理。

1.9 用户帮助系统

在一个优选实施例中，这个网页打印机具有一个被标记为“帮助”的

单独的按钮。当按下这个按钮时，就引出一个单独的帮助页面 46 的信息，包括:

· 打印机连接的状态
· 打印机消耗品的状态
· 顶级帮助菜单
· 文档功能菜单
· 顶级网页网络目录

这个帮助菜单提供了关于如何使用这个网页系统的分层次的指导手册。

文档功能菜单包括下面的功能:

· 打印一个文档的一份拷贝
· 打印一份表格的一个原始拷贝
· 打印一个文档的状态

通过选择文档并且随后按下按钮，就启动了文档功能。文档的状态表示谁出版了它，以及在什么时间、向谁发送了该文档，以及后来在什么时间、向谁发送了作为一份表格的该文档。

如果打印机不能进行打印，很显然就不能获得这个帮助页面。在这种情况下，“出错”灯就被点亮，并且用户可以通过网络请求远程诊断。

2 个性化的出版模型

在下面的描述中，新闻作为一个标准的出版示例被用于显示这个网页系统中的个性化机制。虽然新闻经常被用于狭义上的新闻报纸和新闻杂志新闻，但是本发明上下文中所指的范围更宽。

在这个网页系统中，使用了不同的机制来对一个新闻出版中的编辑内容和广告内容进行了个性化处理。这个编辑内容是根据读者的明确说明以及暗地捕获的兴趣资料而进行了个性化处理。广告内容是根据读者的地点和人口统计而进行了个性化处理。

2.1 编辑个性化处理

一个用户可以使用两类新闻资源：那些发送新闻出版物的新闻资源，和那些发送新闻流的资源。虽然新闻出版是被出版者所组合并且进行编辑的，但是新闻流或者可以被一个新闻出版者所编辑，或者可以被一个专业新闻收集者所编辑。典型地，新闻出版与传统的新闻报纸和新闻杂志相应，而新闻流可以是很多并且可以被改变：来自一个新闻服务的一个“原始”新闻，一个卡通带(cartoon strip)，一个自由作家的栏目，一个朋友的布告板，或者读者自己的电子邮件。

这个网页出版服务器支持被编辑的新闻出版物的出版和多个新闻流的聚合。通过对直接被读者所选择的新闻流进行聚合处理和由此进行格式化处理，这个服务器能够将广告放置在那些否则没有编辑控制的页面上。

这个用户通过选择一个或者多个提供新闻的出版物，并且为每一个产生一个个性化的版本，就可以建立一个新闻日报。所产生的日报版本被打印并且一起被绑定到一单个新闻报纸中。一个家庭的各个成员典型地通过选择不同的日报出版物并且然后对它们进行定制，来表达他们不同的兴趣和口味。

对每一个出版物，这个读者可选地选择特定的部分。某些部分是每天出现的，而其它是每周出现的，来自纽约时代在线的每天出现的部分，例如，包括“头版头条(page-one-plus)”，“国家”，“国际的”，“观点”，“商业”，“艺术与生活”，“技术”，和“运动”。可获得的部分的集合是对一个出版物特定的，这是缺省的子集。

这个读者可以通过产生定制部分来扩展新闻日报，每一个定制部分使用任何数目的新闻流。定制部分可以是对电子邮件和朋友的通告（“个性化”）而产生的，或者被产生用于监视关于特定题目的新闻源（“提醒”或者“剪辑”）。

对每一个部分来说，这个读者可选地规定其大小，或者定性的（例如，短的，中等的，或者长的），或者用数字表示的（即，作为对页面数目的一个限制），和所希望的广告部分，或者是定性的（例如，高，普通，低，无），或者用数字表示的（即，作为一个百分比）。

这个读者也可以可选地表达希望有更多数目的短文或者更少数目的长

篇文章的爱好。理想地，每一篇文章被用短形式的和长形式两个方式来写（或者编辑）以支持这个爱好选项。

一篇文章也可以以不同的版本来写（或者编辑），以满足这个读者所期望的复杂性，例如，可以提供小孩版本和成人版本。合适的版本是根据读者的年龄来选择的。这个读者也能够规定一个“阅读年龄”，这个阅读年龄比他们的生理年龄有更高的优先级。

组成每一个部分的文章被编辑进行选择和进行优先级排列，并且每一个被分配了一个有用的寿命时间。缺省地，它们被发送到所有相关的用户，并且是按优先级顺序发送的，并服从用户版本中的空间限制。

在合适的部分中，这个读者可以可选地进行合作滤波。然后，这被应用到具有足够长寿命时间的文章。每一篇满足合作滤波规则的文章被打印，并且在这篇文章末尾有多个评价按钮，这些按钮提供了一个容易的选择（例如，“喜欢”和“不喜欢”），这使读者更可能操心去评价这篇文章。

因此具有高优先级和短使用时间的文章被编辑认为是最需要被阅读的重要文章，并且被发送到大多数相关用户。

这个读者可选地规定了一个主题的偶然组配因子，或者是定性的（例如，给我，或者不给我一个惊奇），或者用数字表示。一个高主题的偶然组配因子降低了在合作滤波期间进行匹配所使用的阈值。一个高因子使相应的部分将被填充到读者规定的容量中的机会更多。一个不同的主题的偶然组配因子可以对周内的每天是不同的。

这个读者也可以可选地规定一个部分中特别感兴趣的题目，并且这修改了编辑所分配的优先级。

读者的互联网连接速度影响了图象被发送的质量。这个读者可以可选地规定一个优选项，来请求较少的图象或者较小的图象，或者同时请求这两个选项。如果图象的数目或者大小没有被减少，然后，就以较低的质量来发送图象（即，以较低的分辨率或者使用更高的压缩比例）。

从全球的角度来说，这个读者可以规定数量，日期，时间，和货币值如何被进行本地化。这涉及规定单位是采样英制还是采样公制，一个本

地时区和时间格式，和一个本地的汇率，和本地化是否在原地包括翻译或者注释。这些优选项缺省是从读者的地点来推断出来的。

为了减少因视力较差而导致的阅读困难，这个读者可选地可以规定一个全局选项，以请求使用更大的外观。文本和图象均被进行相应地放大，并且在每一页上包括较少的信息。

一个新闻出版物出版时所使用的语言，和其它相应的文本编码是这个出版物的一个特性，并且不是这个用户所表示的一个选项。但是，这个网页系统能够被配置成以各种外表来提供自动的翻译服务。

2.2 广告的本地化和目标对象

编辑内容的个性化直接影响了广告的内容，因为广告典型地是被放置来利用编辑内容的上下文的。例如，旅游广告更可能出现在一个旅游栏目中，而不是出现在其它的地方。编辑内容对一个登广告人（和所以是对出版者）来说的价值在于它吸引具有合适人口统计的大量读者的能力。

有效的广告是基于地点和人口统计学的。地点决定了特殊服务，零售商等等的近似性，和与本地社区和环境相关的特殊兴趣与注意力。人口统计学特点决定了一般的兴趣和偏见及可能的消费模式。

一个新闻出版者最能够带来利润的产品是广告“空间”，由出版物的地理覆盖范围，其读者人数的大小，其读者人数的人口统计特性所决定的一个多维实体，和用于广告的页面区域。

在这个网页系统中，这个网页出版服务器在对出版物的地理覆盖范围，这个部分的读者人数，每一个读者部分编辑的大小，每一个读者的广告比例，和每一个读者的人口统计特性进行考虑的基础上，对每一个部分计算一个出版物可销售广告空间的多维尺寸。

与其它媒体相比，这个网页系统允许以更大的细节来定义广告空间，并且允许分别以更小的部分来进行销售。所以，它允许以更接近真正价值的价格来销售它。

例如，相同的广告“条”能够以不同的比例销售给几个登广告的人，而每一个读者的页面随机地接收一个登广告人或者另一个的广告，整体

上来说，保持了销售给每一个登广告人的空间比例。

这个网页系统允许所广告的信息被直接链接到详细的产品信息和在线购买。所以，它增加了广告空间的固有价值。

因为能个性化和本地化处理是被网页出版服务器自动处理的，所以一个广告聚合可以提供任意宽的地理和人口覆盖范围。随后的去聚合是有效的，因为其过程是自动的。这使出版者在处理广告聚合体时，比直接捕获广告的性价比更高。即使这个广告聚合占了广告收入的一部分，但是出版者也可能改变的利润中间点，因为聚合有更大的效率。这个广告聚合也用作登广告人和出版者之间的一个中间角色，并且可以在多个出版物中放相同的广告。

值得注意的是，在一个网页出版物中放一个广告可能比在出版物的传统相应部分中放广告更复杂。虽然忽略了在登广告人，广告聚合和出版者之间进行协商的全部复杂性，但是这个网页系统的优选实施方式提供了对这些协商的某种自动支持，包括支持广告空间的拍卖。对产生少量收入的广告的放置来说使用自动方式是特别可取的，例如小的或者地理性很强的广告。

一旦已经协商好了广告放置，这个聚合就捕获和编辑广告并且将其记录在一个网页广告服务器上。相应地，这个出版者将这个广告放置记录在相关的网页出版服务器上。当这个网页出版服务器对每一个用户个性化的出版进行布局设计时，它从这个网页广告服务器中拾取相关的广告。

2.3 用户简档

2.3.1 信息过滤

报纸和其它出版物的个性化处理依赖于用户所特有的简档信息的分类，包括:

- 出版物的客户定制
- 合作的过滤矢量
- 详细的联系方式
- 展示优选项

出版物的客户定制典型地是出版物所特有的，所以，客户定制信息是由相关的网页出版物服务器来维护的。

合作的过滤矢量包括这个用户对一些报纸栏目的评价。它被用于对不同用户的兴趣进行相关，以便提出建议。虽然保持一个单独的合作的过滤矢量跟任何特定的出版物无关是有利的，但是，有两个原因使得对每一种出版物保持一个独立的矢量是更实际的：用户对相同出版物的矢量之间的重叠部分比这些用户对不同出版物的矢量之间的重叠部分更多；以及一种出版物可能希望将其用户的合作的过滤矢量展现为其品牌价值的一部分，而这是在其它地方所找不到的。所以，合作的过滤矢量也被相关的网页出版物服务器所保持。

详细的联系方式，包括名字，街道地址，邮政编码，州，国家，电话号码，它们在本质上是全球通用的，并且被一个网页注册服务器所保存。

类似地，展示优选项，包括关于数量，日期和时间的优选事项也是全球性的，并且也用相同的方法加以保存。

广告的本地化处理依赖于在用户的详细联系方式中所指出的地点，虽然广告的目标依赖于个人信息，例如出生日期，性别，婚姻状态，收入，职业，教育程度，或者定性的导出数据，例如年龄范围和收入范围。

对那些为广告目的而选择展现个人信息的用户来说，这些信息被保存在相关的网页注册服务器中。在缺乏这样的信息时，广告是根据与用户的邮政编码或者 ZIP+4 编码相关的人口统计特性来进行定位的。

每一个用户，笔，打印机，应用程序提供商和应用程序都被分配以其自己的唯一标识符，并且这个网页注册服务器保存了它们之间的关系，如图 21，22，23 和 24 所显示。为了注册的目的，一个出版商就是一个特定类型的应用程序提供商，并且一种出版物是一种特定类型的应用程序。

每一个用户 800 都可以被授权使用任何数目的打印机 802，并且每一部打印机都可以允许任何数目的用户来使用它。每一个用户都有一个单独的缺省的打印机（在 66），各种期刊杂志以缺省方式被发送到这部缺省打印机，而按需打印的页面则被发送到用户与之进行交互的打印机。

这个服务器跟踪一个用户已经授权哪一家出版商（将出版物内容）打印到这个用户的缺省打印机。一个出版商不能够记录任何特定打印机的 ID，而是当它需要时才解析这个 ID。用户还可以被指定为对打印机享有管理特权 69，让该用户授权其他用户去使用该打印机。只有当打印机针对这样的操作方式需要管理特权 84 时，这才是有意义的。

当一个用户订阅 808 一个出版物 807 时，这家出版商 806（即，应用程序提供商 803）被授权（将出版物内容）打印到一部指定的打印机或者这个用户的缺省打印机。在任何时刻，这个用户都可以撤消此项授权。每一个用户可能有几支笔 801，但是一支笔是一个单独的用户所专用的。如果一个用户被授权使用一部特定的打印机，则该打印机就能识别这个用户的任何一支笔。

笔 ID 被用于定位由特定的网页注册服务器所保存的相应的用户简档，这是使用一种通常的方法经由 DNS 来进行的。

一个 Web 终端 809 可以被授权在一个特定的网页打印机上进行打印，这使得在浏览 Web 期间所看到的 Web 页面和网页文档可以方便地被打印在最近的网页打印机上。

这个网页系统可以代表一个打印机提供者，对在这个提供者的打印机上打印出版物所获得的收入进行费用和佣金的收取。这样的收入包括广告费用，点击费用，电子商务佣金以及交易费用。若这部打印机是用户所拥有的，则该用户就是打印机提供者。

每一个用户也都有一个网页帐号 820，这个网页帐号被用于累加零星的收入和支出（例如，在前面的段落中所描述的那些）；详细的联系方式 815，包括名字，地址和电话号码；全球的优选项 816，包括隐私，发送和本地化设置；任何数目的生物统计学记录 817，包括这个用户的编码签名 818，指纹 819，等等；被这个系统自动地保存的一个手写模型 819；以及用以进行电子商务支付的 SET 付费卡帐号 821。

除了用户专有的网页帐号以外，每一个用户还有该用户被授权使用的每一部打印机所特有的网页帐号 936。每一部打印机专有的帐号被用来积累涉及该用户在该打印机上的活动的零星的收入和支出。该用户被定

期地通知任何未结清的借方余额。

用户可选地出现在网页用户目录 823 之中，以便让其他用户能定位该用户，并向其发送电子邮件（等）。

2.4 智能页面布局设计

这个网页出版服务器对每一个部分均自动进行针对每一个用户的个性化出版页面布局设计。因为大多数广告是格式预定的矩形，所以在放编辑内容以前，将它们放在页面上。

在这个部分的每一个页面上的广告比例可以有很大的变化范围，广告布局设计算法利用了这个比例变化特性。这个算法被配置成将紧密联系的编辑内容和广告内容放在一起，例如将关于屋顶材料的广告特别地放在出版物中，因为具有自己动手修复屋顶的特殊特征。

为这个用户所选择的编辑内容，包括文本的和相关的图象与图形，然后被根据各种审美规则而进行布局设计。

一旦整个布局已经汇聚，整个过程，包括广告的选择和编辑内容的选择，必须被迭代以更好地实现用户所申明的栏目尺寸优选项。但是，这个栏目尺寸优选项可以是长时间内，平均来说有比较好的匹配，这允许可以在每一天进行大的变化与调整。

2.5 文档格式

一旦这个文档已经被进行了布局设计，它就被为进行有效的传送分发而编码并且被有效地永久保存在这个网页网络中。

这个基本有效的机制是将针对一单个用户版本的信息和被多个用户版本所共享的信息分开。这个专门的信息包括页面布局设计。共享的信息包括这个页面布局所涉及的对象，包括图象，图形，和文本片段。

一个文本对象包括完全格式化的、使用可扩展纸张类型语言(Extensible Stylesheet Language)（XSL）以可扩展的标记语言（XML）来表示的文本。XSL 提供了对文本格式的精确控制，而与这个文本所放置的区域无关，在这个情形下，文本放置区域是被布局设计所提供的。文本对象包

括允许自动翻译的嵌入式语言代码，和帮助段落格式化的嵌入式的、用连字符连接的暗示。

一个图象对象使用 JPEG 2000 基于小波的压缩图象格式来对一个图象进行编码。一个图形对象使用可缩放矢量图形（SVG）格式来对一个 2D 图形进行编码。

这个布局自己包括一系列被放置的图象和图形对象，文本对象通过其流动的被链接文本流对象，如上面所描述的超级链接和输入字段，和水印区域。这些布局对象被汇总在表 3 中。这个布局使用了适合有效分发和保存的一个紧凑格式。

表 3 网页布局对象

布局对象	属性	被链接对象的格式
图象	位置	-
	图象对象 ID	JPEG 2000
图形	位置	-
	图形对象 ID	SVG
文本流	文本流 ID	-
	区域	-
	可选的文本对象 ID	-
超级链接	类型	-
	区域	-
	应用 ID，等等	-
字段	类型	-
	意义	-
	区域	-
水印	区域	-

2.6 文档分发

如上面所描述的，为了在这个网页网络上进行有效的分发和永久保存，一个与用户相关的页面布局被与它所涉及的共享对象分开。

当一个被订阅的出版物已经准备好进行分发时，这个网页出版服务器在网页 ID 服务器 12 的帮助下为每一个页面，页面实例，文档，和文档实例分配一个唯一的 ID。

这个服务器计算一组优化的共享内容子集，并且为每一个子集产生一个多播信道，然后将将承载这个布局所使用的共享内容的多播信道的名

字标记到每一个与用户相关的布局上。然后，这个服务器通过合适的页面服务器将每一个用户的布局单播到这个用户的打印机，并且当这个单播完成时，在这个规定的信道上多播这个共享的内容。在接收到其单播后，每一个页面服务器和打印机订阅这个页面布局中所规定的多播信道。在多播期间，每一个页面服务器和打印机从多播流中提取其页面布局所涉及的那些对象。这个页面服务器对所接收的页面布局和共享内容进行永久归档保存。

一旦一个打印机已经接收到其页面布局所涉及的所有对象，这个打印机重新产生完全排版的布局，并且然后进行光栅化处理并且打印它。

在通常的情形下，这个打印机打印页面的速度比页面分发的速度快。假设每一个页面的四分之一是图象，平均页面的大小比 400KB 约小一点。所以，这个打印机能够在其 64MB 存储器中保存超过 100 张这样的页面的内容，这允许能够进行临时缓存等等。这个打印机以每秒一张的速度进行打印。这相当于每秒 400KB 或者大约 3M 比特的页面数据，这可与通过一个宽度网络而实现的最高期望页面数据分发速度相比。甚至在异常的情形下，例如当这个打印机的打印纸用完时，很可能的是，在这个打印机的 100 页内部保存容量被使用完以前，用户就已经在打印机中增加了新的打印纸。

但是，如果这个打印机的内部存储器被填满了，然后这个打印机就不能够在多播第一次发生时就使用多播。所以，这个网页出版服务器允许打印机提交关于再次多播的请求。当接收到一个临界数目的请求或者发生超时时，这个服务器重新多播相应的共享对象。

一旦已经打印了一个文档，一个打印机可以在任何时刻通过从相关的页面服务器中检索其页面布局和内容产生一个精确的复制品。

2.7 文档点播

当根据需要请求一个网页文档时，其个性化处理和分发的方式与期刊杂志的情形非常相同。但是，因为没有共享的内容，分发是直接给请求的打印机的，而不需要使用多播。

当根据需要请求一个非网页文档时，它不被进行个性化处理，并且它被通过一个指定网页格式化服务器进行分发，这个指定网页格式化服务器重新将其格式化为一个网页文档。一个网页格式化服务器是一个网页出版服务器的一个特殊实例。这个网页格式化服务器了解各种互联网文档格式，包括 Adobe 的便携式文档格式（PDF），和超文本标记语言（HTML）。在 HTML 的情形下，它可以使用打印页面的高分辨率来以一个多栏的格式展示万维网页面，并且具有一个内容表。它可以自动地包括所有直接被链接到这个被请求页面的万维网页面。这个用户可以通过一个优选项来调节这个行为。

这个网页格式化服务器进行可以在任何互联网文档上获得的标准的网页行为，包括交互性和连续性，不管其起源和格式是什么。它向网页打印机和网页页面服务器隐藏了不同文档格式的细节，并且向万维网服务器隐藏了网页系统的细节。

3 安全性

3.1 加密方法

加密方法被用于保护在保存中和在传送中的敏感信息，并且被用于对一个交易的参与者进行认证。有两类广泛使用的加密方法：密钥加密方法和公钥加密方法。这个网页网络使用了这两类加密方法。

密钥加密方法，也被称作对称加密方法，使用了相同的密钥来对一个消息进行加密和解密。希望交换消息的双方必须首先安全地交换这个密钥。

公钥加密方法，也被称作非对称加密方法，使用了两个加密密钥。这两个密钥在数学上是这样相关的，使用一个密钥被加密的任何消息仅能够被使用另一个密钥进行解密。这些密钥中的一个然后被公开，而另一个密钥被私下保存。这个公钥被用于加密任何希望发送到这个私钥持有者的消息。一旦使用了这个公钥进行加密，一个消息仅能够使用这个私钥被进行解密。这样，双方可以安全地交换消息而不需要首先交换密钥。为了确保私钥是安全的，通常是私钥持有者产生这个密钥对。

公钥加密可以被用于产生一个数字签名。私钥持有者可以产生一个消息的已知杂凑，并且然后使用这个私钥对杂凑进行加密。然后，任何人可以通过使用这个公钥对被加密的杂凑进行解密并且使用这个消息来证实这个杂凑，而证实被加密的杂凑构成了私钥所有者关于这个特定消息的签名。如果这个签名被附加到这个消息上，然后，这个消息的接收者可以证实这个消息是真实的并且在传送过程中没有被修改。

为了使公钥加密方法能够很好地工作，必须有一个方法来分发公钥，并且这个方法能够避免假冒。这通常是使用证书和证书管理机构来完成的。一个证书管理机构是一个可被信任的第三方，它对在一个公钥和某个人的身份之间的连接进行认证。这个证书管理机构通过检查身份文档来证书这个人的身份，并且然后产生并且签署一个数字证书，这个数字证书包括这个人的身份细节和公钥。任何相信这个证书管理机构的个人可以使用这个证书中的公钥，并且完全可以确信这个公钥是真实的。他们仅仅需要证实这个证书确实是被这个证书管理机构所签署的，证书管理机构的公钥是众所周知的。

在大多数交易环境下，公钥加密方法仅被用于产生数字签名，并且用于安全地交换私下会话密钥。私钥加密方法被用于所有其它的目的。

在下面的讨论中，当提到在一个网页打印机和一个服务器之间进行安全的信息传送时，实际上所发生的是这个打印机获得这个服务器的证书，使用这个证书的管理机构来证实这个证书，使用这个证书中的公钥交换密钥来与这个服务器交换一个私下会话密钥，并且然后使用这个私下会话密钥对这个消息数据进行加密。从定义来说，一个会话密钥可以有一个任意短的有效使用时间。

3.2 网页打印机安全性

每一个网页打印机在制造时就被分配了一对唯一的标识符，这对唯一的标识符被保存在这个打印机的只读存储器中，并且被保存在这个网页注册服务器的数据库中。第一个 ID 62 是公开的，并且唯一地标识了这个网页网络上的这个打印机。第二个 ID 是保密的，并且当这个打印机首先

注册到网络上就被使用。

当这个打印机在安装后第一次连接到这个网页网络时，它产生一个签名公开/私有密钥对。它将这个私有 ID 和公钥安全地传送给这个网页注册服务器。这个服务器将这个私有 ID 与被记录在其数据库中的打印机的保密 ID 进行比较，并且如果这两个 ID 匹配的话就接受这个注册。然后，它就产生和签署一个证书，这个证书包括这个打印机的公开 ID 和公开签名密钥，并且将这个证书保存在注册数据库中。

这个网页注册服务器用作这些网页打印机的一个证书管理机构，因为它能够访问允许它证实打印机的身份的保密信息。

当一个用户订阅一个出版物时，就在这个网页注册服务器数据库中产生一个记录，该记录授权这个出版者将这个出版物打印到这个用户的缺省打印机或者一个规定的打印机。经过一个页面服务器被发送到一个打印机的每一个文档可以被一个特定的用户访问，并且被这个出版者使用出版者的私有签名密钥进行签名。这个页面服务器通过这个注册数据库证实，这个出版者已经被授权将出版物发送到这个规定的用户。这个页面服务器使用这个出版者的公钥来证实这个签名，出版者的公钥是从被保存在注册数据库中的出版者的证书中获得的。

这个网页注册服务器接受将打印授权增加到数据库中的请求，只要这些请求是通过注册到这个打印机的一个笔发起的。

3.3 网页笔的安全性

每一个网页笔在制造时就被分配了一个唯一的标识符，这个唯一的标识符被保存在笔的只读存储器中，并且被保存在网页注册服务器数据库中。笔 ID 61 唯一地标识了这个网页网络上的这个笔。

一个网页笔能够“知道” 网页打印机的数目，并且一个打印机能够“知道”笔 的数目。一个笔通过一个无线频率信号与一个打印机进行通信，无论何时它处于这个打印机的范围内时。一旦一个笔和打印机被注册了，它们就定期地交换会话密钥。无论何时这个笔将数字墨水发送到这个打印机，数字墨水总是被使用合适的会话密钥进行加密。数字墨水

决不会以明文的形式被传送。

一个笔为它所知道的每一个打印机保存一个会话密钥，会话密钥的索引是打印机 ID，并且一个打印机为它所知道的每一个笔保存一个会话密钥，这些会话密钥的索引是笔 ID。笔和打印机均有一个很大的但是也有限的存储容量来保存会话密钥，并且能够根据一个最近最少被使用的原则来丢弃一个会话密钥，如果需要的话。

当一个笔处于一个打印机的范围内时，这个笔和打印机发现它们是否能够知道对方。如果它们均不知道对方，然后，这个打印机判断它是否应知道这个笔。例如，这可能是因为这个笔属于已经注册到使用这个打印机的一个用户。如果这个打印机被意味着应知道这个笔但是不能够知道，然后它就发起自动笔注册过程。如果这个打印机不应知道这个笔，然后它就同意忽略这个笔，直到这个笔被放置在一个收费的杯中，这时它就发起注册过程。

除了其公开 ID，这个笔包括一个保密的密钥交换密钥。这个密钥交换密钥也在制造时被记录在网页注册服务器数据库中。在注册期间，这个笔将其笔 ID 发送到这个打印机，并且这个打印机将笔 ID 发送到这个网页注册服务器。这个服务器产生一个会话密钥以被这个打印机和笔所使用，并且安全地将这个会话密钥传送到这个打印机。它也发送使用笔的密钥交换密钥进行加密的会话密钥的一个拷贝。这个打印机将这个会话密钥保存在内部，其索引是笔 ID，并且将这个被加密的会话密钥发送到笔。笔将这个会话密钥保存在内部，其索引是打印机 ID。

虽然一个伪造的笔能够在笔注册协议中模仿一个笔，但是仅一个真正的笔能够对这个打印机所发送的会话密钥进行解密。

当一个前面没有注册的笔第一次注册时，它被有限地使用，直到它被链接到一个用户。一个注册的但是“不被所有的”笔仅被允许用于请求和填充网页用户和笔注册表格，以注册一个将被这个新笔自动链接的新用户，或者以将一个新笔增加到一个已有的用户。

这个笔使用私钥而不是公钥加密方法，因为笔中的硬件性能限制。

3.4 安全文档

这个网页系统支持安全文档的发送，例如票和赠券。这个网页打印机包括一个设施来打印水印，但是仅在接收到被合适授权的出版者的请求后才打印水印。这个出版者在其证书中标明其打印水印的授权，这个打印机能够证实该证书。

这个“水印”打印过程在这个页面的规定“水印”区域使用了一个替代的抖动矩阵。背靠背页面包括镜像水印区域，当进行打印时它们是重合的。在奇数和偶数页面的水印区域中被使用的这个抖动矩阵被设计成当这些区域被一起观看时会产生一个干扰效果，这个效果是透过打印纸张而获得的。

这个效果与一个水印类似的地方在于，当仅看这个页面的一个面时它是不可见的，当使用普通的装置来拷贝这个页面时它会被丢失。

安全文档的页面不能够使用在上面的部分 1.9 中所描述的内建网页拷贝机制进行拷贝。这可以延伸到在网页知道的复印机上对网页进行拷贝。

安全文档典型地是作为一个电子商务交易的一部分而被产生的。所以，它们可能包括用户的照片，当这个用户将其生理信息注册到这个网页注册服务器上时，该用户的照片被捕获，如在部分 2 中所描述的。

当展示一个安全网页文档时，这个接收者可以通过使用通常的方法来请求其状态，而证实其可靠性。一个安全文档的唯一 ID 仅在这个文档的有效使用时间内才有效。并且安全文档 ID 的分配不是连续的，以避免它们被机会主义者预测出来。可从开发一种内建关于证实失败的反馈的安全文档证实笔，以支持简易的展示点文档证实。

很清楚，从一个加密的角度来说，水印也不安全，用户的照片也不安全。它们简单地对偶然的伪造提供了大的障碍。联机文档证实，特别地使用一个证实笔，在它所需要的地方所提供的安全性增加了，但是仍然不能够完全避免不被伪造。

3.5 不可否认

在这个网页系统中，用户所提交的表格是被可靠地发送到表格处理者，

并且在网页页面服务器中可被永久进行归档。所以，接收人不可能否认该发送。

通过该系统而进行的电子商务付费，如在部分 4 中所描述的，也不可能被收款人所否认。

4 电子商务模型

4.1 安全的电子交易（SET）

这个网页系统使用安全电子交易（SET）系统作为其付费系统的一部分。SET 是已经被 MasterCard and Visa 所开发出来的系统，并且是用于付费卡的，这可以从其术语名字中看出来。但是，这个系统的大部分是与所使用的帐号类型无关的。

在 SET 中，卡持有者和商人注册到一个证书管理机构，并且被发放了包括其公开签名密钥的证书。这个证书管理机构使用合适的卡发放者来证实一个卡持有人的注册细节，并且使用合适的获得者来证实一个商人的注册细节。卡持有人和商人将他们 相应的私有签名密钥安全地保存在他们的计算机中。在付费过程期间，这些证书被用于相互认证一个商人和卡持有人，并且用于向这个付费网关对他们进行认证。

SET 还没有被广泛地接受，部分地是因为卡持有人认为维护密钥和证书是比较麻烦的。将卡持有人的密钥和证书保存在一个服务器上并且允许这个卡持有人通过一个密码来访问这个服务器的临时解决方法已经取得了部分成功。

4.2 SET 付费

在这个网页系统中，这个网页注册服务器用作 SET 付费交易中的这个网页用户（即这个卡持有人）的一个代理。

这个网页系统使用生理信息来认证这个用户并且授权 SET 付费。因为这个系统是基于笔的，所以所使用的生理信息是这个用户的联机签名，它包括随时间变化的笔的位置和压力。一个指纹生理信息也可以被使用，这可以通过在这个笔中设计一个指纹传感器，但是其成本更高。所使用

的这个生理信息类型仅影响这个生理信息的捕获，不影响这个系统的授权。

能够进行 SET 付费的第一个步骤是将这个用户的生理信息注册到网页注册服务器。这可以在一个被控制的环境下进行，例如一个银行，其中在这个用户的身份被证实的同时可以捕获这个生理信息。这个生理信息被捕获并且被保存在注册数据库中，被链接到这个用户的记录。这个用户的照片也被可选地捕获并且被链接到这个记录。这个 SET 卡持有人注册过程就完成了，并且所产生的私有签名密钥和证书被保存在数据库中。这个用户的付费卡信息也被保存，这给网页注册服务器足够的信息来在任何 SET 付费交易中充当这个用户的代理。

当这个用户最终提供了这个生理信息来完成一个付费，例如，通过对一个网页订单表格进行签名，这个打印机安全地将这个订购信息，这个笔 ID 和生理信息数据传送给网页注册服务器。这个服务器证实这个笔 ID 所标识的这个用户的生理信息，并且从这个时刻起，这个服务器充当这个用户的代理来完成 SET 付费交易。

4.3 微付费

这个网页系统包括用于进行微付费的一个机制，以允许这个用户方便地为根据需要打印低成本的文档和为拷贝有版权的文档而进行付费，并且可能地，也允许对这个用户为打印广告材料所引起的费用进行补偿。这后一个情形取决于已经被提供给这个用户的补助程度。

当这个用户注册电子商务时，聚合微付费的一个网络帐号就被建立。这个用户定期地接收一个支付结算表，并且可以使用标准的付费机制解决任何的未付款的登入借方的余额。

这个网络帐号可以被扩展到聚合关于期刊的订阅费用，另外，这也可以独立的付费结算表的表格形式提供给用户。

4.4 交易

当一个用户请求一个特定应用上下文中的一个网页时，这个应用能够

被嵌入到这个页面的、一个与用户相关的交易 ID55 中。通过这个页面随后进行的输入被用交易 ID 进行标记，并且由此这个应用能够为用户的输入建立一个合适的上下文。

但是，当输入是通过与用户不相关的一个页面而进行时，这个应用必须使用这个用户的唯一身份来建立一个上下文。一个典型的示例包括将一个预打印的目录页面上的项目增加到用户的虚拟“购物车”中。但是，为了保护这个用户的私有性，为这个网页系统所知道的这个唯一的用户 ID 60 不被泄漏到应用。这是为了防止不同的应用提供者能够轻易地对独立收集的行为数据进行相关。

相反，网页注册服务器通过一个唯一的别名 ID 65 维持在一个用户和一个应用之间的一个匿名关系，如图 24 中所显示的。无论何时这个用户激活了具有“被注册的”属性的一个超级链接，这个网页页面服务器要求这个网页注册服务器将这个相关的应用 ID 64，和笔 ID 61 翻译成一个别名 ID65。这个别名 ID 然后被提交给这个超级链接的应用。

这个应用保存由别名 ID 所索引的状态信息，并且能够检索与用户相关的状态信息，而不需要知道这个用户的全球身份。

这个系统也为一个用户的每一个应用保存一个独立的证书和私有签名密钥，以允许它能够仅使用与应用相关的信息，就代表这个用户对应用交易进行签名。

为了帮助系统对产品条形码（UPC）“超级链接”激活进行路由，这个系统代表这个用户对任何数目的产品类型记录了一个优选的应用。

每一个应用与一个应用提供者相关，并且这个系统代表每一个应用提供者保存了一个帐号，以允许它为点击费用等等而为这个提供者存款和登入借方。

一个应用提供者可以是期刊被订阅内容的一个出版者。这个系统记录了用户关于接收这个订阅的出版物的希望，以及所期望的出版频率。

5 通信协议

一个通信协议定义了在实体之间交换的一个有序的消息。在这个网页

系统中，实体，例如笔，打印机和服务器，利用了一组已定义协议来合作地处理用户与这个网页系统的交互式通信。

每一个协议被一个序列图来描述，其中水平方向被用于表示消息流，而垂直方向被用于表示时间。每一个实体被包括该实体的名字和表示这个实体有效使用时间的一个垂直列来表示。在一个实体存在的时间内，生命线被显示为虚线。在一个实体处于激活的时间内，生命线被显示为双线。因为这里所考虑的协议不产生或者破坏实体，所以一旦一个实体停止参与到一个协议，其生命线一般就被削短。

5.1 订阅发送协议

一个订阅发送协议的一个优选实施方式被显示在图 40 中。

很多数量的用户可能会订阅一个期刊出版物。每一个用户的版本可能会被进行不同的设计，但是很多用户的版本将共享共同的内容，例如文本对象和图象对象。所以，这个订阅发送协议通过单播将文档结构发送到每一个打印机，但是通过多播来发送共享的内容对象。

这个应用（即，出版者）首先从一个 ID 服务器 12 获得关于每一个文档的一个文档 ID 51。然后，它对这个文档新分配的 ID 作出响应，将每一个文档结构，包括其文档 ID 和页面描述发送到这个页面服务器 10。它包括其自己的应用 ID 64，这个用户的别名 ID 65，和相关的多播信道名字集合。它使用其私有签名密钥对这个消息进行签名。

这个页面服务器使用这个应用 ID 和别名 ID 来从这个注册服务器获得相应的用户 ID 60，这个用户选择的打印机的 ID 62（这可以是明确地为该应用选择的打印机，或者可以是这个用户的缺省打印机），和这个应用的证书。

这个应用的证书允许这个页面服务器证实这个消息的签名。如果这个应用 ID 和别名 ID 一起不能够标识一个订阅 808，这个页面服务器到注册服务器的请求失败。

然后，这个页面服务器分配文档和页面实例 ID，并且转发这个页面描述，包括页面 ID 50，到这个打印机。它包括这个打印机所侦听的相关多

播信道名字的集合。

然后，它将新分配的页面 ID 返回给这个应用，以在未来用作参考。

一旦这个应用已经通过相关的页面服务器将所有的文档结构分发到这个用户选择的打印机，它在前面选择的多播信道上多播共享对象的各种子集。页面服务器和打印机均监视合适的多播信道并且接收他们需要的内容对象。然后，他们能够将前面单播的文档结构应用上去。这允许页面服务器能够将完全的文档增加到它们的数据库中，并且它允许打印机能够打印这个文档。

5.2 超级链接激活协议

一个超级链接激活协议的一个优选实施方式被显示在图 42 中。

当一个用户使用一个网页笔在一个网页上进行点击时，这个笔将这个点击通信给最近的网页打印机 601。这个点击标识出这个页面和在这个页面上的一个位置。这个打印机已经从笔连接协议中知道了笔的 ID 61。

这个打印机通过 DNS 确定处理特定页面 ID 50 的页面服务器 10a 的网络地址。这个地址可能已经在其缓冲器中，如果这个用户最近与相同的页面发生了交互式通信。然后，这个打印机将笔 ID，其自己的打印机 ID 62，页面 ID 和点击位置转发给这个页面服务器。

这个页面服务器载入这个页面 ID 所标识的页面描述 5，并且判断这个点击位于哪一个输入部件的区域 58 中，如果有的话。假设相关的输入部件是一个超级链接部件 844，然后，这个页面服务器获得相关的应用 ID 64 和链路 ID 54，并且通过 DNS 获得驻留了这个应用 71 的应用服务器的网络地址。

这个页面服务器使用笔 ID 61 来从注册服务器 11 获得相应的用户 ID 60，并且然后分配一个全球唯一的超级链接请求 ID 52 并且建立一个超级链接请求 834。这个超级链接请求类图被显示在图 41 中。这个超级链接请求记录了进行请求的用户和打印机的 ID，并且标识被点击的超级链接实例 862。这个页面服务器然后将其自己的服务器 ID 53，超级链接请求 ID，和链路 ID 发送到这个应用。

这个应用根据与应用相关的逻辑来产生一个响应文档，并且从一个 ID 服务器 52 获得一个文档 ID 51。然后，它对这个文档新分配的 ID 作出响应，将这个文档，和进行请求的页面服务器 ID 和超级链接请求 ID 发送到这个页面服务器 10b。

第二页面服务器将超级链接请求 ID 和应用 ID 发送到第一页面服务器，以获得相应的用户 ID 和打印机 ID 62。第一页面服务器拒绝这个请求，如果这个超级链接请求已经过期了或者是关于一个不同的应用的。

第二页面服务器分配文档实例和页面 ID 50，将新分配的页面 ID 返回给这个应用，并且将完整的文档增加到其自己的数据库中，最后将这个页面描述发送到进行请求的打印机。

这个超级链接实例可能包括一个有意义的交易 ID 55，在这个情形下，第一页面服务器在发送到这个应用中的消息中包括这个交易 ID。这允许这个应用能够为超级链接激活建立一个与交易相关的上下文。

如果这个超级链接需要一个用户的别名，即，其“需要别名”的属性被设置了，然后，这第一页面服务器将笔 ID 61 和超级链接应用 ID 64 发送到这个注册服务器 11，以不仅获得与这个笔 ID 相应的用户 ID，而且也获得与这个应用 ID 和用户 ID 相应的别名 ID 65。它在发送到这个应用的消息中包括这个别名 ID，这允许这个应用能够为超级链接激活建立与用户相关的一个上下文。

5.3 手写识别协议

当一个用户在一个网页上使用一个网页笔来画一个笔画时，这个笔将这个笔画传送到这个最近的网页打印机。这个笔画标识了这个页面和在这个页面上的一个路径。

这个打印机使用通常 的方法，将笔 ID 61，其自己的打印机 ID 62，页面 ID 50 和笔画路径转发到这个页面服务器 10。

这个页面服务器载入这个页面 ID 所标识的页面描述 5，并且确定这个笔画与哪一个输入部件的区域 58 进行相交，如果有的话。假设相关输入部件是一个文本字段 878，这个页面服务器将这个笔画附加到文本字段的

数字墨水上。

在这个文本字段的区域中没有发生活动的一段时间后，这个页面服务器将笔 ID 和挂起的笔画发送到这个注册服务器 11，以进行解释。这个注册服务器标识与这个笔相应的用户，并且使用用户的累积手写模型 822 来理解作为手写文本的笔画。一旦它已经将这些笔画转换为文本，这个注册服务器将这个文本返回给进行请求的页面服务器。这个页面服务器将这个文本附加到文本字段的文本值上。

5.4 签名证实协议

假设这个笔画与其区域相交的输入部件是一个签名字段 880，这个页面服务器 10 将这个笔画附加到签名字段的数字墨水上。

在这个签名字段的区域中没有发生活动的一段时间后，这个页面服务器将笔 ID 61 和挂起的笔画发送到这个注册服务器 11，以进行证实。它也发送与这个签名是其一部分的表格相关的应用 ID 64，和表格 ID 56 和这个表格的当前数据内容。这个注册服务器标识与这个笔相应的用户，并且使用这个用户的动态签名生理信息 818 来证实作为这个用户的签名的笔画。一旦它已经证实了这个签名，这个注册服务器使用应用 ID 64 和用户 ID 60 来标识这个用户的、与应用相关的私有签名密钥。然后，它使用这个密钥来产生这个表格数据的一个数字签名，并且将这个数字签名返回给进行请求的这个页面服务器。这个页面服务器将这个数字签名分配给签名字段，并且将相关的表格状态设置为冻结。

这个数字签名包括相应用户的别名 ID 65。这允许一单个表格能够捕获多个用户的签名。

5.5 表格提交协议

一个表格提交协议的一个优选实施方式被显示在图 43 中。

表格提交是通过一个表格超级链接激活而发生的。这样，它遵循在部分 5.2 中所定义的协议，并且具有某些与表格相关的补充部分。

在一个表格超级链接的情形下，被这个页面服务器发送到这个应用 71

的这个超级链接激活消息也包括表格 ID 56 和这个表格的当前数据内容。如果这个表格包括任何签名字段，然后，该应用通过提取与相应数字签名相关的别名 ID 65，并且从注册服务器 11 获得相应的证书就可以证实每一个签名字段。

6 网页笔描述

6.1 笔的结构

参考图 8 和 9，这个笔一般被用标号 101 来表示，并且包括一个塑料铸模形成的一个外壳 102，这个外壳 102 具有定义了用于安装笔部件的一个内部空间 104 的壁 103。笔顶部 105 是可以被旋转地安装在外壳 102 的一端 106 的。一个半透明的壳 107 被安全地安装到这个外壳 102 的另一端 108。壳 107 也是用铸模塑料做的，并且是用半透明材料做的，以能够使用户看到被安装在外壳 102 中的 LED 的状态。壳 107 包括基本上围绕外壳 102 的末端 108 的一个主要部分 109 和从这个主要部分 109 往后凸出的并且可以被安装在外壳 102 的墙壁 103 中所形成的一个相应槽 111 中的一个凸出部分 110。一个无线天线 112 被安装在凸出部分 110 的后面，并且在外壳 102 内。围绕在壳 107 上的一个孔 113A 的螺旋螺纹 112 被安排成与一个金属末端片 114 啮合，这个金属末端片包括相应的螺旋螺纹 115。金属末端片 114 是可以被拆卸的，以允许可以替换墨水盒。

另外，被安装在壳 107 内的是在一个弯曲 PCB 117 上的一个三色状态 LED 116。这个天线 112 也被安装在这个弯曲 PCB 117 上。状态 LED 116 被安装在笔 101 的顶部以实现比较好的全向视角。

这个笔也能够作为一个普通的标记笔使用，同时也能够作为一个非标记的输入笔。具有笔尖 119 的一个墨水笔墨盒 118 和具有输入笔笔尖 121 的一个输入笔 120 被并排安装在外壳 102 内。通过旋转笔头 105，或者是墨水墨盒笔尖 119 或者是输入笔笔尖 121 可以被旋转到通过金属末端片 114 的开口 122。相应的滑动块 123 和 124 被分别安装在墨水墨盒 118 和输入笔 120 中。一个可旋转的凸轮桶 125 被安全地安装到笔头 105，并且可以进行工作与其一起旋转。这个凸轮桶 125 包括在凸轮桶的墙壁 181

内的一个槽形式的凸轮 126。从滑动块 123 和 124 中凸出来的凸轮输出器 127 和 128 啮合在凸轮槽 126 中。 在凸轮桶进行旋转时，这个滑动块 123 或者 124 进行相对移动，以将这个笔笔尖 119 或者输入笔笔尖 121 凸出并通过金属末端片 114 中的开口 122。笔 101 具有 3 个工作状态。通过将笔头 105 以 90°为步长进行旋转，这 3 个状态是：

输入笔 120 笔尖 121 出来；

墨水墨盒 118 笔尖 119 出来；和

输入笔 120 笔尖 121 和墨水墨盒 118 笔尖 119 均不出来。

一第二弯曲 PCB 129 被安装在位于外壳 102 内的一个电子机壳 130 上。这第二弯曲 PCB 129 将用于提供发射用的红外辐射的一个红外 LED 131 安装在这个表面上。一个图象传感器 132 被安装在这第二弯曲 PCB129 上，以接收表面上的反射红外辐射。第二弯曲 PCB 129 也安装了包括一个 RF 发送器和 RF 接收器的一个无线频率芯片 133，和用于控制笔 101 的工作的一个控制器芯片 134。一个光学模块 135（用铸模的干净塑料做的）位于壳 107 内，并且将一个红外线束发射到这个表面，并且将图象接收传送到图象传感器 132。电源线 136 将第二弯曲 PCB129 上的部件连接到电池接触点 137，电池接触点也被安装在凸轮桶 125 上。一个终端 138 将电池接触点 137 和凸轮桶 125 连接在一起。一个 3V 电压可充电电池 139 位于凸轮桶 125 内并且与电池接触点连接。一个感应充电线圈 140 被安装在第二弯曲 PCB 板 129 的周围，以通过感应对电池 139 进行充电。这个第二 PCB 129 也安装了一个红外线 LED 143 和一个红外线光电二极管 144 来检测在凸轮桶 125 中的移动，当输入笔 120 或者墨水墨盒 118 被用于书写时，以判断笔笔尖 119 或者输入笔笔尖 121 施加到这个表面上的力量。IR 光电二极管 144 通过被安装在滑动块 123 和 124 上的反射器（没有显示）来检测来自 IR LED 143 的光。

橡胶夹子垫 141 和 142 被提供到外壳 102 的末端 108，以帮助夹住笔 101，并且顶部 105 也包括一个夹子 142 来将这个笔 101 夹到一个口袋上。

6.2 笔控制器

笔 101 被安排成来通过在红外线谱中对笔尖附近的表面区域进行成象来决定其笔尖的位置（输入笔笔尖 121 或者墨水墨盒笔尖 119）。它记录来自最近位置标记的位置数据，并且被安排成使用光学模块 135 和控制器芯片 134 计算笔尖 121 或者 119 距位置标记的距离。控制器芯片 134 从这个被成象标记上所观察到的透视畸变来计算这个笔的方向和笔尖到标记的距离。

使用这个 RF 芯片 133 和天线 112，笔 101 可以将数字墨水数据（它被进行加密以确保安全，并且被进行分组化以进行有效的传输）发送到这个计算系统。

当这个笔在一个接收器的范围内时，输入墨水数据就按其形成的而被发送。当笔 101 移动出了其范围时，数字墨水数据被缓存在笔 101 的内部（笔 101 电路包括被安排成能够保存笔在这个表面上移动大约 12 分钟的数字墨水数据的一个缓冲器），并且可以被较后的时间被发送。

控制器芯片 134 被安装在笔 101 的第二弯曲 PCB 129 上。图 10 是显示控制器芯片 134 的结构细节的一个模块图。图 10 也显示了 RF 芯片 133，图象传感器 132，三色状态 LED 116，IR 发射 LED 131，IR 力量传感器 LED 143 和力量传感器光电二极管 144 的表示。

笔控制器芯片 134 包括一个控制处理器 145。总线 146 使在控制器芯片 134 的部件之间交换数据成为可能。闪存 147 和一个 512KB DRAM 148 也被包括在其中。一个模拟到数字转换器 149 被安排成将来自力量传感器光电二极管 144 的模拟信号转换为一个数字信号。

一个图象传感器接口 152 与这个图象传感器 132 进行接口通信。一个收发器控制器 153 和基带电路 153 也被包括来与 RF 芯片 133 进行接口通信，RF 芯片 133 包括一个 RF 电路 155 和 RF 振荡器和被连接到天线 112 的电感 156。

这个控制处理器 145 捕获和解码通过图象传感器 132 从这个表面的标记来的位置数据，监视力量传感器光电二极管 144，控制 LED 116，131 和 143，并且通过无线收发器 153 处理短距离无线通信。它是一个中等性能（～40MHz）的通用 RISC 处理器。

这个处理器 145，数字收发器部件（收发器控制器 153 和基带电路 154），图象传感器接口 152，闪存 147 和 512KB DRAM 148 被集成在一单个控制器 ASIC 中。模拟 RF 部件（RF 电路 155 和 RF 振荡器和电感 156）被提供在独立的 RF 芯片中。

这个图象传感器是带一个 IR 滤波器的一个 215 × 215 点的 CCD（例如，由 Matsushita Electronic Corporation 所生产的一个传感器，它被描述在 Itakura, K T Nobusada , Nokusenya, R Nagayoshi, and M Ozaki 等写的一篇文章，“a 1mm 50k-Pixel IT CCD Image Sensor for Miniature Camera System”，IEEE Transactions on Electronic Devices, Vol. 47, number 1, January 2000，它 在这里被用作参考）。

当笔 101 不与表面进行接触的一段非活动时间后，控制器 ASIC 134 进入一个静止状态。它包括一个专用电路 150 来监视力量传感器光电二极管 144 并且在一个笔按下的事件发生后就通过电源管理器 151 来唤醒控制器 134。

无线收发器在通常是被无绳电话所使用的非许可 900MHz 频带内进行通信，或者替代的，在非许可 2.4GHz 工业，科学和医药（ISM）频带内进行通信，并且使用跳频和碰撞检测技术来提供无干扰的通信。

在一个替代的实施方式中，笔包括了一个红外线数据协会(IrDA)接口来与一个基站或者网页打印机进行短距离通信。

在另一个实施方式中，笔 101 包括一对正交的加速计，它们被安装在笔 101 轴的垂直平面上。这对加速计 190 以细小的轮廓线被显示在图 9 和 10 中。

提供了加速计后可以使笔 101 的这个实施方式探测到运动，而不需要参考表面的位置标记，这允许可以使用较低的采样速率来采样位置标记。然后，每一个位置标记 ID 可以标识一个感兴趣的对象，而不是表面上的一个位置。例如，如果这个对象是一个用户接口输入部件（例如，一个命令按钮），然后，在这个输入部件的区域内的每 一个位置标记的这个标记 ID 可以直接地标识出输入部件。

在每一个 x 和 y 轴上的加速计所测量的加速度可以与时间一起来传输

一个瞬时的速度和位置。

因为笔画的开始位置是不知道的，所以仅可以计算一个笔画内的相对位置。虽然位置集成累积了所探测加速度的误差，但是典型地，加速计具有高的分辨率，并且累积错误的一个笔画的持续时间比较短。

7 网页打印机描述

7.1 打印机机械结构

垂直安装的网页墙挂式打印机 601 在图 11 中显示为完全装配状态。它使用双向 8 1/2" Memjet™ 打印引擎 602 和 603，如图 12 和 12a 中所显示的，在 Letter/A4 大小的媒质上打印网页。它使用一个直的纸张路径，并且纸张 604 通过双向的打印引擎 602 和 603，这两个打印引擎使用全色和全渗透来同时在一个纸张的两面进行打印。

一个集成捆绑装订装配部件 605 沿每一个打印纸张的一个边缘施加一个胶条，当被按压时允许它能够粘结到前一个纸张。这产生了一个最终捆绑装订的文档 618，其厚度可以从一张纸到几百张纸。

可替换的墨水墨盒 627 在图 13 中被显示，它与双向打印引擎连接，并且具有用于保存固定剂，粘结剂，和青色，品红色，黄色，黑色和红外墨水的空腔或者小室。这个墨盒也在基部压制件中包括一个微型空气过滤器。这个微型空气过滤器通过一个软管 639 与这个打印机内的一个空气泵 638 进行连接。这将被过滤的空气提供给打印头，以避免将微颗粒输入到这个 Memjet™ 打印头 350，否则颗粒将阻塞打印头的喷嘴。通过将空气过滤器包括在墨盒中，过滤器的工作寿命可以有效地与墨盒的使用寿命绑在一起。这个墨盒是完全可再生的产品，并且其容量可以用于打印和粘结 3000 页面（1500 张纸）。

参考图 12，这个用电动机带动的媒质拾取辊子装配部件 626 将最上面的纸张直接从媒质盘推动通过第一打印引擎 602 上的一个纸张传感器，并且送到双向的 Memjet™ 打印头装配部件。这两个 Memjet™ 打印引擎 602 和 603 被安装在沿直纸张路径上的、相对的、在线上依次排列的结构中。这个纸张 604 通过集成的电动拾取辊子 626 被拖入第一打印引擎 602。

纸张 604 的位置和大小被探测，并且进行全渗透打印。固定剂被同时打印以有助于在最短可能时间内变干。

这张纸通过一组电动退出带钉轮子（沿直的纸张路径排列）退出第一 Memjet™ 打印引擎 602，这组电动带钉轮子作用在一个涂上橡胶的辊子上。这些带钉的轮子接触“湿的”被打印表面，并且继续将这纸张 604 送入到第二 Memjet™ 打印引擎 603。

参考图 12 和 12a，纸张 604 从双向的打印引擎 602 和 603 进入捆绑装订装配部件 605。被打印的页面通过带一个纤维支撑辊子的一个电动带钉轮子轴 670 和具有带钉轮子和一个瞬时作用胶轮子的另一个可移动轮轴之间的空间。这可移动的轴/胶装配部件 673 被安装到一个金属支撑托架上，并且它被在一个凸轮轴的作用下，通过齿轮向前传送到与电动轴 670 接触。一个独立的电动机带动这个凸轮轴。

胶轮装配部件 673 包括一个部分中空的轮轴 679，该轮轴 679 具有一个与来自墨水墨盒 627 的胶水提供软管 641 联接的旋转联接器。这个轮轴 679 连接到通过径向的孔的毛细管作用而吸附粘结剂的一个胶轮。一个模制的外壳 682 围绕这个胶轮，并且在前面有一个开口。绕枢轴转动的侧压制件和被支在弹簧上的外部门被连接到这个金属托架，并且当这个装配部件 673 的其余部分往前冲出时转动到一侧。这个动作通过模制外壳 682 的前面暴露出胶轮。张力弹簧关闭这个装配部件并且在非活动期间内有效地密封这个胶轮。

当纸张 604 进入到这个胶轮装配部件 673 中时，粘结剂被施加到前侧上的一个垂直边缘（除了一个文档的第一纸张），当它被向下传送到捆绑装订装配部件 605 时。

7.2 打印机控制器结构

这个网页打印机控制器包括一个控制处理器 750，一个被工厂安装的或者在现场被安装的网络接口模块 625，一个无线收发器（收发器控制器 753，基带电路 754，RF 电路 755，和 RF 振荡器和电感 756），双光栅图象处理器（RIP）DSP 757，双向打印引擎控制器 760a 和 760b，闪存

658，和 64MB DRAM 657，如图 14 中所显示的。

这个控制处理器处理与网络 19 和与本地无线网页笔 101 的通信，探测帮助按钮 617，控制用户接口 LED 613－616，并且馈送和同步 RIP DSP 757 和打印引擎控制器 760。它包括一个中等性能的通用微处理器。这个控制处理器 750 通过一个高速串行总线 659 与这个打印引擎控制器 760 进行通信。

RIP DSP 对页面描述进行光栅化处理并且将其压缩到网页打印机的压缩页面格式。每一个打印引擎控制器实时地解压缩，抖动和打印页面图象到其相关的 Memjet™ 打印头 350（即，以每分钟超过 30 页的速度）。这个双向打印引擎控制器可以同时在一个纸张的两面进行打印。

主打印引擎控制器 760a 与主 QA 芯片 665 和墨水墨盒 QA 芯片 761 一起控制纸张的传送和监视墨水的使用情况。

这个打印机控制器的闪存 658 保存了关于处理器 750 和 DSP 757 的软件，并且保存了配置数据。这在启动时被拷贝到主存储器 657。

处理器 750，DSP 757，和数字收发器部件（收发器控制器 753 和基带电路 754）被集成在一单个控制器 ASIC 656 中。模拟 RF 部件（RF 电路 755 和 RF 振荡器和电感 756）被提供在一个独立的 RF 芯片 762 中。这个网络接口模块 625 是分开的，因为网页打印机允许这个网络连接可以被工厂选择，也可以在现场进行选择。闪存 658 和 2×256 Mbit 比特（64MB）DRAM 657 也是一个独立的芯片。这个打印引擎控制器 760 被提供在独立的 ASIC 中。

可以提供很多类型的网络接口模块 625，并且每一个提供一个网页网络接口 751 和可选地提供一个本地计算机或者网络接口 752。网页网络互联网接口包括 POTS 调制解调器，混合光纤同轴电缆（HFC）调制解调器，ISDN 调制解调器，DSL 调制解调器，卫星收发器，当前的和下一代的蜂窝电话收发器，和无线本地环路（WLL）收发器。本地接口包括 IEEE 1284（并行口），10Base-T 和 100Base-T 以太网口，USB 和 USB 2.0 口，IEEE 1394（火警线），和各种不断涌现的家庭网络接口。如果一个以太网连接可以在一个本地网络上获得，然后，这个本地网络接口可以被用

作网页网络接口。

无线收发器 753 在通常是被无绳电话所使用的非许可 900MHz 频带内进行通信，或者替代的，在非许可 2.4GHz 工业，科学和医药（ISM）频带内进行通信，并且使用跳频和碰撞检测技术来提供无干扰的通信。

这个打印机控制器可选地包括一个红外线数据协会(IrDA)接口来用于接收从设备，例如网页照相机中“喷出”的数据。在一个替代的实施方式中，这个打印机使用 IrDA 接口来与合适配置的网页笔进行短距离通信。

7.2.1 光栅化处理和打印

一旦这个主处理器 750 已经接收到并且证实了该文档的页面布局设计和页面对象，它就在 DSP 757 上运行合适的 RIP 软件。

DSP 757 对每一个页面描述进行光栅化，并且压缩被光栅化的页面图象。主主处理器将每一个被压缩的页面图象保存在存储器中。对多个 DSP 进行负载平衡的最简单方法是让每一个 DSP 对一个独立的页面进行光栅化。这个 DSP 总是很忙，因为一般来说，一个任意数目的被光栅化页面可能被保存在存储器中。只在对短的文档进行光栅化时，这个负载平衡策略会潜在地导致 DSP 的利用率很低。

在这个页面描述中的水印区域被光栅化到一个连续色调分辨率的(contone-resolution)双电平比特图，这个比特图被无损地压缩到可忽略的尺寸并且形成了被压缩图象的一部分。

被打印页面的红外（IR）层包括被编码网页标记，其密度是每英寸大约 6 个标记。每一个标记对这个页面 ID，标记 ID，和控制比特进行编码，而每一个标记的内容在进行光栅化处理期间被产生并且被保存在被压缩页面图象中。

这个主处理器 750 将背对背页面图象传送到这个双向打印引擎控制器 760。每一个打印引擎控制器 760 将被压缩页面图象保存在其本地存储器中，并且开始对这个页面进行解压缩和打印流程处理。页面解压缩和打印是流水线处理的，因为将整个 114MB 双电平 CMYK + IR 页面图象

保存在存储器中是不实际的。

7.2.2 打印引擎控制器

打印引擎控制器 760 的页面解压缩和打印流水线处理包括一个高速的 IEEE1394 串行接口 659，一个标准的 JPEG 解码器 763，一个标准的第 4 类传真解码器 764，一个定制半色调板/排字机单元 765，一个定制标记编码器 766，一个行加载器/格式化器单元 767，和到这个 Memjet™ 打印头 350 的一个定制接口。

这个打印引擎控制器 360 使用一个双缓冲器的方式进行工作。虽然一个页面通过高速串行接口 659 被载入到 DRAM 769 中，前面被载入的页面被从 DRAM 769 中 读取出来的，并且通过打印引擎控制器流水线处理。一旦这个页面已经被打印出来了，刚才被载入的页面就被打印，而另一个页面被载入。

这个流水线处理的第一级解压缩（在 763）JPEG－压缩的连续色调 CMYK 层，解压缩（在 764）第 4 类传真压缩双电平黑色层，并且根据在部分 1.2 中所定义的标记格式来再现（在 766）双电平网页标记层，所有这些是并行处理的。第二级抖动（在 765）连续色调 CMYK 层和在所产生的双电平 CMYK 层合成（在 765）双电平黑色层。所产生的双电平 CMYK + IR 点数据被缓存和进行格式化（ 在 767）以通过一组行缓冲器而在 Memjet™ 打印头 350 上进行打印。这些行缓冲器中的大多数被保存在芯片外的 DRAM 中。最后一级通过打印头接口 768 将 6 个信道的双电平点数据（包括固定剂）打印到 Memjet™ 打印头 350。

当几个打印引擎控制器 760 被协调使用时，例如在一个双向结构中，它们通过一个共享的行同步信号 770 进行同步。仅一个通过外部主/从管脚 771 而选择的打印引擎 760 产生行同步信号 770 到这个共享线上。

打印引擎控制器 760 包括一个低速处理器 772，这个低速处理器 772 用于对页面解压缩和再现流水线处理进行同步，用于通过一个低速串行总线 773 配置这个打印头 350，并且控制步进电机 675，676。

在纸张大小为 81/2"的网页打印机中，这两个打印引擎中的每一个沿

页面的长度方向（11”）每分钟打印 30 张纸，其行速在 1600dpi 下为 8.8kHz。在纸张大小为 12”的网页打印机中，这两个打印引擎中的每一个沿页面的宽度方向（81/2”）每分钟打印 45 张纸，其行速为 10.2KHz。这些行速很好地落在 Memjet™ 打印头的工作频率范围内，在目前 的设计中这超过了 30kHz。

8 在线分类

网页系统提供了一种在线分类应用程序，允许广告商列出分类广告，并允许用户去搜索各分类列表。

8.1 应用程序绘图标注

每一段应用程序的用户接口流都被表示为由命令箭头联系在一起的文档的集合。一个命令箭头表示目标文档作为用户在源页面上按压相应的命令按钮的一个结果而被打印。某些命令箭头用由斜杠（/）隔开的多项命令标记，表示所指定的各项命令中的任何一项都能导致目标文档被打印。虽然多项命令可以用来标记相同的命令箭头，但是它们典型地具有不同的副作用。

从应用的意义上说，重要的是区分网页文档和网页表格。文档含有已打印的信息以及命令按钮，用户可以按压各命令按钮来请求进一步的信息或某些其他操作。表格除了起到普通文档的作用外，还包括可以由用户填入的各输入字段。它们为本系统提供了一种数据输入机制。同样有用的是区分含有一般的信息的文档与含有介于用户和应用程序之间的一种特定的交互作用的专门信息的文档。一般文档可以是事先印好的出版物，例如在报摊上出售的杂志或者出现在公共场所中的广告招贴。表格也可以是事先印好的，例如，包括，出现在事先印好的出版物上的订阅表格。当然，也可以由网页打印机响应于用户请求而立即把它们打印出来。通常由网页打印机响应于用户请求立即生成用特定的文档和表格。图 48 表示一般文档 990，一般表格 991，用户指定文档 992，以及用户指定表格 993。

通过抽象的页面布局来进一步地说明参与用户接口流的各网页。页面布局可以包括各种元素，每一种元素都具有不同于其他元素的独特的样式。如图 49 所示，这当中包括固定信息 994，可变信息 995，输入字段 996，命令按纽 997，以及可拖动的命令 998。

当一个用户接口流被分解为许多张图时，除了在定义它的主图以外，在所有的图中，任何被复制的文档都用虚的轮廓线来表示。

8.2 在线分类对象模型

分类对象模型涉及各类目以及各分类列表。

网页分类由各类目以及各子类目的层次结构来形成。每一个类目 501 都含有一组子类目和/或一组分类列表 504。各分类的类目图示于图 46。

分类提供商 500 具有已注册的客户 505（即，广告商），他们中的每一个都有一个唯一的标识符 65。从相应的网页用户的细节导出客户的名字和描述。每一家广告商 505 在分类提供商 500 那里都有一个帐号 506，其中包括一份流水余额(running balance)。帐目支付 507 直接联系于客户帐号 506。支付类目图示于图 47。

最普通的支付方法示于图 47。由一个特定的提供商所支持的支付方法的集合将是该提供商所特有的，并且对不同的客户来说，根据他们的信用额度等可以有所不同。

当使用网页帐目支付方法 509 时，用户的网页帐号 820 为借方，并且交易出现在用户网页帐号的说明中。

当使用客户帐目支付方法 510 时，向用户开出发票。

当使用 SET 支付方法 512 时，使用与该用户相联系的相应的 SET 付费卡 821，根据正常的 SET 协议进行支付。

当使用付费卡支付方法 511 时，根据介于提供商以及他们的银行或机构（负责处理特定的付费卡类型）之间的正常协议，使用特定的付费卡进行支付。

广告商可以在一个或多个分类类目下定购列表。每一份列表都有一个唯一的列表号码 514、定购列表的日期和时间，在各分类中列表出现的起

止日期，一段简短的描述，详细的列表文本以及列表费用。列表费用被添加到该用户的广告商帐户余额之中。

任何网页用户都可以通过分类列表进行浏览和搜索，而不必在提供商那里进行注册，但是只有已注册的用户才能定购列表。

8.3 在线分类用户界面

用户可以从多种链接中获得网页分类主页，包括:

- 网页目录
- 网页用户自己的书签
- 一份广告

网页分类用户界面流程图示于图 48。

8.3.1 分类主页

如图 50 所示，分类主页 515 显示主要的分类类目。

为了察看在一个类目下的各子类目和列表，用户应点击类目名，这时，表示针对这个类目的各子类目和各列表的页面 516 被打印，如图 51 所示。

用户可以从主页中进行各分类的基本搜索。用户在搜索字段中输入关键字或短语。为了指定一个多字短语，用户应将该短语放进一个括号之中。为了指定在搜索中必须包括的一个字，用户紧靠在该字前面写一个加号（ + ），为了在搜索中排除一个字，用户紧靠在该字前面写一个减号（ – ）。用户可以在字的末端键入一个星号（ * ）来进行通配符搜索。例如，若用户搜索 "small*"，这将跟 "small", "smaller", "smallest" 等相匹配。

用户可以在搜索字段下，通过选中适当的复选框，来指定该次搜索中应返回的匹配的数目。

已经指定所有所需的字或短语之后，用户点击<搜索>按钮。与搜索标准相匹配的分类列表被打印在一个或多个搜索结果页面 518 之上，如图 52 所示。用户通过点击列表描述，来打印特定列表 517 的

细节（未示出）。

用户可以通过点击<注册>按钮，在分类提供商那里进行注册。这时，打印出一份用户注册表格 519（未示出）。当一个用户进行注册之后，就为该用户生成一个帐号，然后该用户被允许在各分类中定购列表。

用户可以通过点击<察看帐目>按钮，来察看他们的帐目的细节。这时，打印出一份帐目明细页面 522（未示出），给出费用和支付的细节，以及该帐号的未清余额。用户可以使用付费卡方法或者 SET 付费卡方法，从这个页面为他们的帐号选择一种支付方法。

用户可以通过点击<定购列表>按钮，向分类提供商定购一份列表，这时打印出一份定购列表步骤 1 表格 520，如图 53 所示。

用户可以通过点击<我的列表>按钮，来察看所有的他们的当前分类列表。这时打印出一份察看/修改列表页面 521（未示出）。用户有能力从这个页面察看列表的全部细节，改变列表的终止日期，或者从分类中撤消该列表。

用户可以通过点击位于主页底部的<空白表格>按钮，来打印一份空白的网页分类主页 515。

8.3.2 察看子类目和列表

当用户从网页分类主页 515 中选择一个类目时，子类目和列表页就被打印出来，如图 51 所示。每一个类目可以含有更多的子类目、分类列表，或两者都有。紧跟在每一个子类目名之后的是出现在括号之中的数字。这就是出现在该子类目下的列表的计数。用户可以通过点击另一个子类目，来继续查找各分类，或者通过点击列表描述，来打印一份特定列表的细节。

用户还可以从这个页面进行基本的文本搜索。用户通过在表格上选中适当的复选框，来指定搜索所有的类目，或者仅搜索当前类目。用户在“查找”字段中写入查询表达式并点击<搜索>按钮。这时，与搜索标准相匹配的各分类列表就被打印在一份或多份搜索结果页

面 518 上，如图 52 所示。

用户可以通过点击列表描述，来打印一份特定列表的细节。

在同一时间内，只能打印两页结果。若有更多的结果，用户可以点击<下一个>按钮，以便打印下面两页结果。

8.3.3 定购一份列表

用户通过首先从分类主页上点击<定购一份列表>，就能定购一份列表。若该用户已经在分类提供商那里注册，则打印一份定购列表一步骤 1 表格 520。若该用户尚未在分类提供商那里注册，则打印一份用户注册表格 519（未示出）。

用户将分类列表的起止日期、列表的简要描述，以及列表的细节输入到表格字段之中。用户可选地在列表中包括一幅图画或图形。用户点击<继续>，以便进入下一个步骤。这时，打印一份定购列表一步骤 2 表格 523，如图 54 所示。

定购列表功能是一种多页面事务。为了帮助用户跟踪与单独的列表搜索事务相关的各页面，在定购列表页面的顶部打印出事务号码以及当前日期和时间。用户可以在页面底部点击<重置表格>，使当前表格失效，并打印一份新表格，作为当前事务的一部分。

在定购列表一步骤 2 表格 523 中，用户选择列表将出现在其下的一个或多个类目。一旦完成之后，用户点击<继续>按钮，以便进入下一个步骤。这时，打印一份定购列表一步骤 3 表格 524，如图 55 所示。

定购列表一步骤 3 表格 524 表示已选择的各类目、列表的起止日期、列表的简要的和详细的描述，以及列表的费用。若列表的各项细节均为正确，则用户应在表格上签名，并点击<确认与计费>按钮以完成该列表。通过网页记录对签名进行验证。

这时，打印出一个列表确认页面 525，如图 56 所示，表示列表的详尽的细节，以及该用户帐号的新的余额。

定购列表的用户界面流程图示于图 49。

结束语

已经参考一个优选实施方式和一些专用的替代实施方式描述了本发明。但是，该相关领域内的技术人员将理解，一些与这些具体描述的实施方式不同的其它实施方式也可以在本发明的精神和范围内。所以，应理解，本发明不局限于在本说明中所描述的具体实施方式，包括用作参考的合适文档。本发明的范围仅局限于后附的权利要求书。

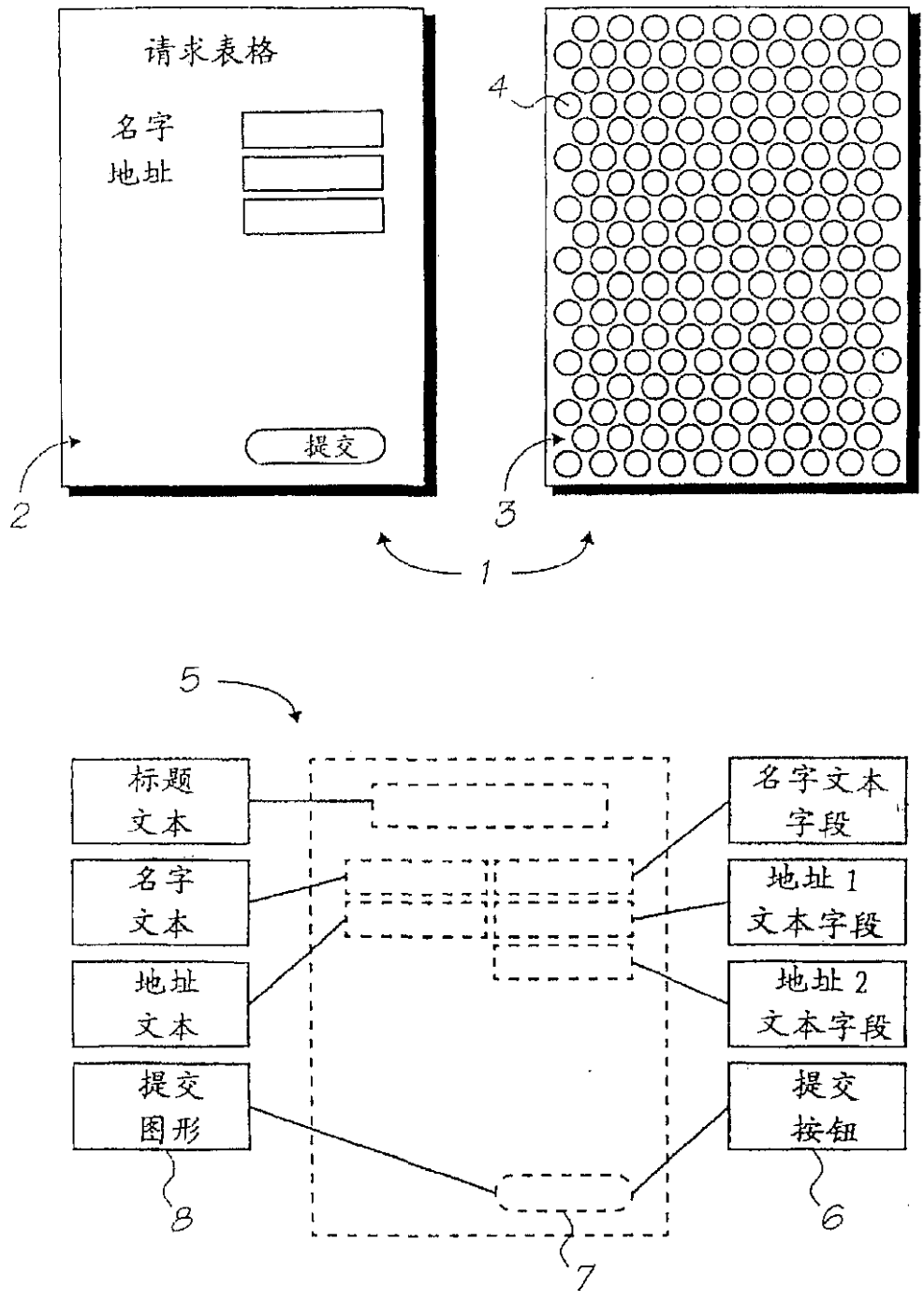

请求表格
名字
地址
提交
2
4
3
1
5
标题
文本
名字
文本
地址
文本
提交
图形
8
名字文本
字段
地址 1
文本字段
地址 2
文本字段
提交
按钮
6
7

图 1

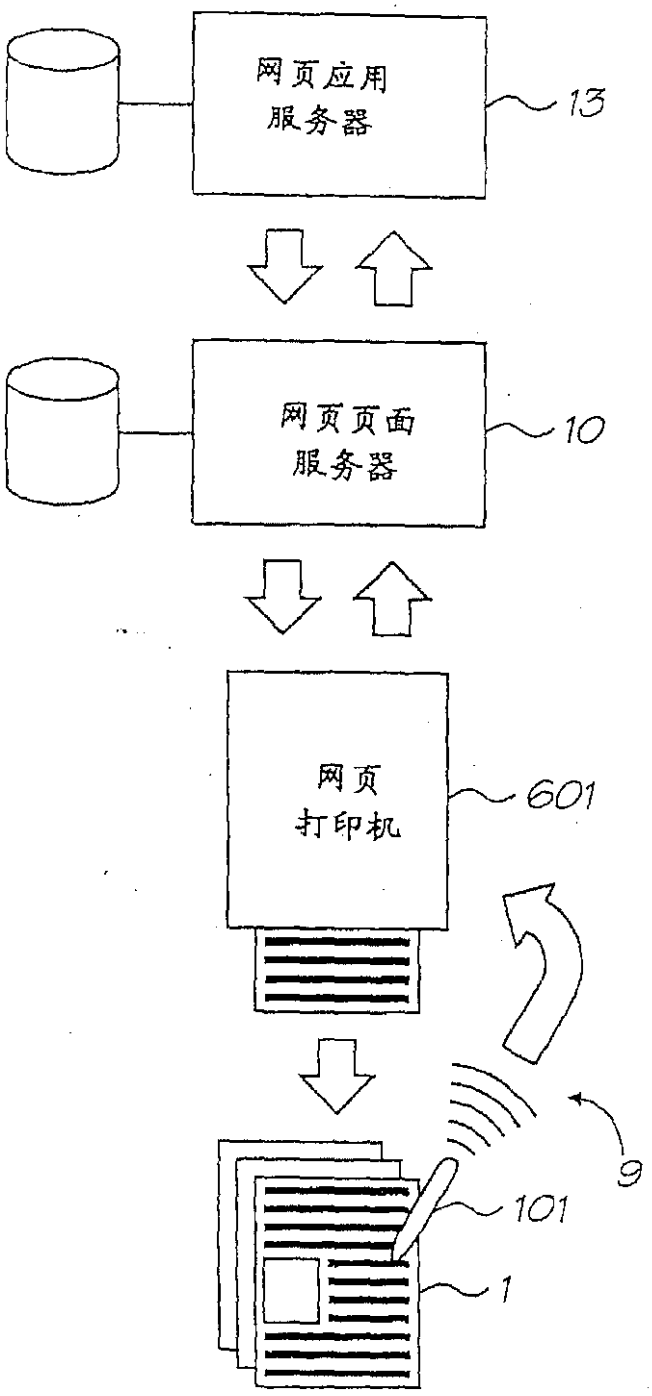


图 2

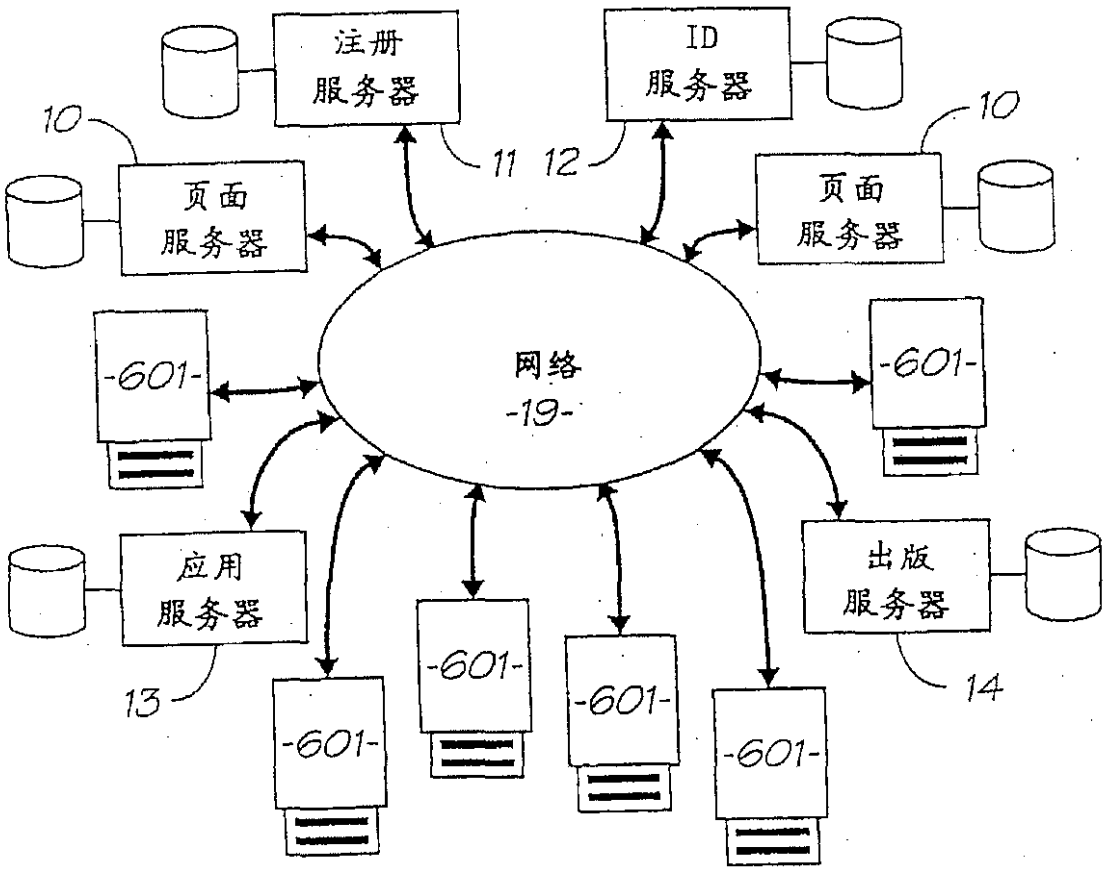

注册
服务器
ID
服务器
10
11
12
10
页面
服务器
页面
服务器
-601-
网络
-19-
-601-
应用
服务器
出版
服务器
13
14
-601-
-601-
-601-
-601-

图 3

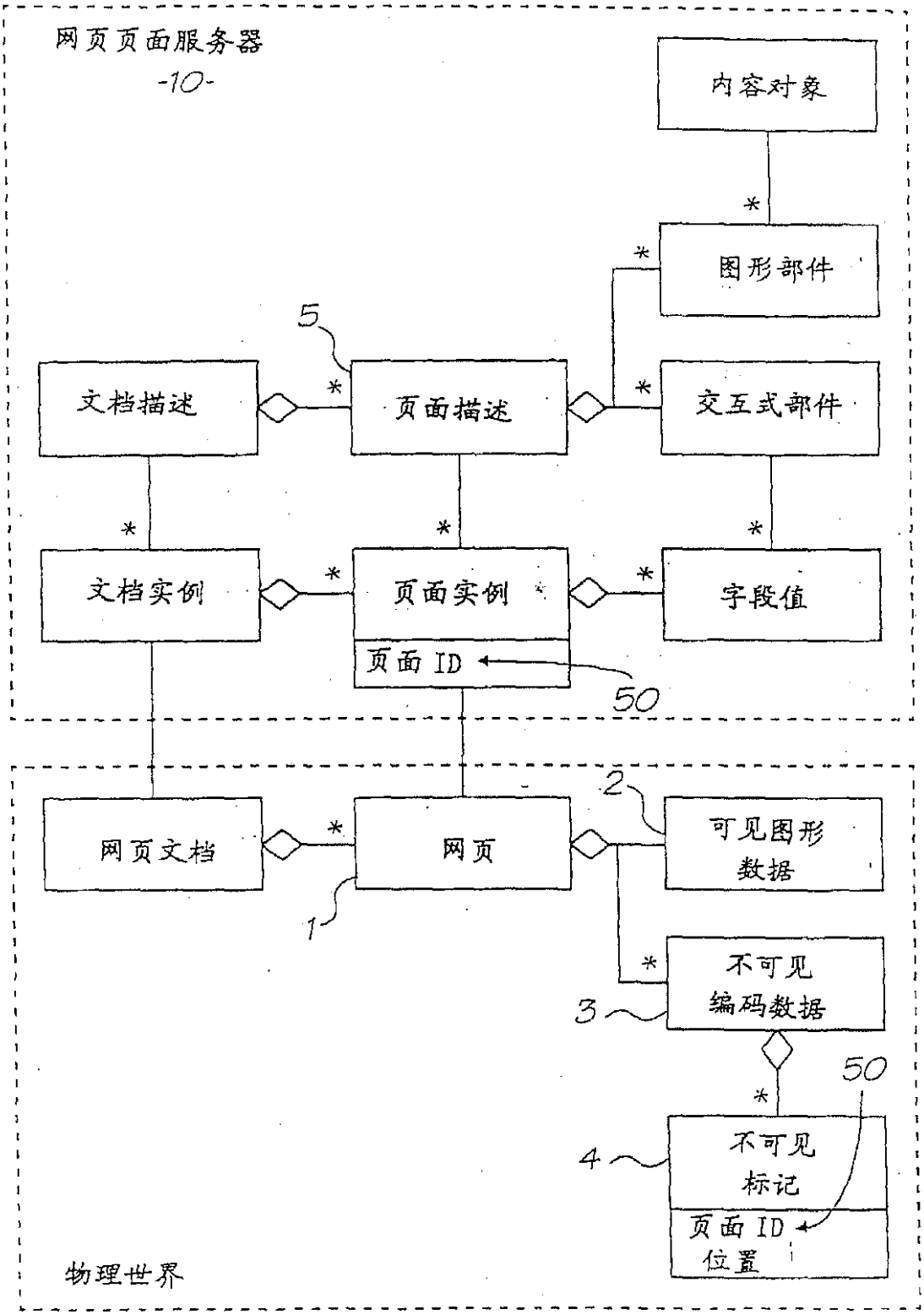

网页页面服务器
-10-
内容对象
图形部件
5
文档描述
页面描述
交互式部件
文档实例
页面实例
字段值
页面 ID
50
网页文档
网页
2
可见图形数据
1
不可见编码数据
3
50
不可见标记
4
页面 ID
位置
物理世界

图 4

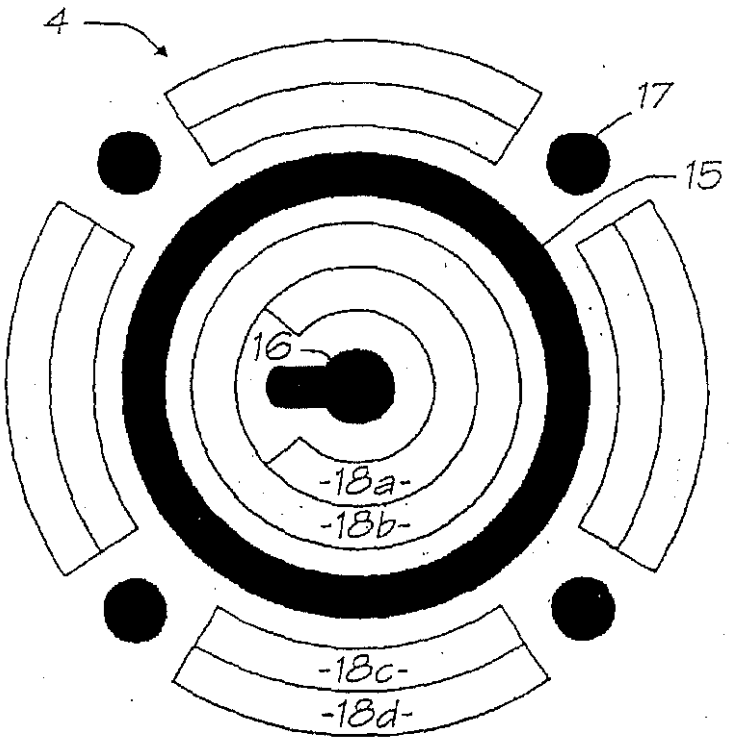


图 5

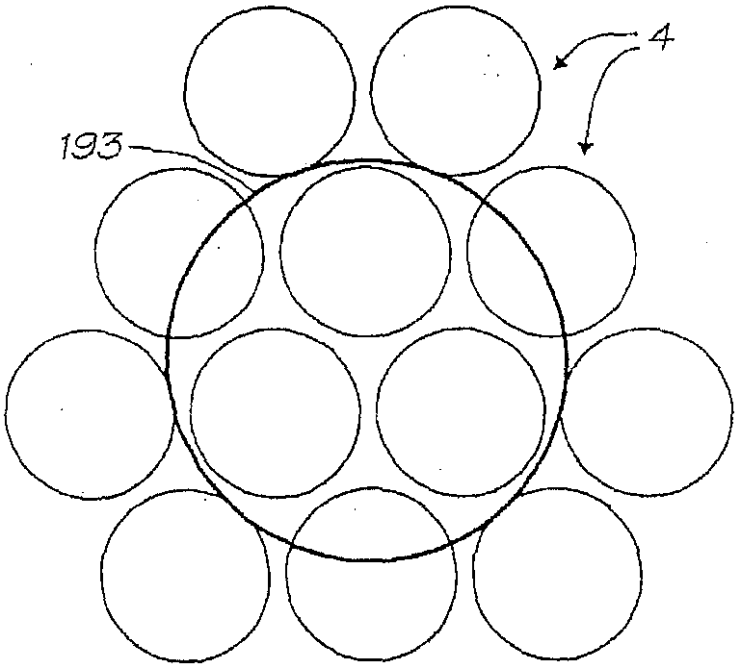


图 6

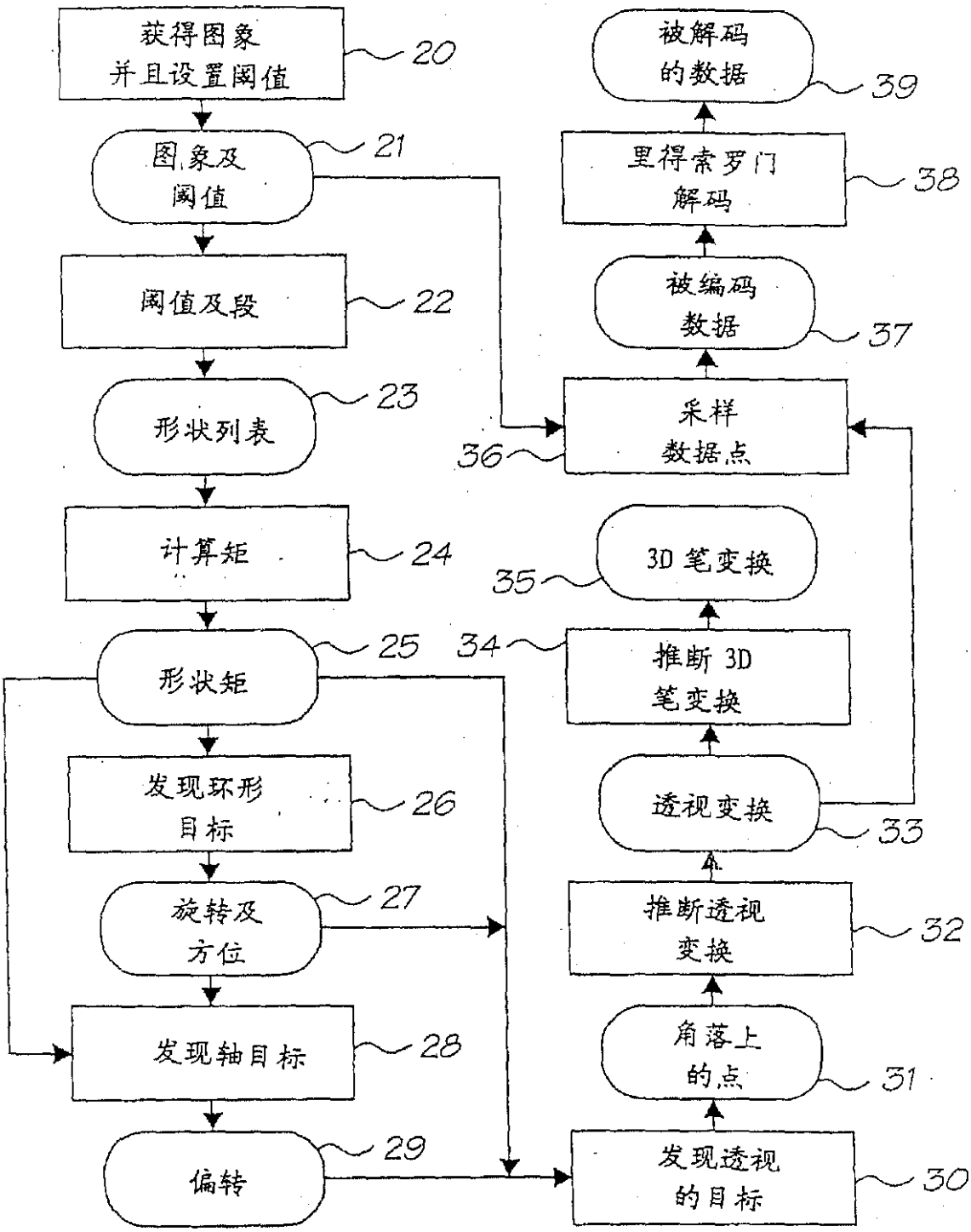

获得图象
并且设置阈值
20
图象及
阈值
21
阈值及段
22
形状列表
23
计算矩
24
形状矩
25
发现环形
目标
26
旋转及
方位
27
发现轴目标
28
偏转
29
被解码
的数据
39
里得索罗门
解码
38
被编码
数据
37
采样
数据点
36
3D 笔变换
35
推断 3D
笔变换
34
透视变换
33
推断透视
变换
32
角落上
的点
31
发现透视
的目标
30

图 7

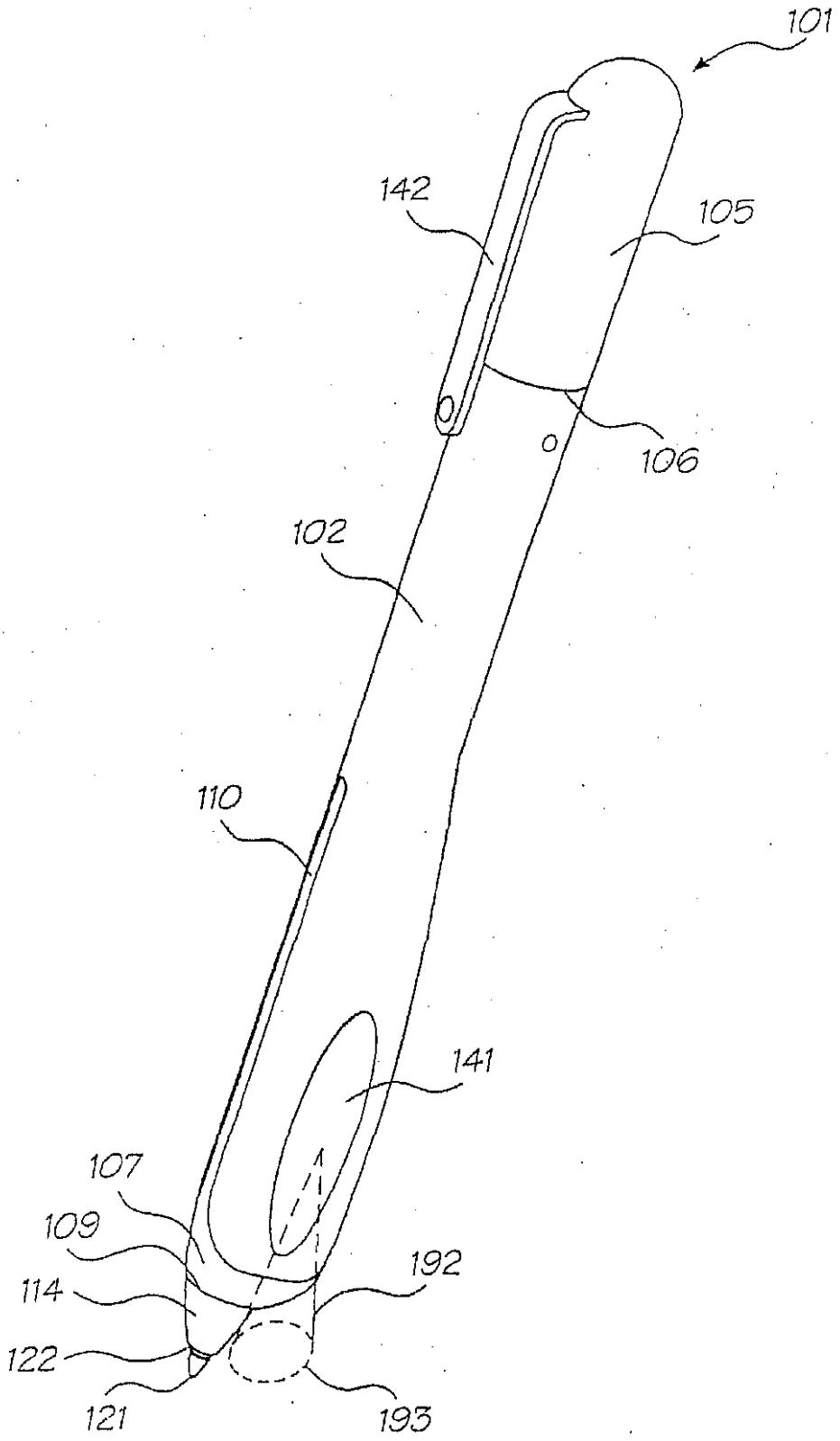


图 8

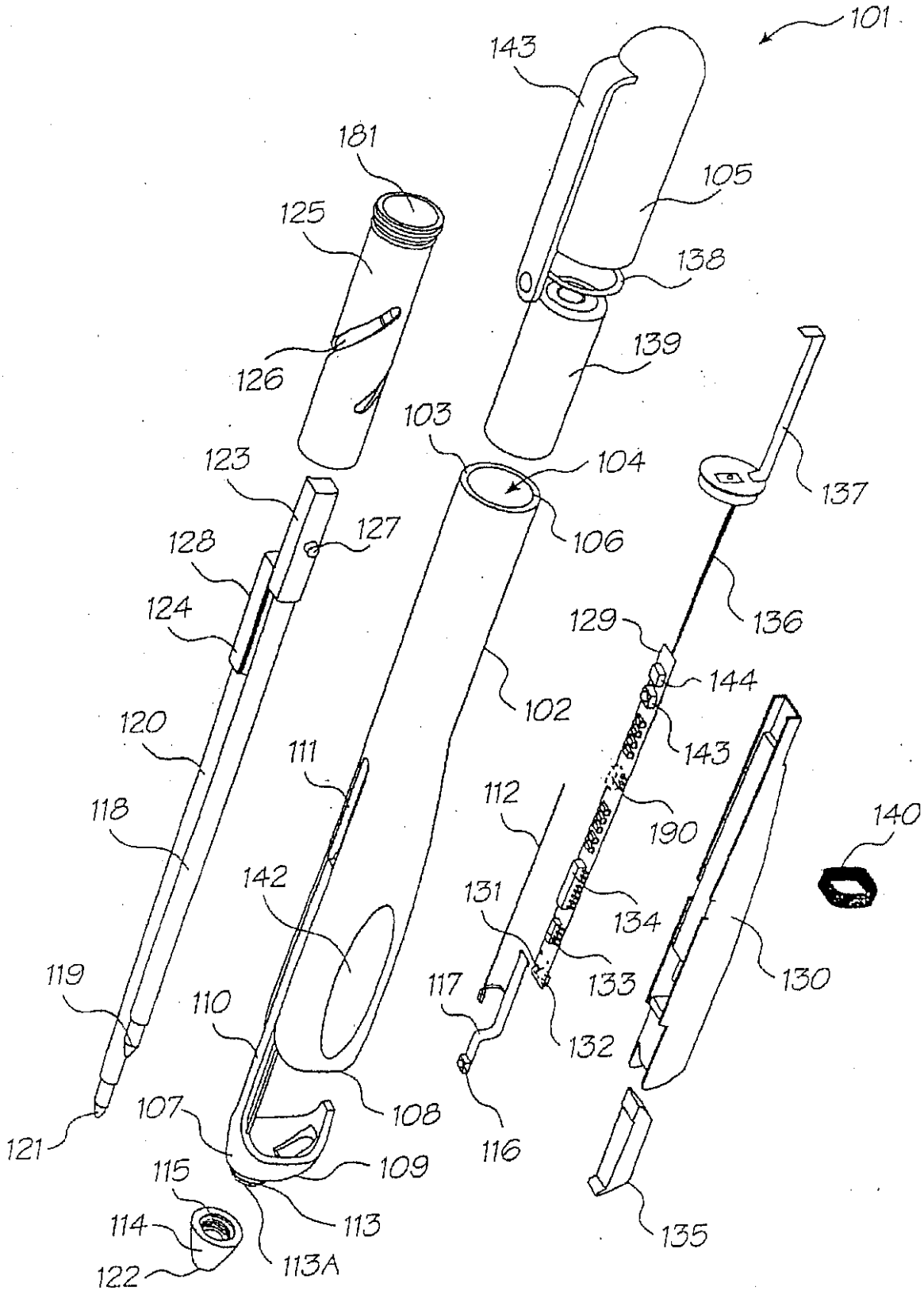

101
143
181
105
125
138
126
139
103
104
123
137
106
127
128
136
124
129
144
102
120
143
111
112
140
118
190
142
131
134
119
133
130
117
110
132
107
108
116
121
109
115
135
114
113
122
113A

图 9

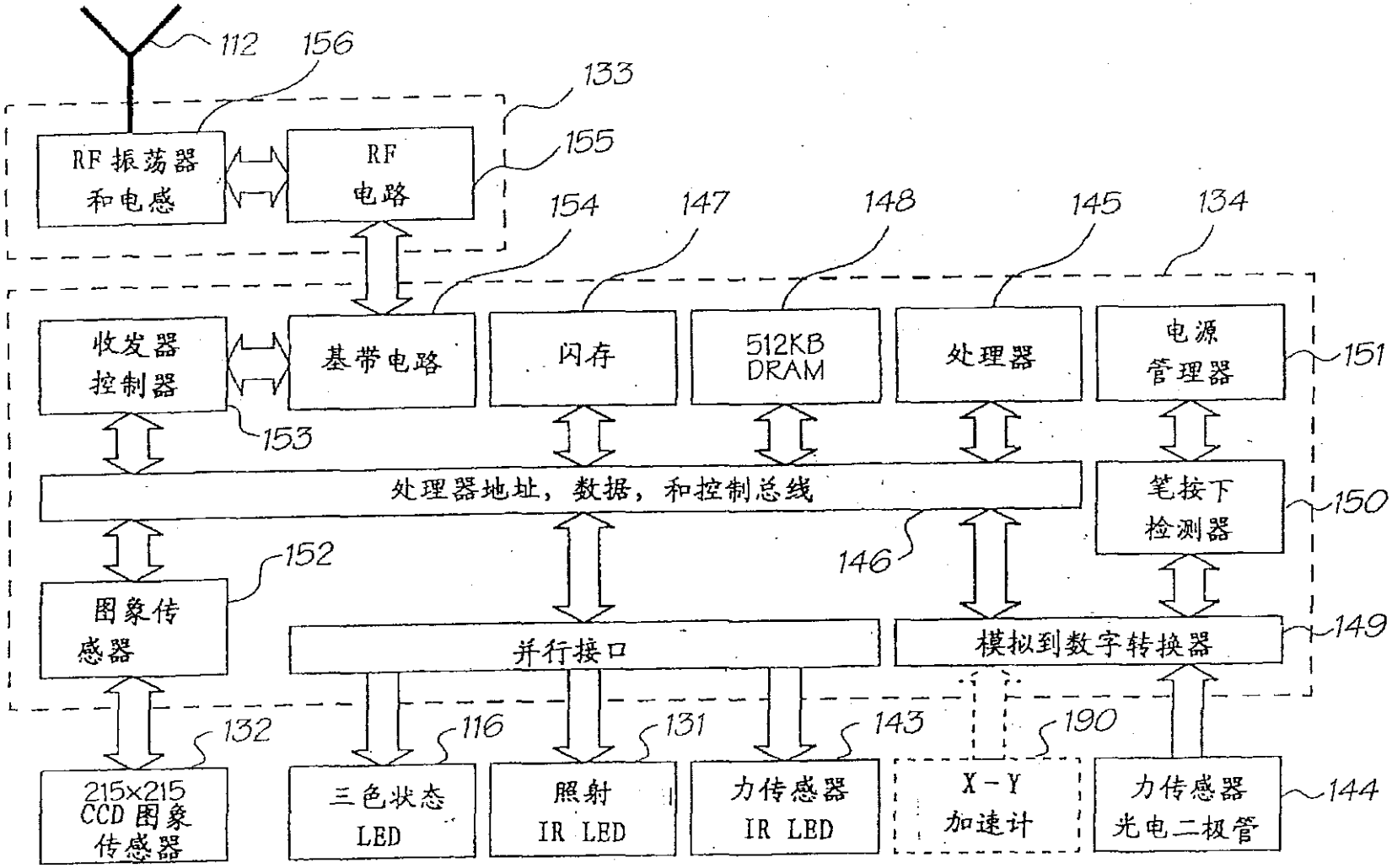

112
156
133
RF 振荡器
和电感
RF
电路
155
154
147
148
145
134
收发器
控制器
基带电路
闪存
512KB
DRAM
处理器
电源
管理器
151
153
处理器地址，数据，和控制总线
笔按下
检测器
150
146
152
图象传
感器
并行接口
模拟到数字转换器
149
132
116
131
143
190
215×215
CCD 图象
传感器
三色状态
LED
照射
IR LED
力传感器
IR LED
X－Y
加速计
力传感器
光电二极管
144

图 10

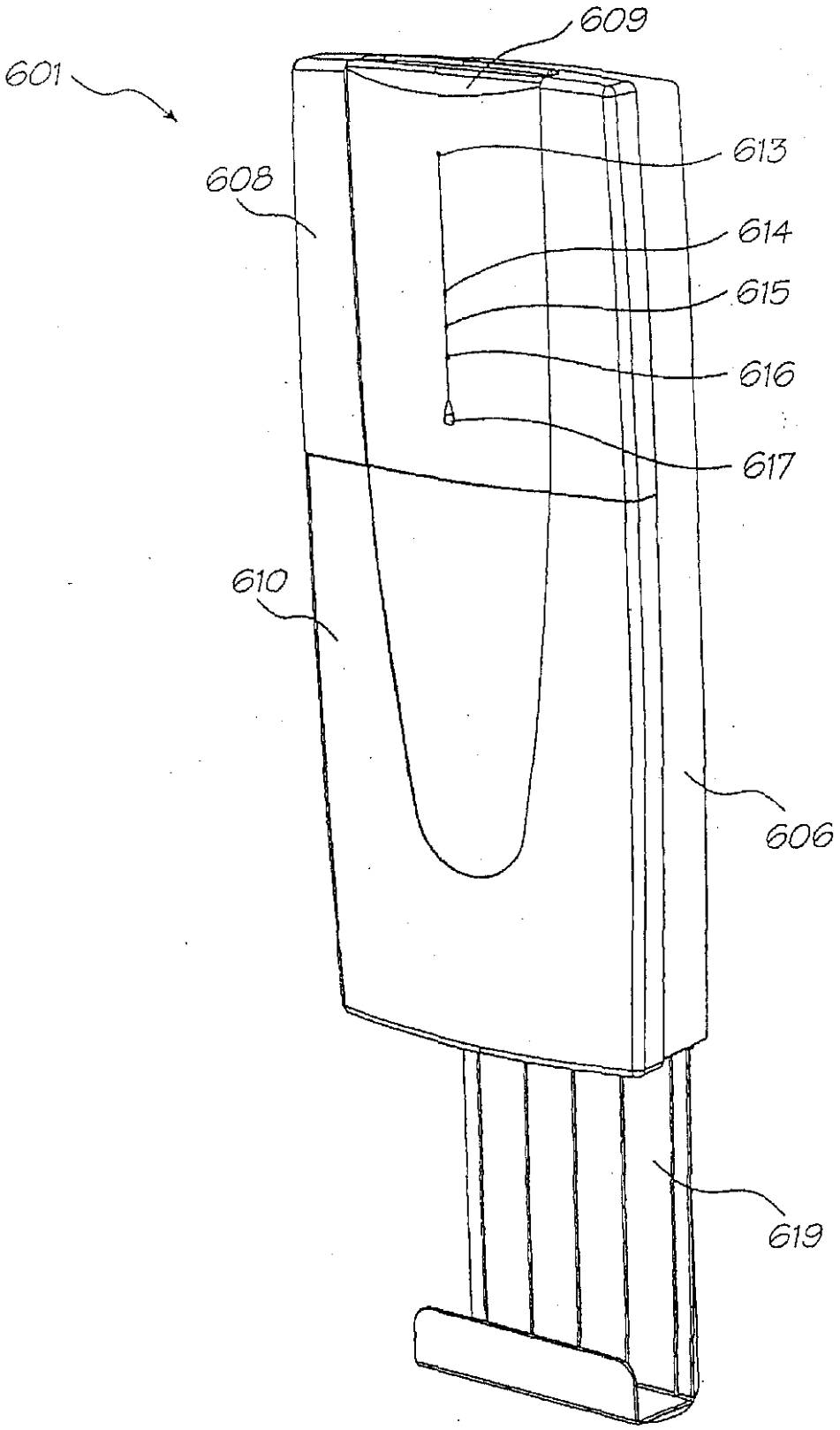


图 11

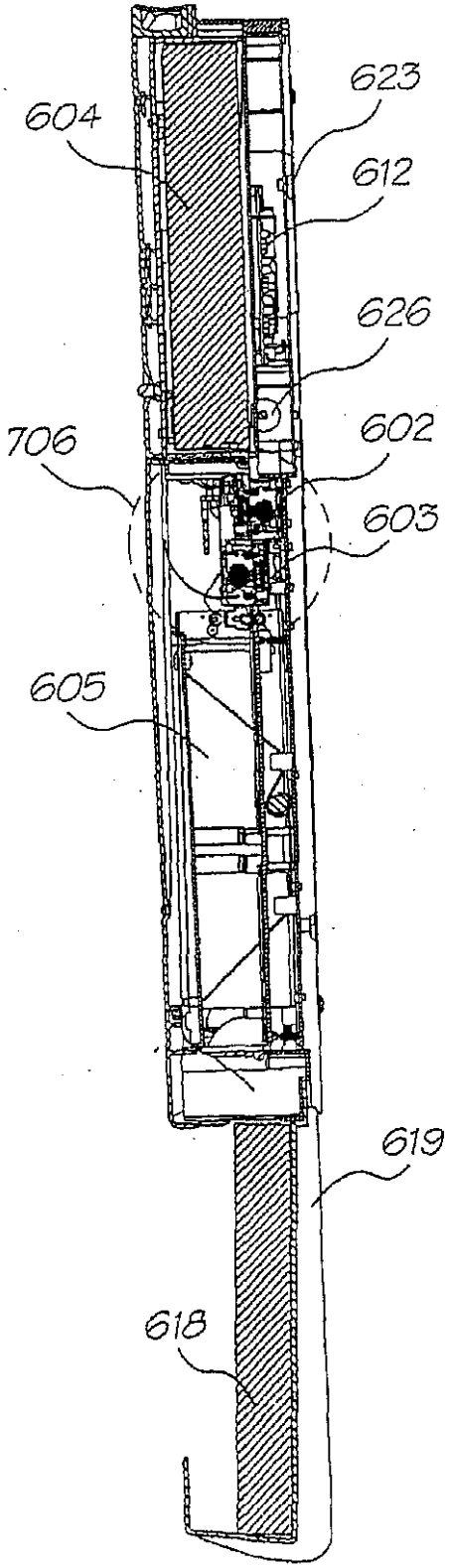


图 12

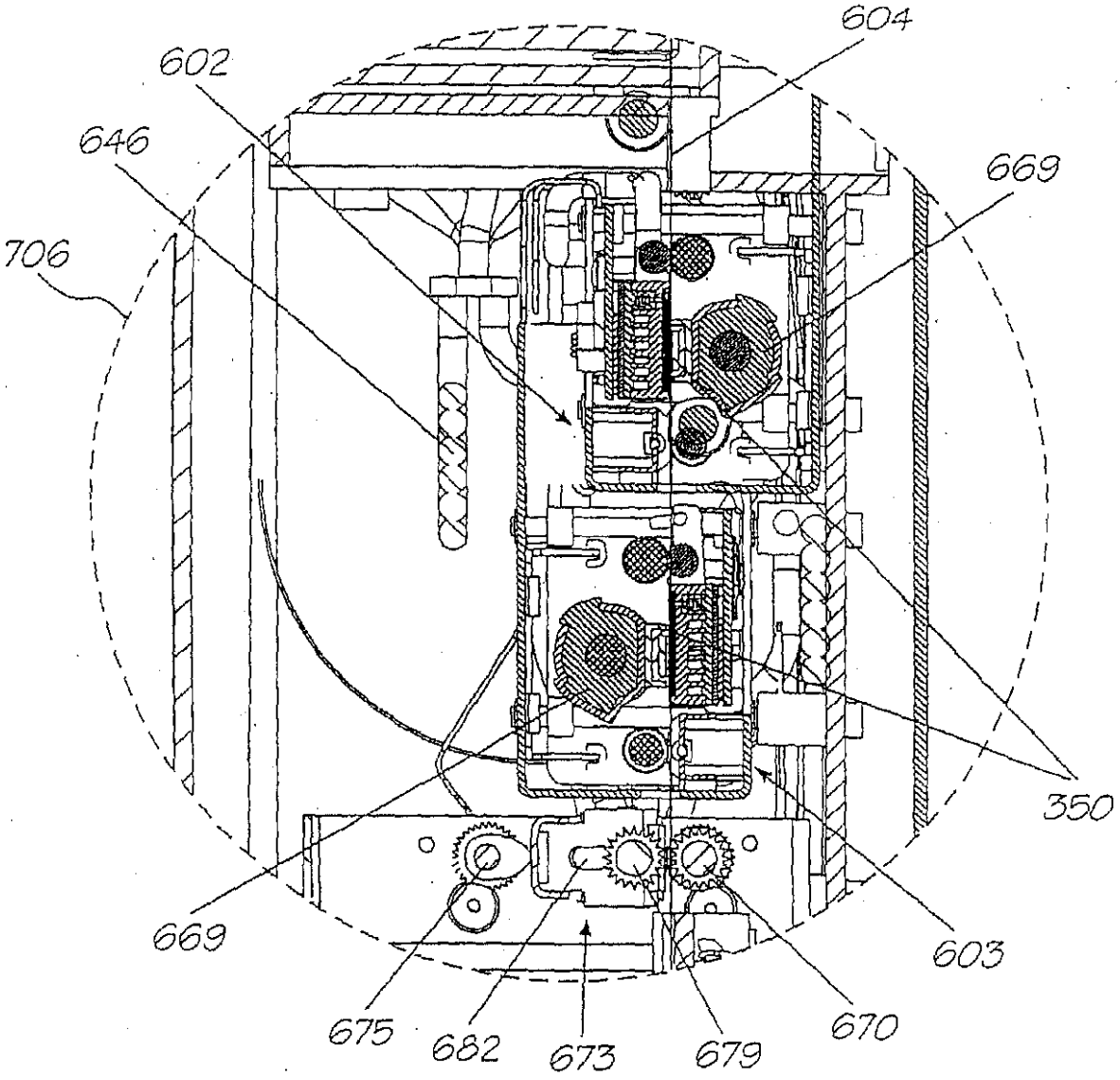


图 12 a

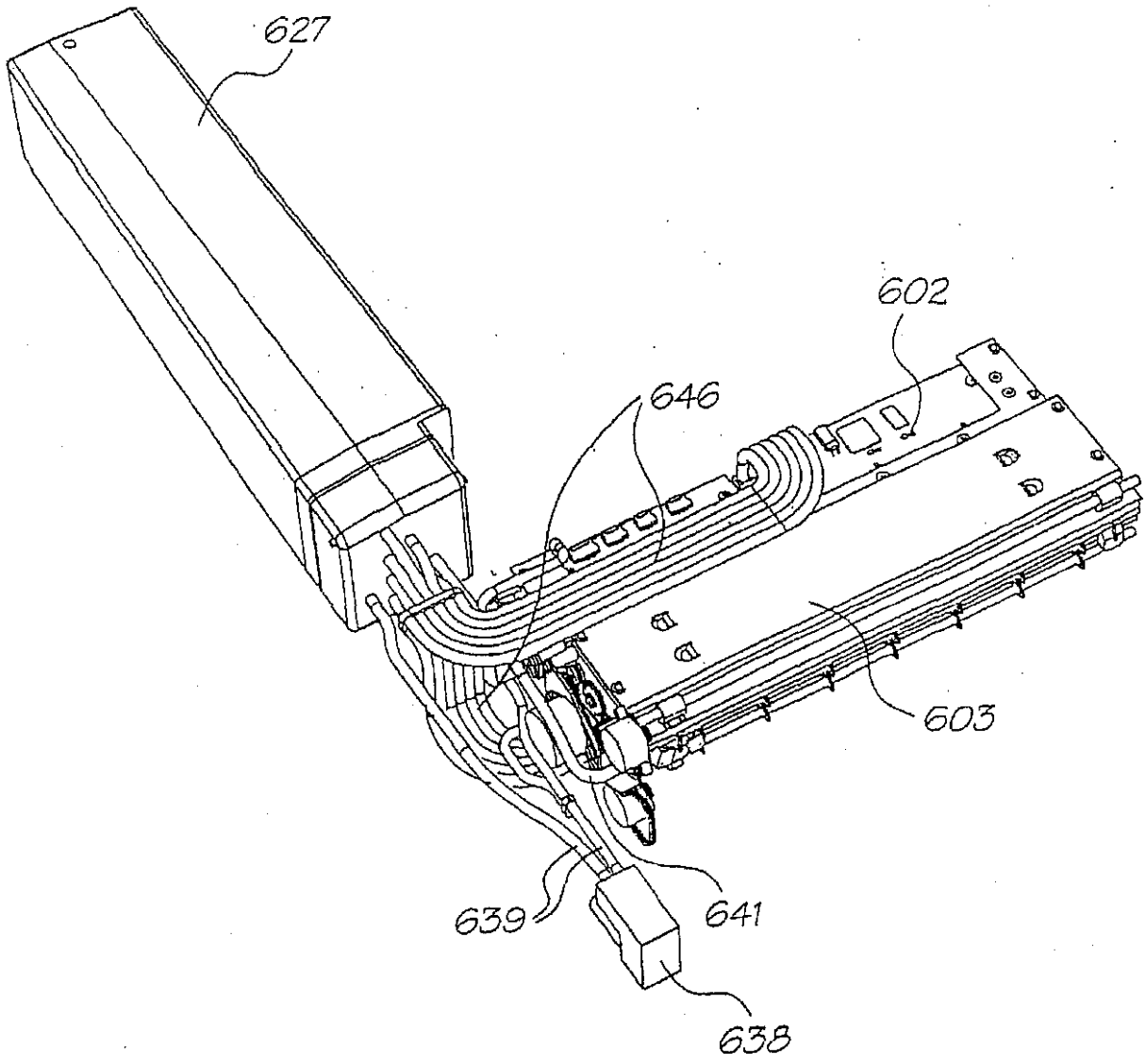


图 13

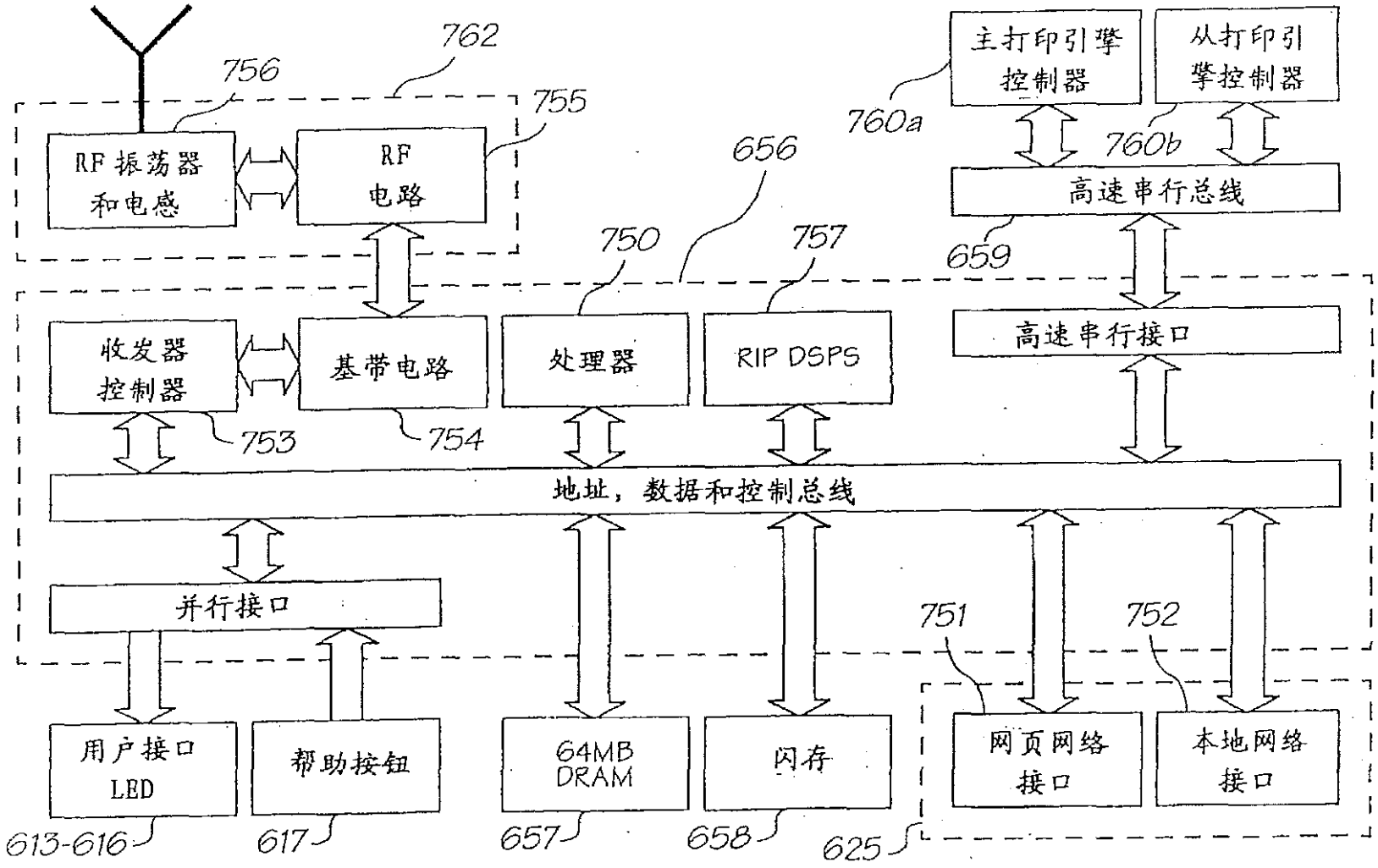

762
756
755
RF 振荡器和电感
RF 电路
760a
主打印引擎控制器
从打印引擎控制器
760b
656
高速串行总线
659
750
757
收发器控制器
基带电路
处理器
RIP DSPS
高速串行接口
753
754
地址，数据和控制总线
并行接口
751
752
用户接口 LED
帮助按钮
64MB DRAM
闪存
网页网络接口
本地网络接口
613-616
617
657
658
625

图 14

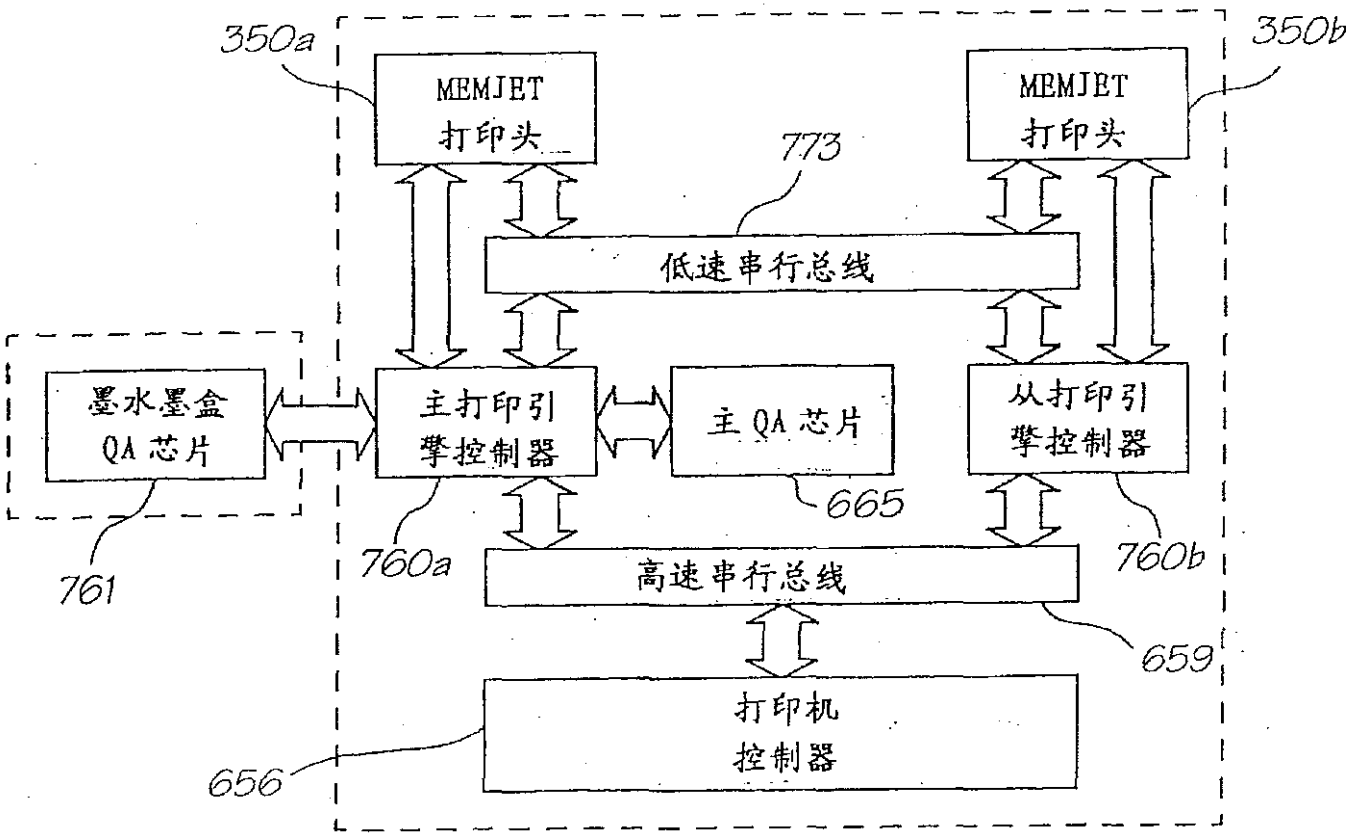

350a
MEMJET
打印头
350b
MEMJET
打印头
773
低速串行总线
墨水墨盒
QA 芯片
主打印引
擎控制器
主 QA 芯片
从打印引
擎控制器
761
760a
665
760b
高速串行总线
659
打印机
控制器
656

图 15

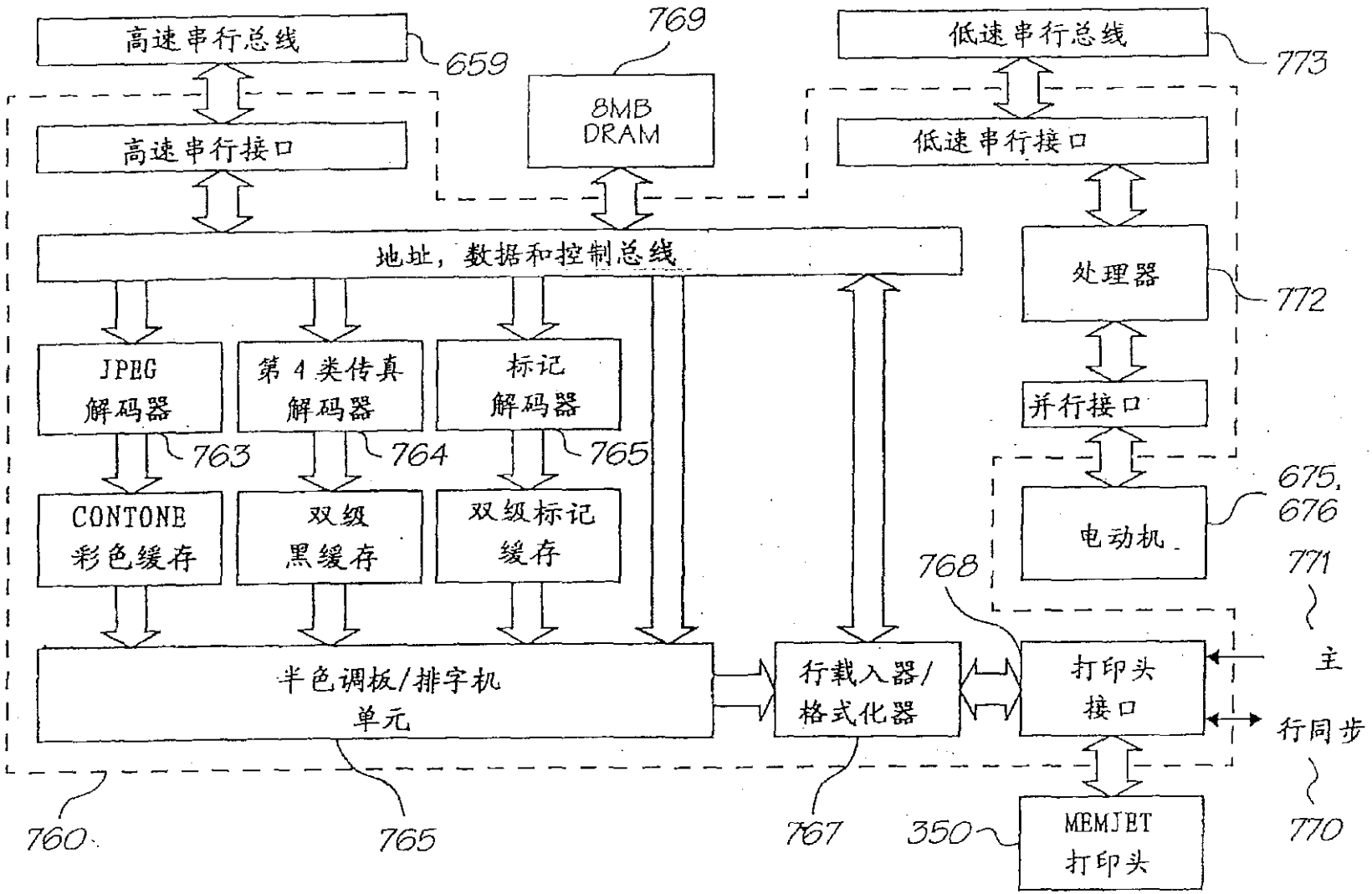

高速串行总线
659
769
8MB DRAM
低速串行总线
773
高速串行接口
低速串行接口
地址，数据和控制总线
处理器
772
JPEG 解码器
763
第 4 类传真 解码器
764
标记 解码器
765
并行接口
675, 676
电动机
CONTONE 彩色缓存
双级 黑缓存
双级标记 缓存
768
771
主
半色调板/排字机 单元
行载入器/ 格式化器
打印头 接口
行同步
760
765
767
350
770
MEMJET 打印头

图 16

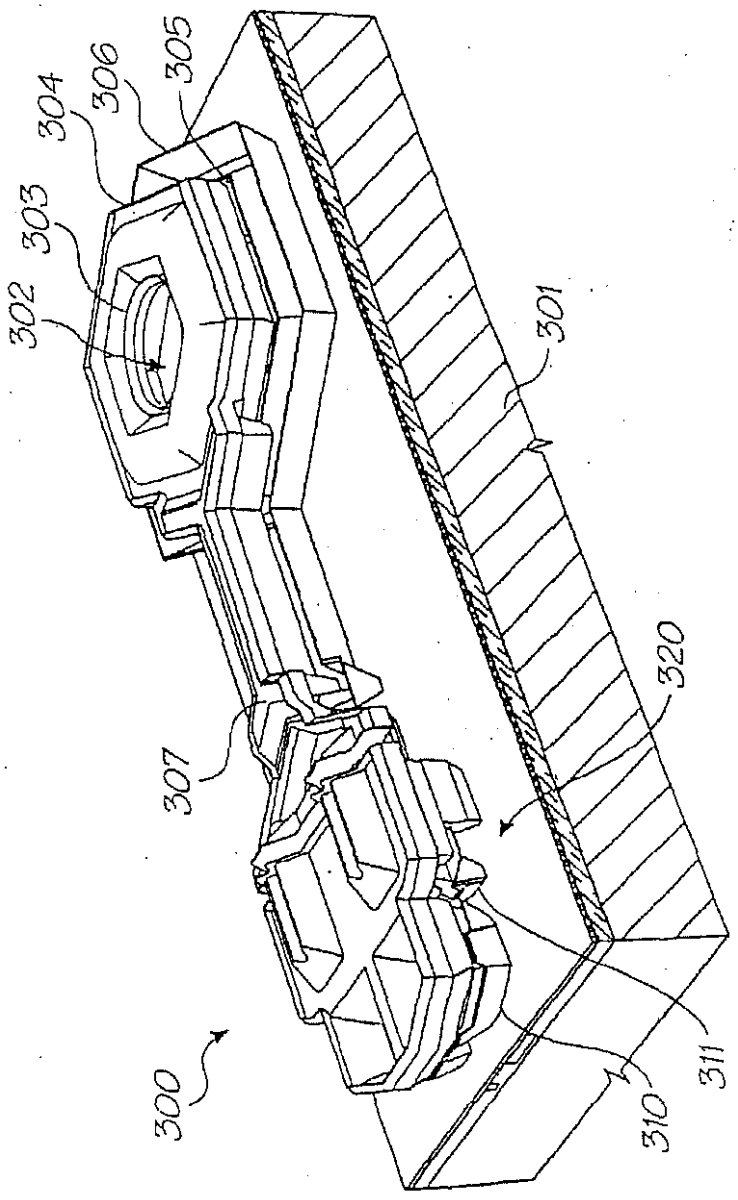


图 17

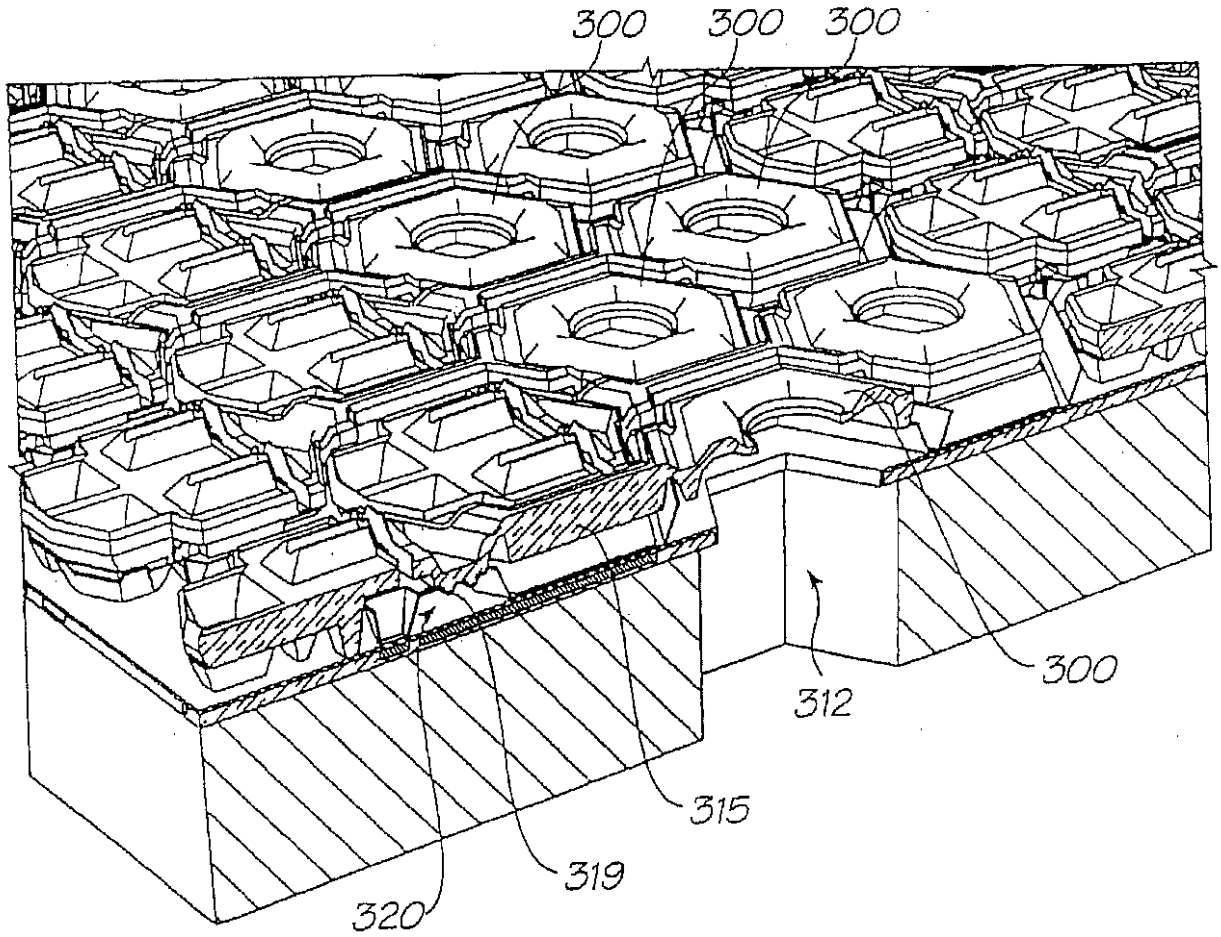


图 18

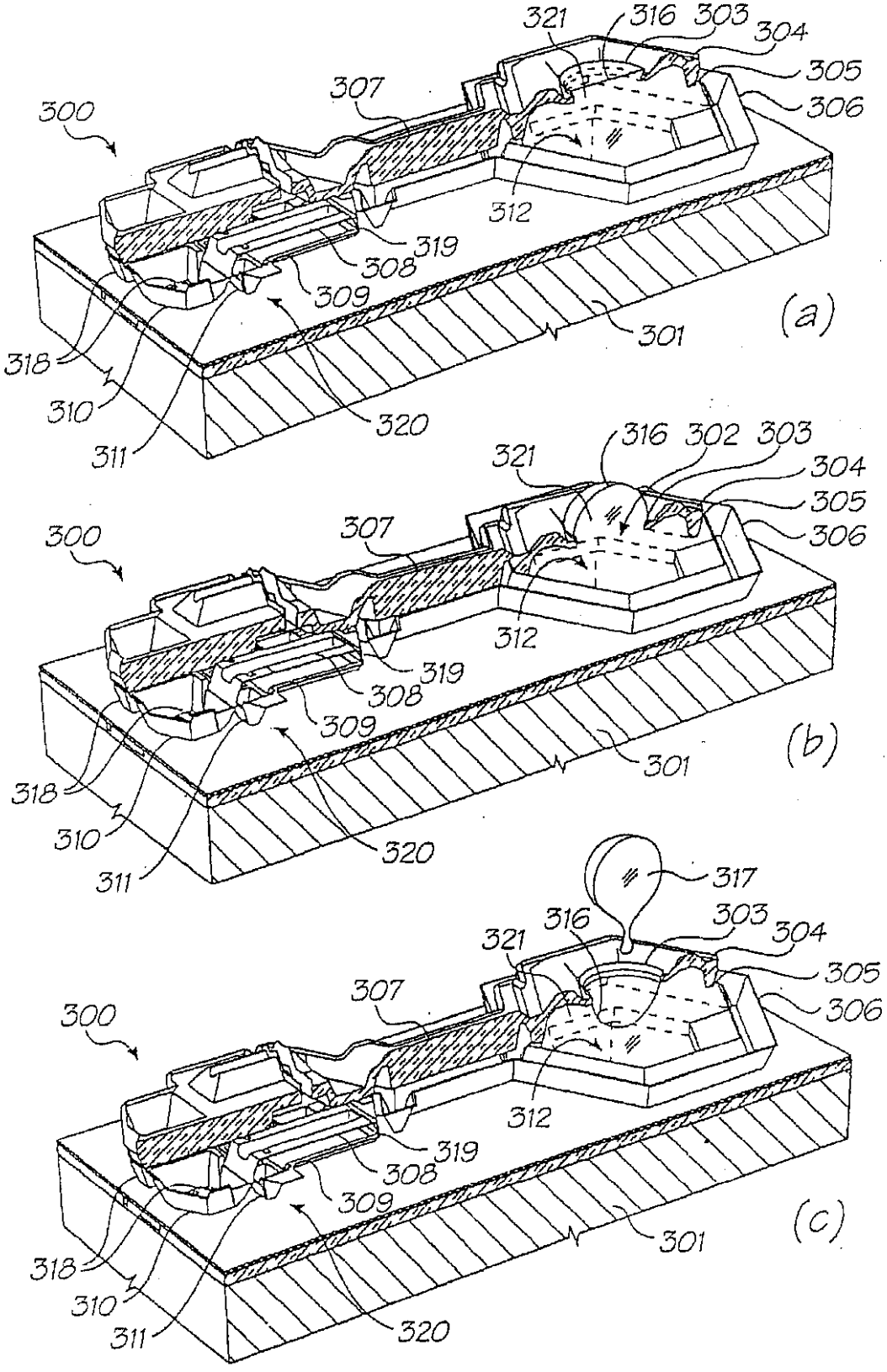

321
316
303
304
305
306
307
300
312
319
308
309
318
310
311
320
301
(a)
316
302
303
321
304
305
306
307
300
312
319
308
309
318
310
311
320
301
(b)
317
316
321
303
304
305
306
307
300
312
319
308
309
318
310
311
320
301
(c)

图 19

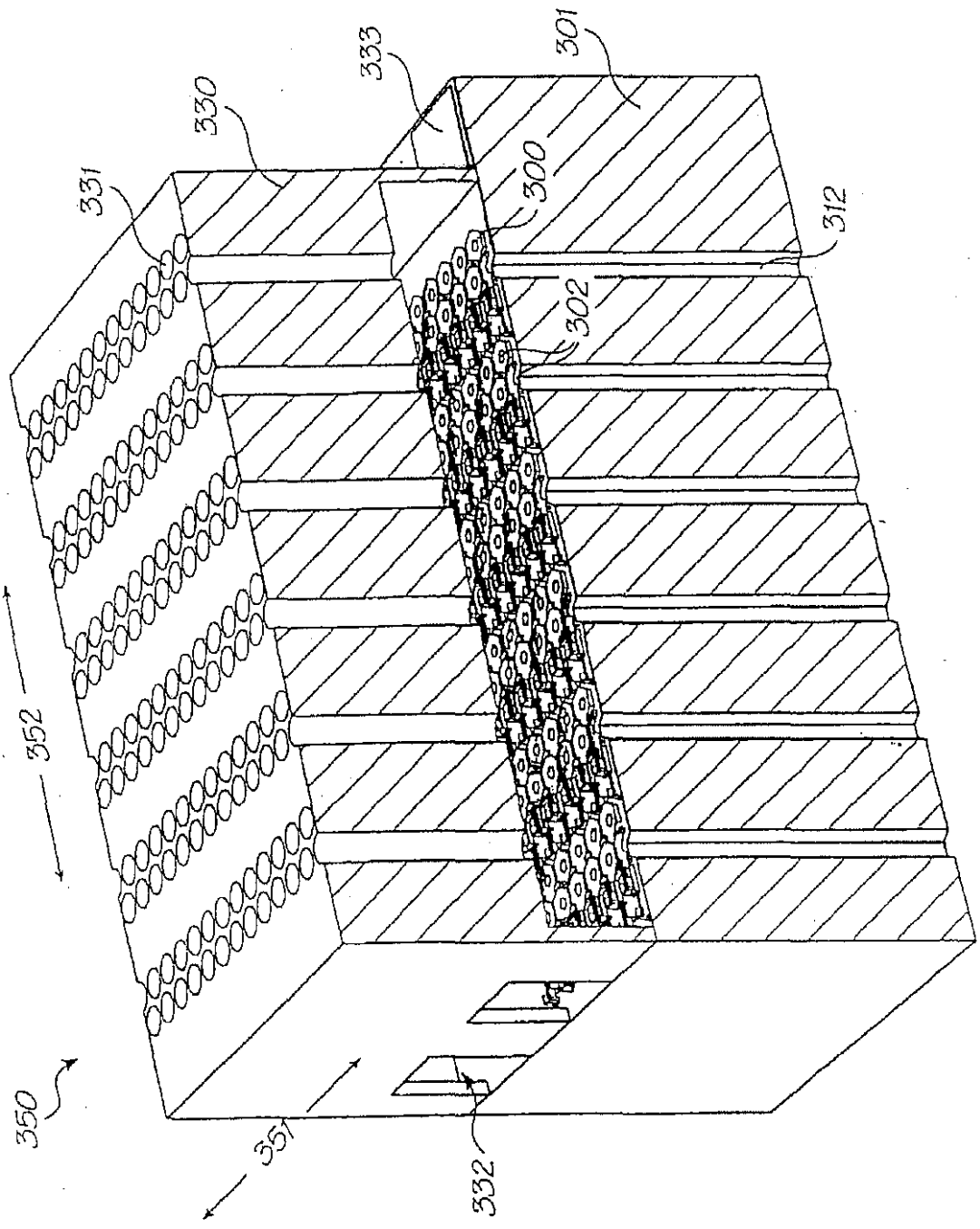


图 20

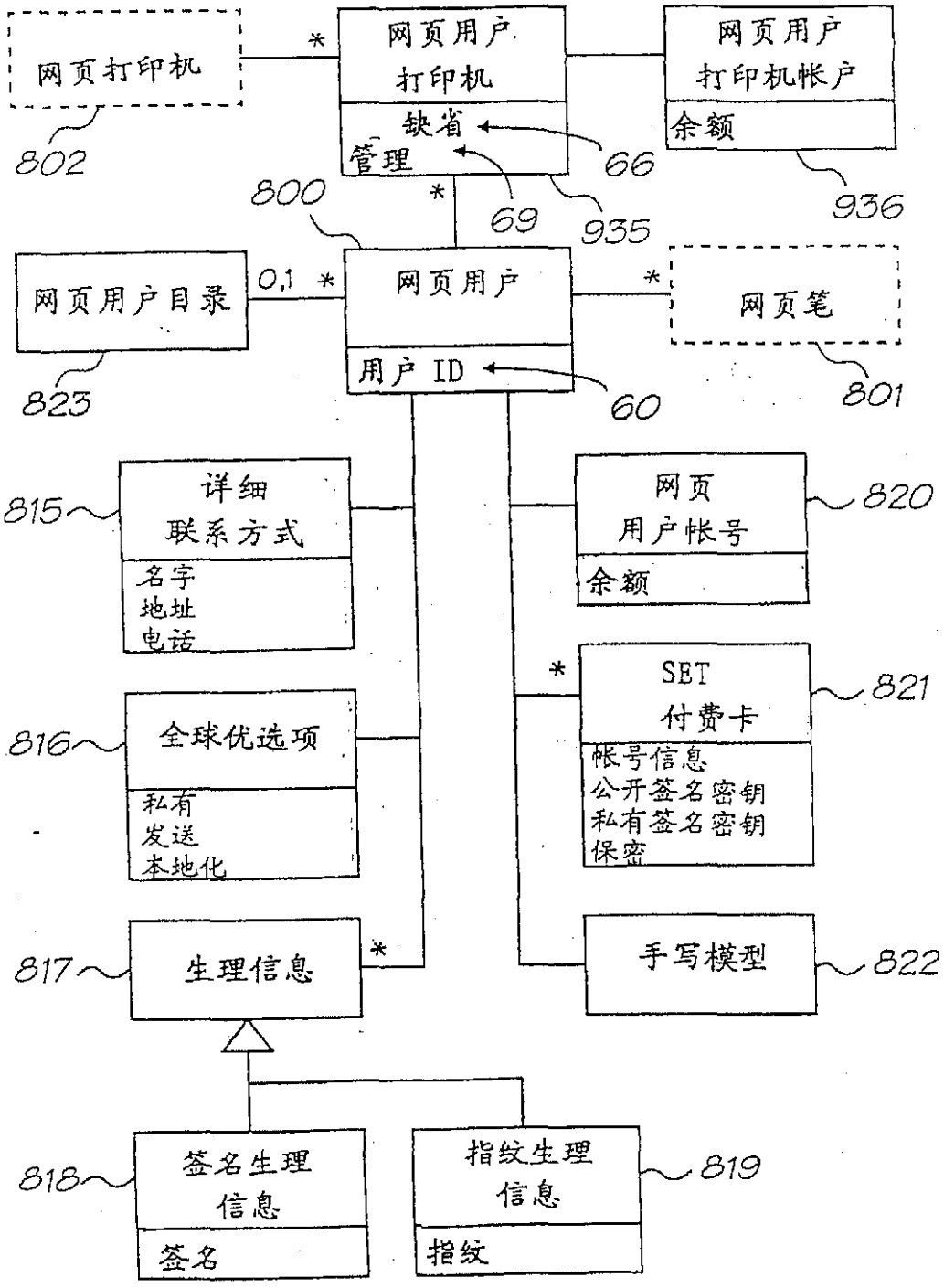

网页打印机
802
*
网页用户
打印机
缺省
管理
66
69
网页用户
打印机帐户
余额
936
935
800
*
网页用户目录
823
0,1 *
网页用户
用户 ID
60
*
网页笔
801
详细
联系方式
名字
地址
电话
815
网页
用户帐号
余额
820
*
SET
付费卡
帐号信息
公开签名密钥
私有签名密钥
保密
821
全球优选项
私有
发送
本地化
816
生理信息
*
817
手写模型
822
签名生理
信息
签名
818
指纹生理
信息
指纹
819

图 21

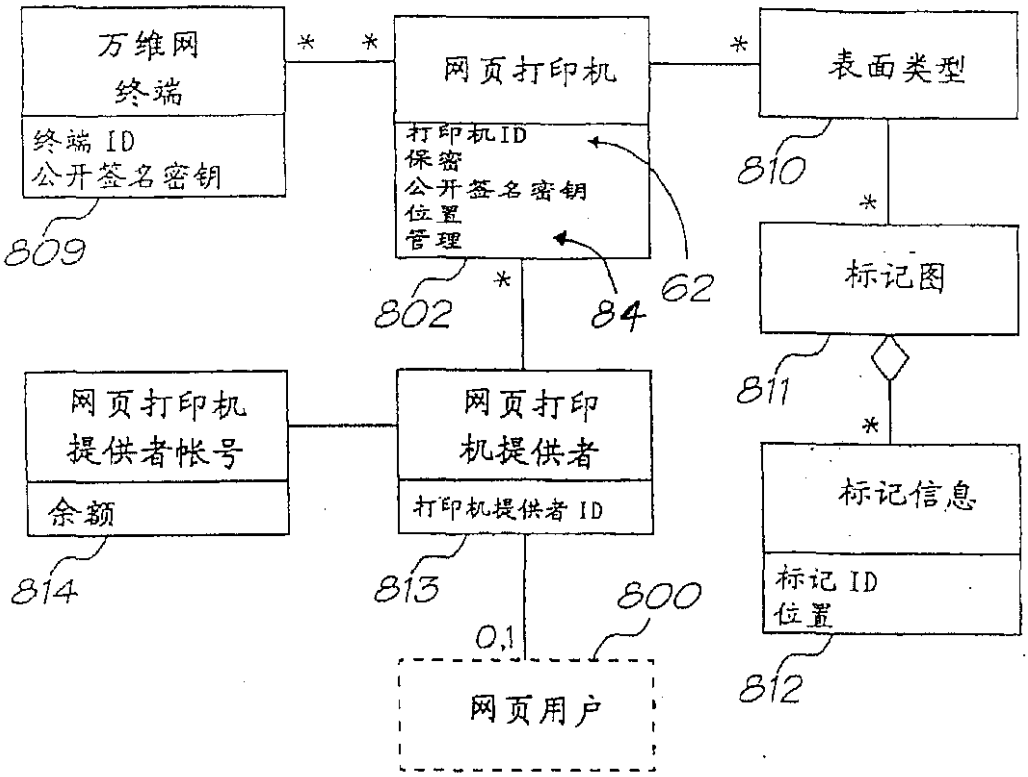

万维网
终端
终端 ID
公开签名密钥
809
网页打印机
打印机ID
保密
公开签名密钥
位置
管理
802
84
62
表面类型
810
标记图
811
标记信息
标记 ID
位置
812
网页打印机
提供者帐号
余额
814
网页打印
机提供者
打印机提供者 ID
813
0,1
800
网页用户

图 22

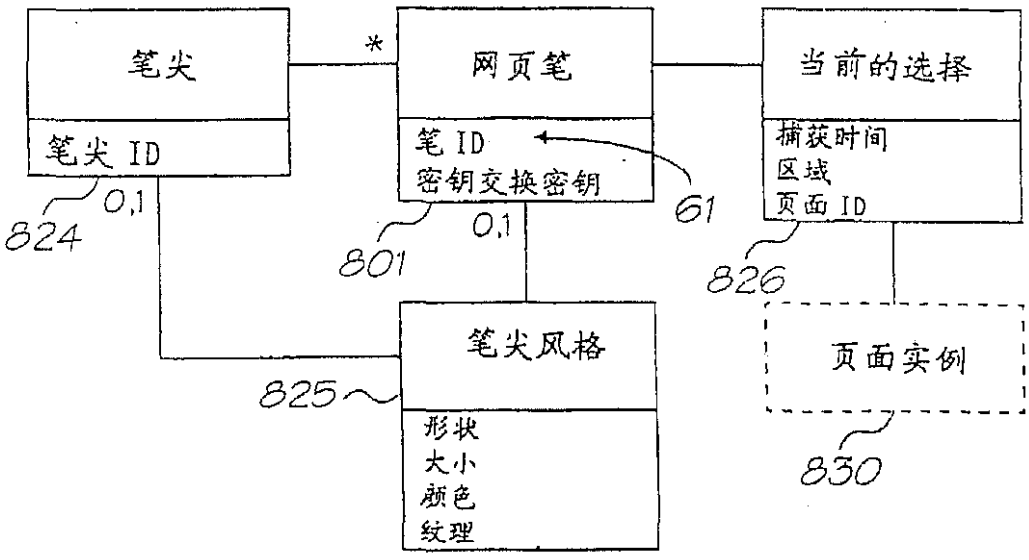

笔尖
笔尖 ID
0,1
824
网页笔
笔 ID
密钥交换密钥
61
0,1
801
当前的选择
捕获时间
区域
页面 ID
826
笔尖风格
825
形状
大小
颜色
纹理
页面实例
830

图 23

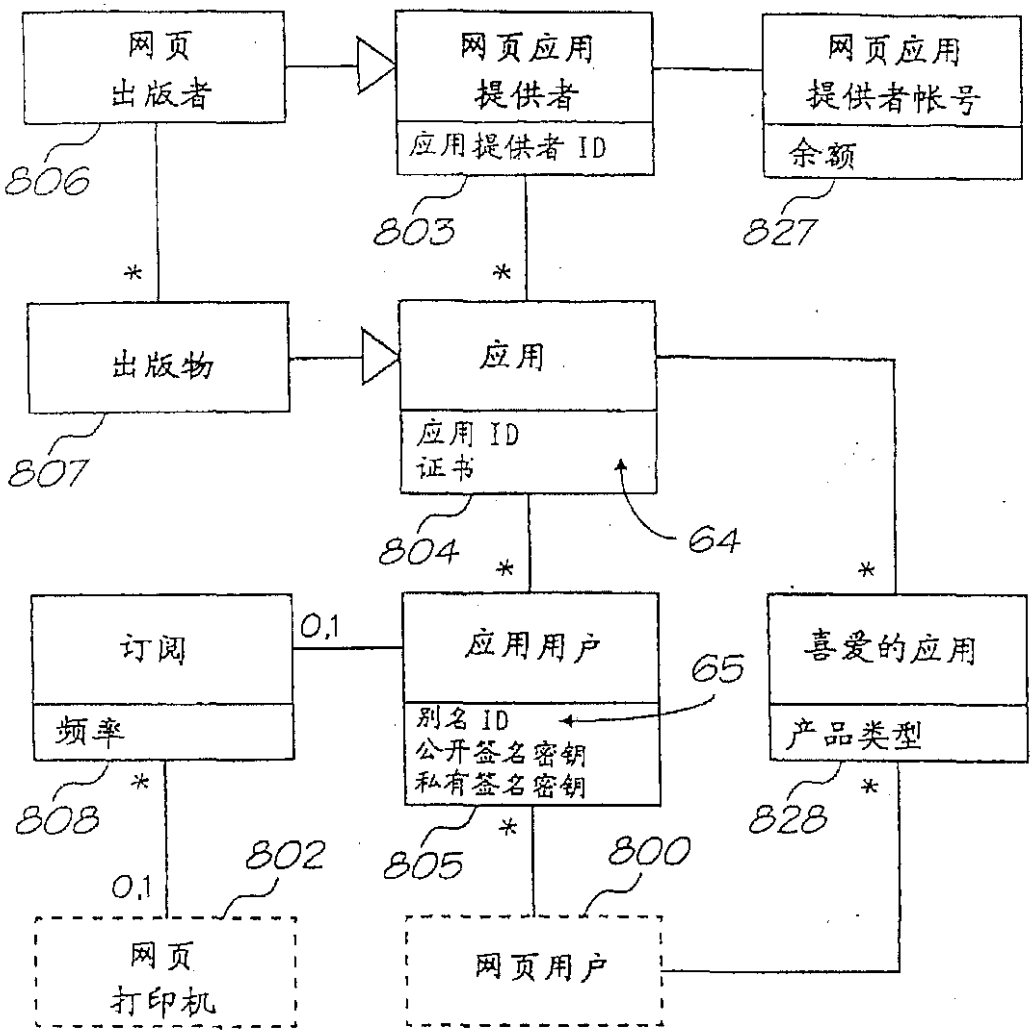

网页
出版者
网页应用
提供者
应用提供者 ID
网页应用
提供者帐号
余额
806
803
827
*
*
出版物
应用
应用 ID
证书
807
804
64
*
*
订阅
0,1
应用用户
65
喜爱的应用
频率
别名 ID
公开签名密钥
私有签名密钥
产品类型
808
*
828
*
*
805
*
0,1
802
800
网页
打印机
网页用户

图 24

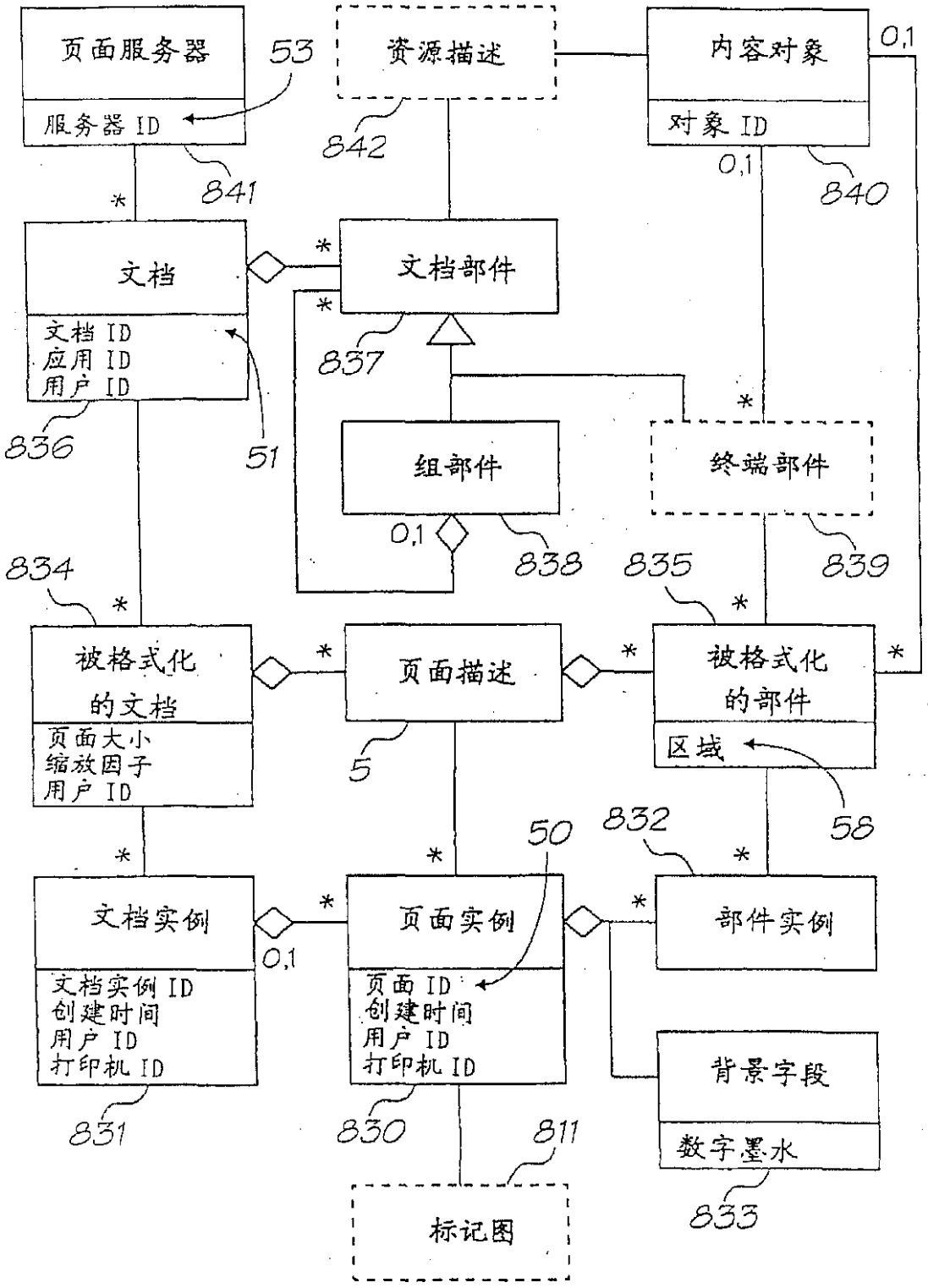

页面服务器
服务器 ID
53
资源描述
842
内容对象
对象 ID
0,1
0,1
841
840
文档
文档 ID
应用 ID
用户 ID
836
51
文档部件
837
组部件
0,1
838
终端部件
839
834
835
被格式化的文档
页面大小
缩放因子
用户 ID
页面描述
5
被格式化的部件
区域
58
832
50
文档实例
文档实例 ID
创建时间
用户 ID
打印机 ID
831
0,1
页面实例
页面 ID
创建时间
用户 ID
打印机 ID
830
部件实例
背景字段
数字墨水
833
811
标记图

图 25

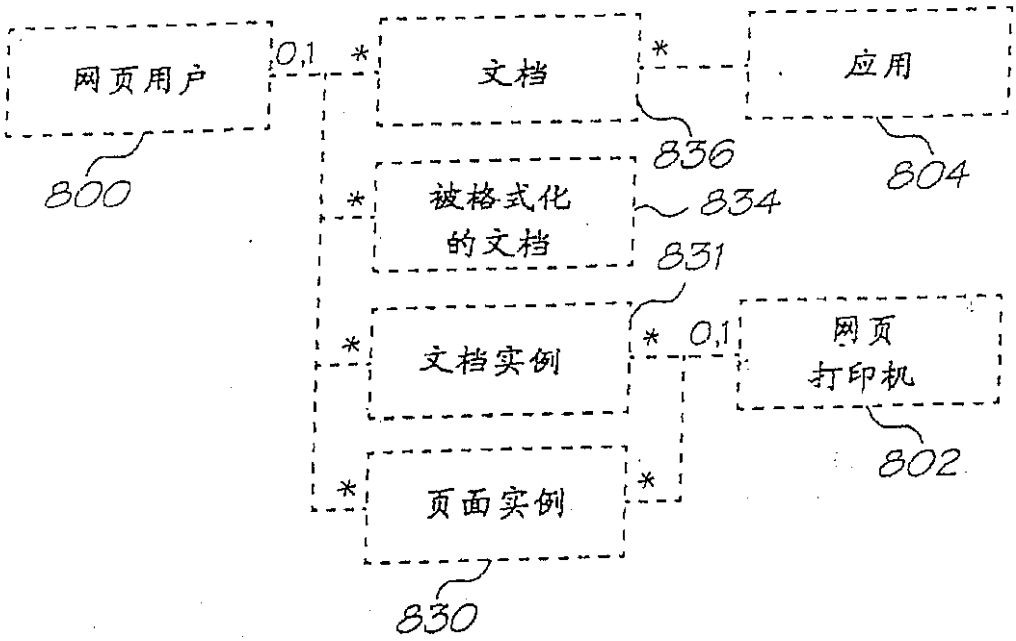

网页用户
0,1
*
文档
*
应用
800
836
804
*
被格式化
的文档
834
831
*
文档实例
*
0,1
网页
打印机
802
*
*
页面实例
830

图 26

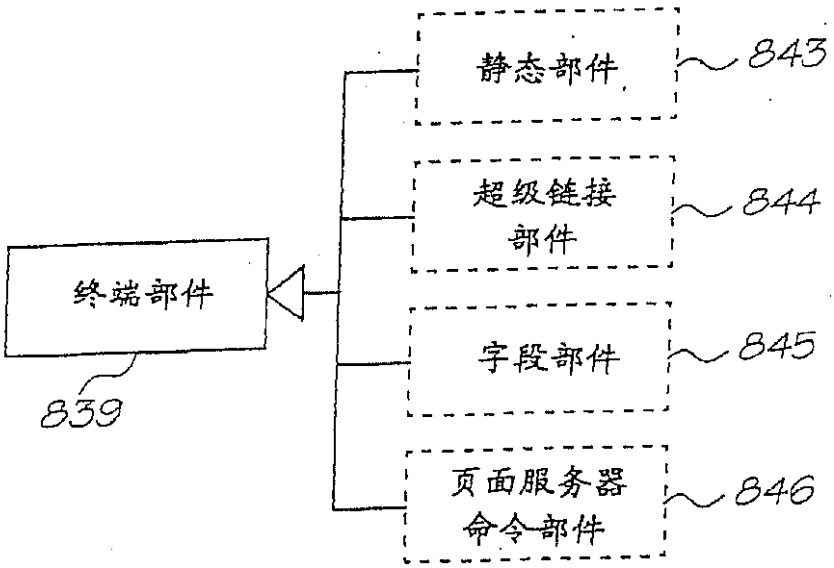

静态部件
843
超级链接
部件
844
终端部件
字段部件
845
839
页面服务器
命令部件
846

图 27

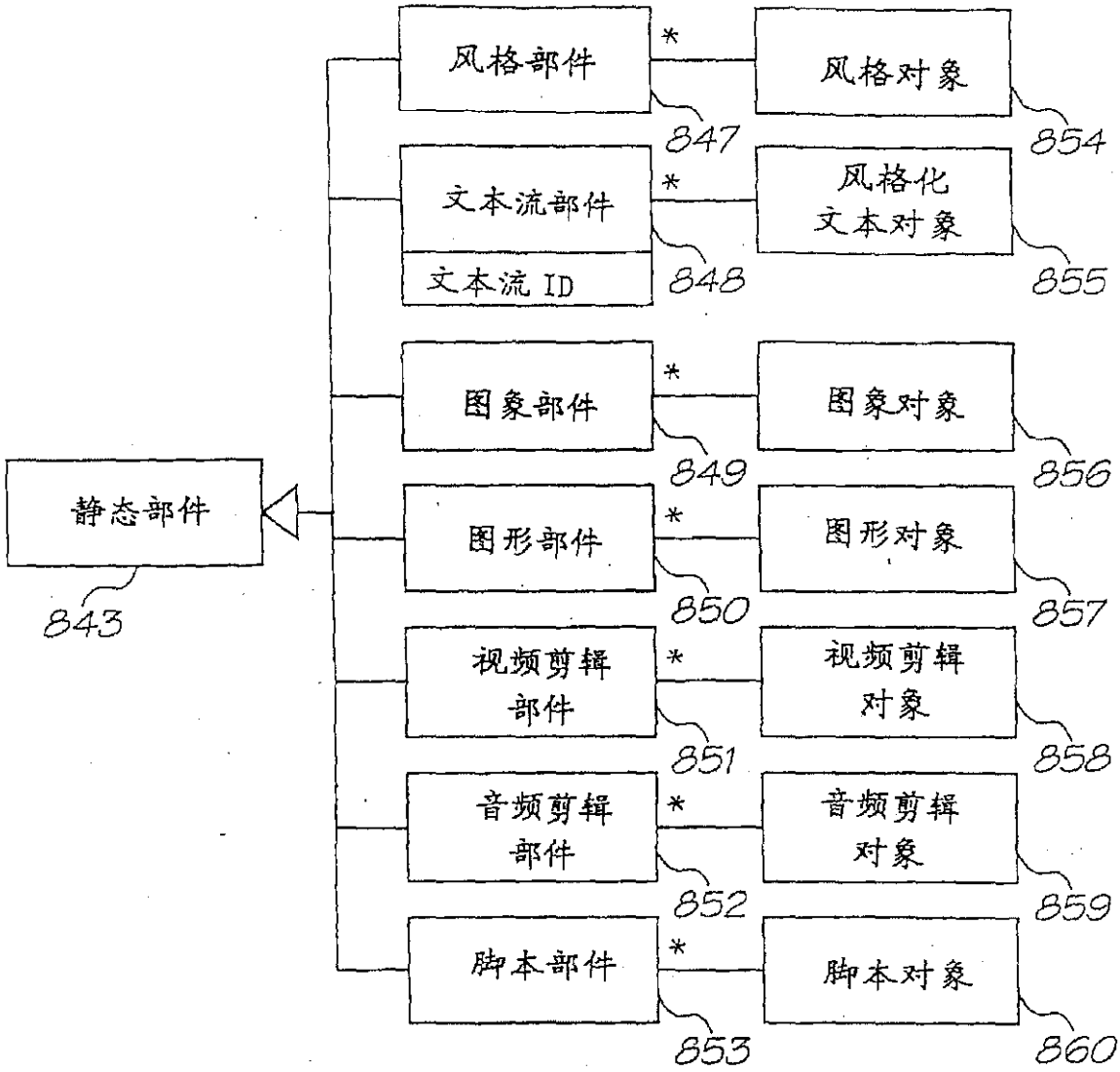

静态部件
843
风格部件
847
*
风格对象
854
文本流部件
文本流 ID
848
*
风格化
文本对象
855
图象部件
849
*
图象对象
856
图形部件
850
*
图形对象
857
视频剪辑
部件
851
*
视频剪辑
对象
858
音频剪辑
部件
852
*
音频剪辑
对象
859
脚本部件
853
*
脚本对象
860

图 28

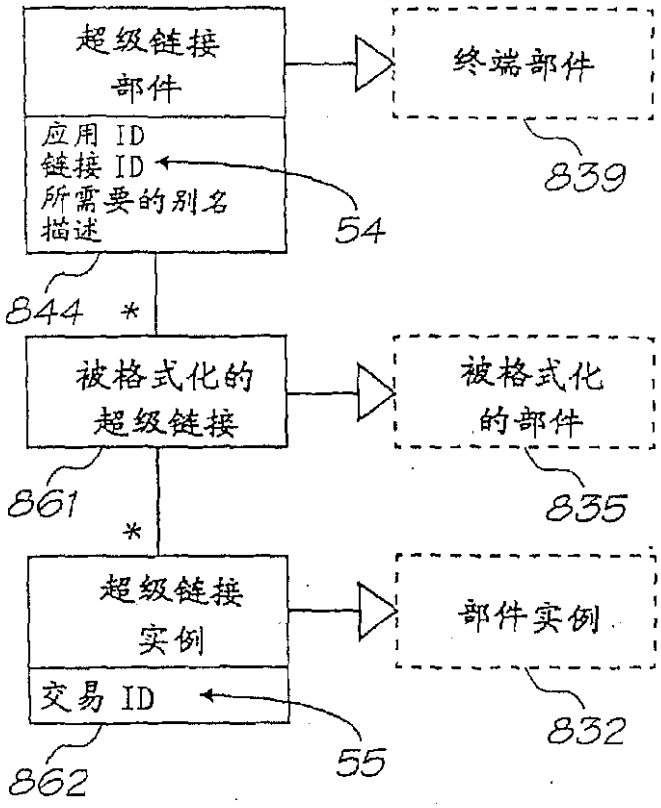

超级链接
部件
应用 ID
链接 ID
所需要的别名
描述
54
844
*
终端部件
839
被格式化的
超级链接
861
*
被格式化
的部件
835
超级链接
实例
交易 ID
862
55
部件实例
832

图 29

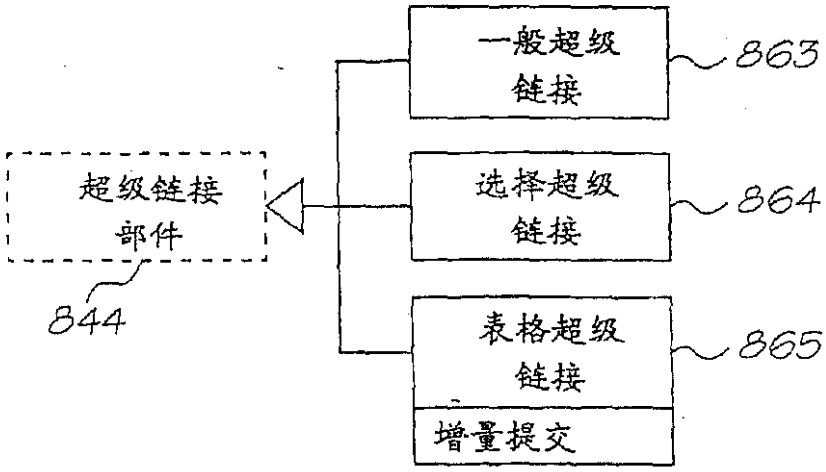

超级链接
部件
844
一般超级
链接
863
选择超级
链接
864
表格超级
链接
增量提交
865

图 30

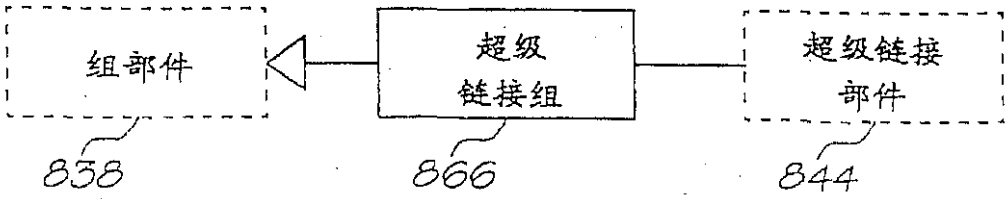

组部件
超级
链接组
超级链接
部件
838
866
844

图 31

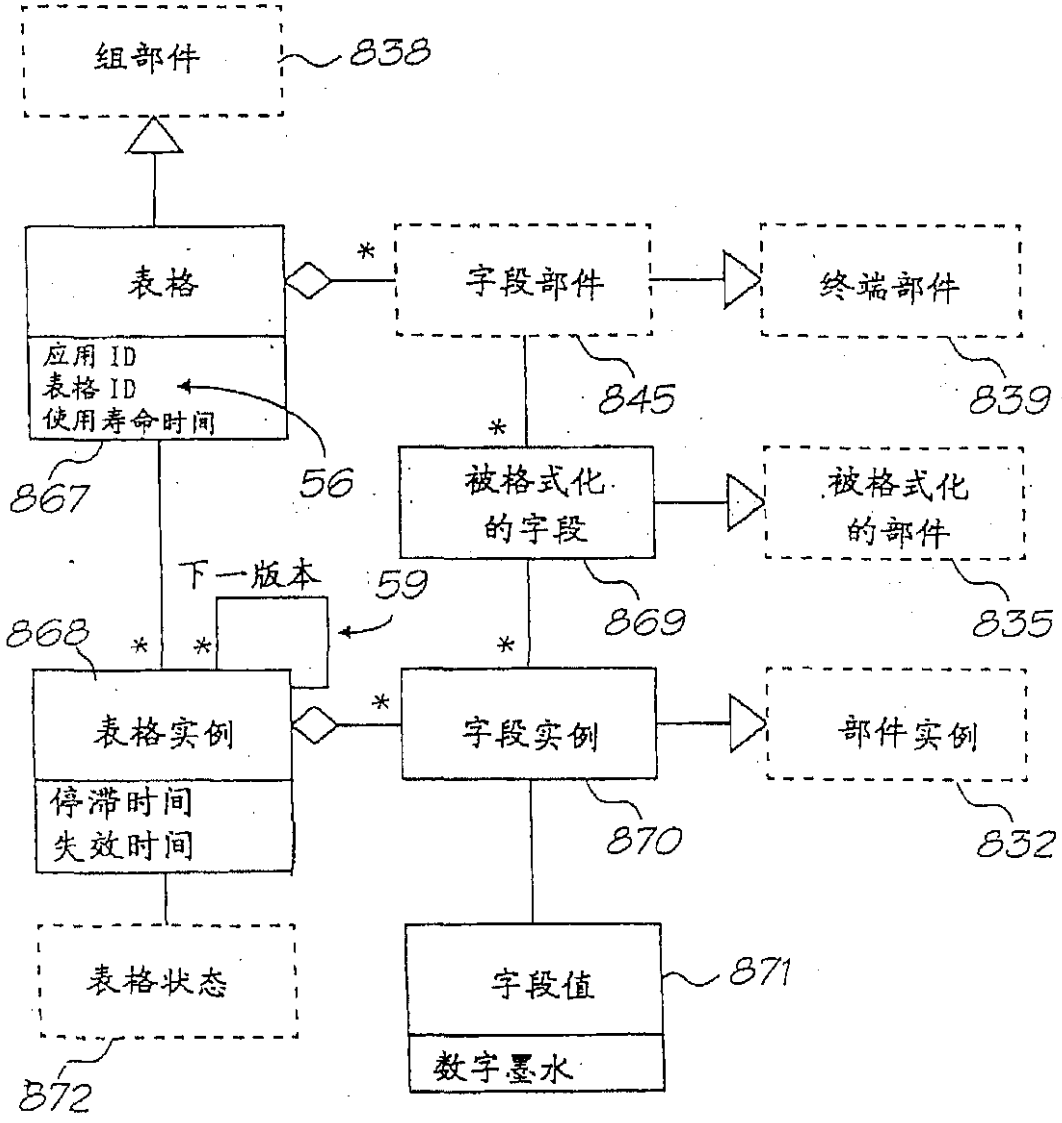

组部件
838
表格
*
字段部件
终端部件
应用 ID
表格 ID
使用寿命时间
845
839
867
56
*
被格式化
的字段
被格式化
的部件
下一版本
59
868
*
*
869
835
*
表格实例
*
字段实例
部件实例
停滞时间
失效时间
870
832
表格状态
字段值
871
数字墨水
872

图 32

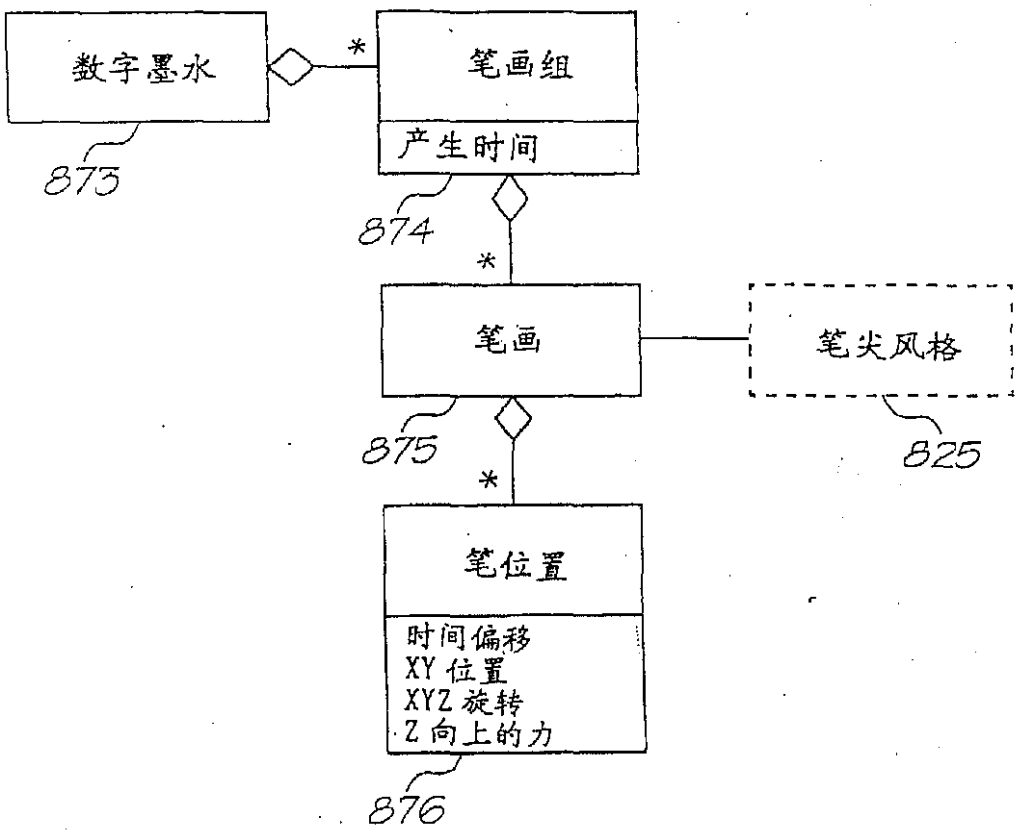

数字墨水
*
笔画组
产生时间
873
874
*
笔画
笔尖风格
875
825
*
笔位置
时间偏移
XY 位置
XYZ 旋转
Z 向上的力
876

图 33

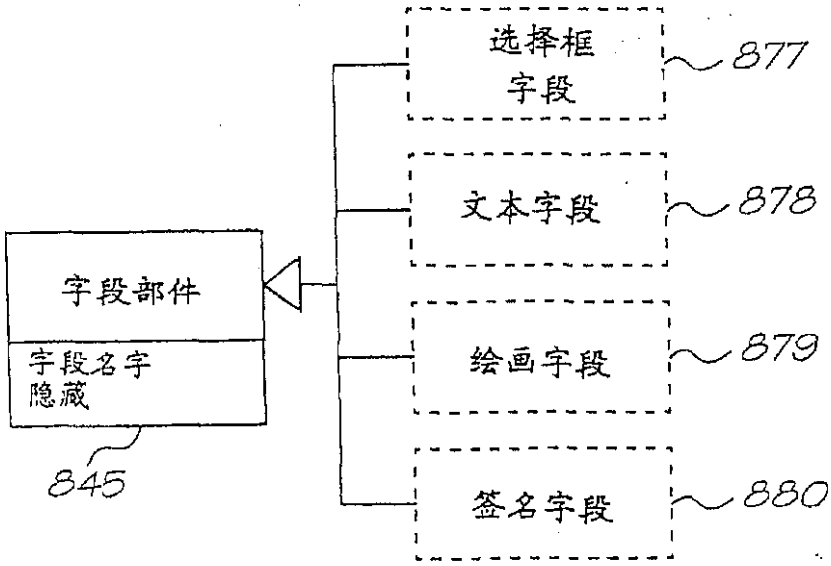

选择框
字段
877
文本字段
878
字段部件
绘画字段
879
字段名字
隐藏
845
签名字段
880

图 34

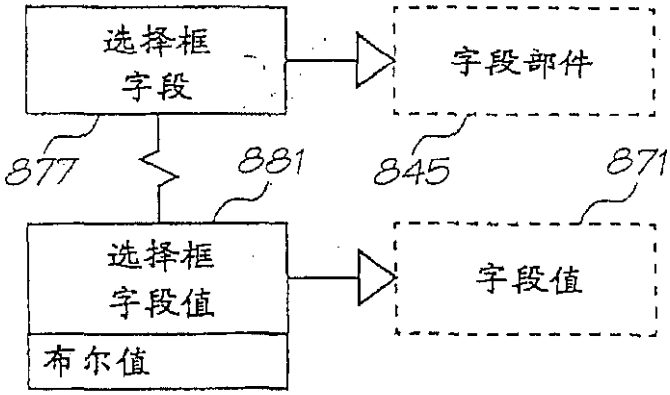

选择框
字段
字段部件
877
881
845
871
选择框
字段值
字段值
布尔值

图 35

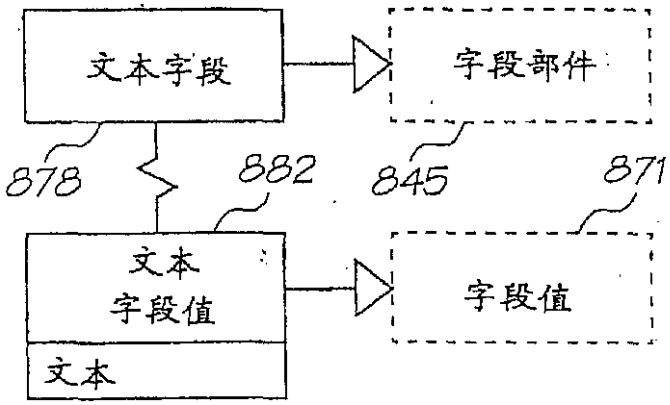

文本字段
字段部件
878
882
845
871
文本
字段值
字段值
文本

图 36

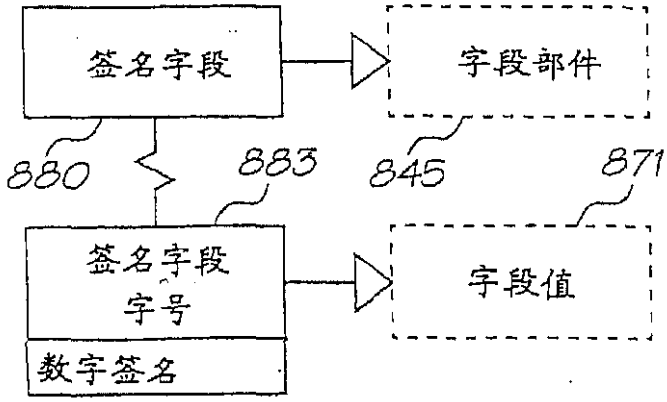

签名字段
字段部件
880
883
845
871
签名字段
字号
字段值
数字签名

图 37

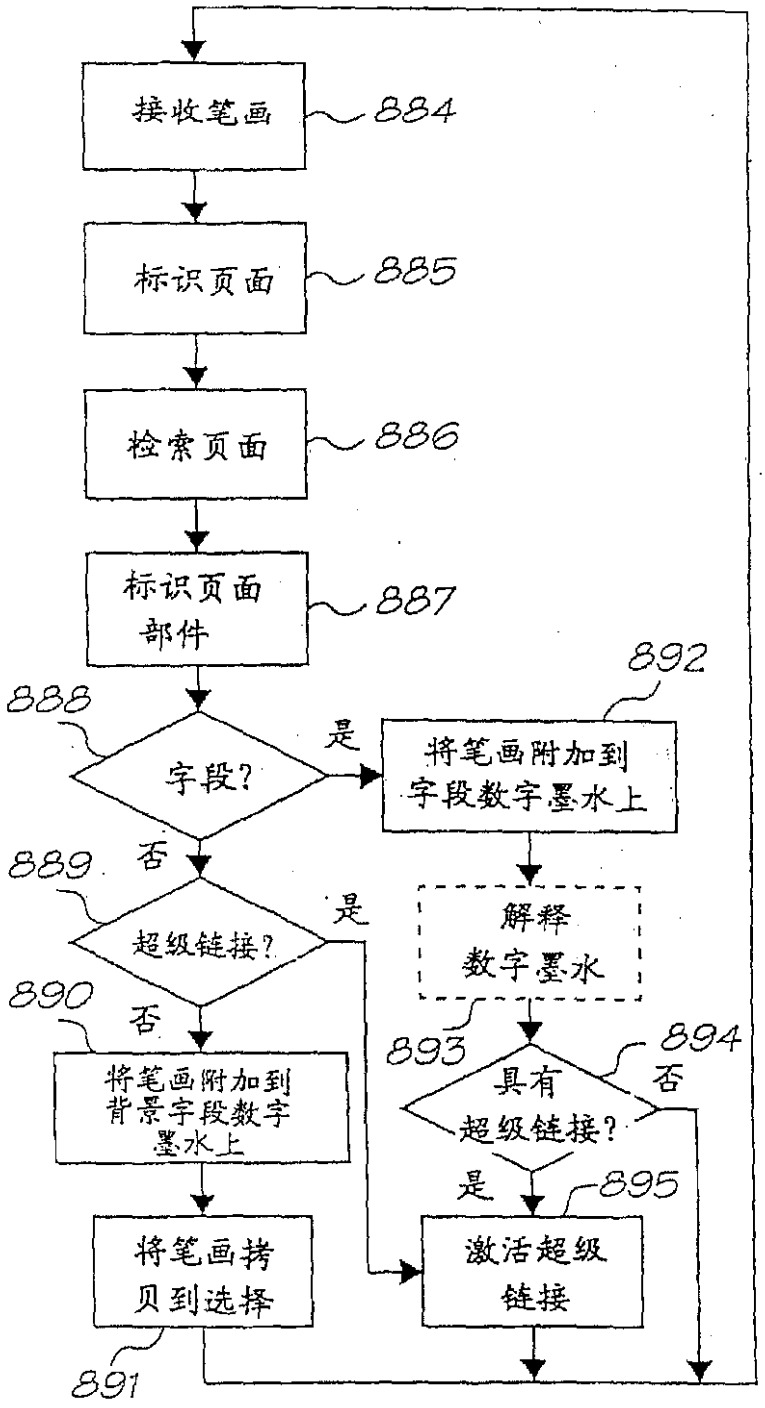

接收笔画
884
标识页面
885
检索页面
886
标识页面部件
887
888
字段?
是
892
将笔画附加到字段数字墨水上
否
889
超级链接?
是
解释数字墨水
890
否
893
894
具有超级链接?
否
是
895
将笔画附加到背景字段数字墨水上
将笔画拷贝到选择
激活超级链接
891

图 38

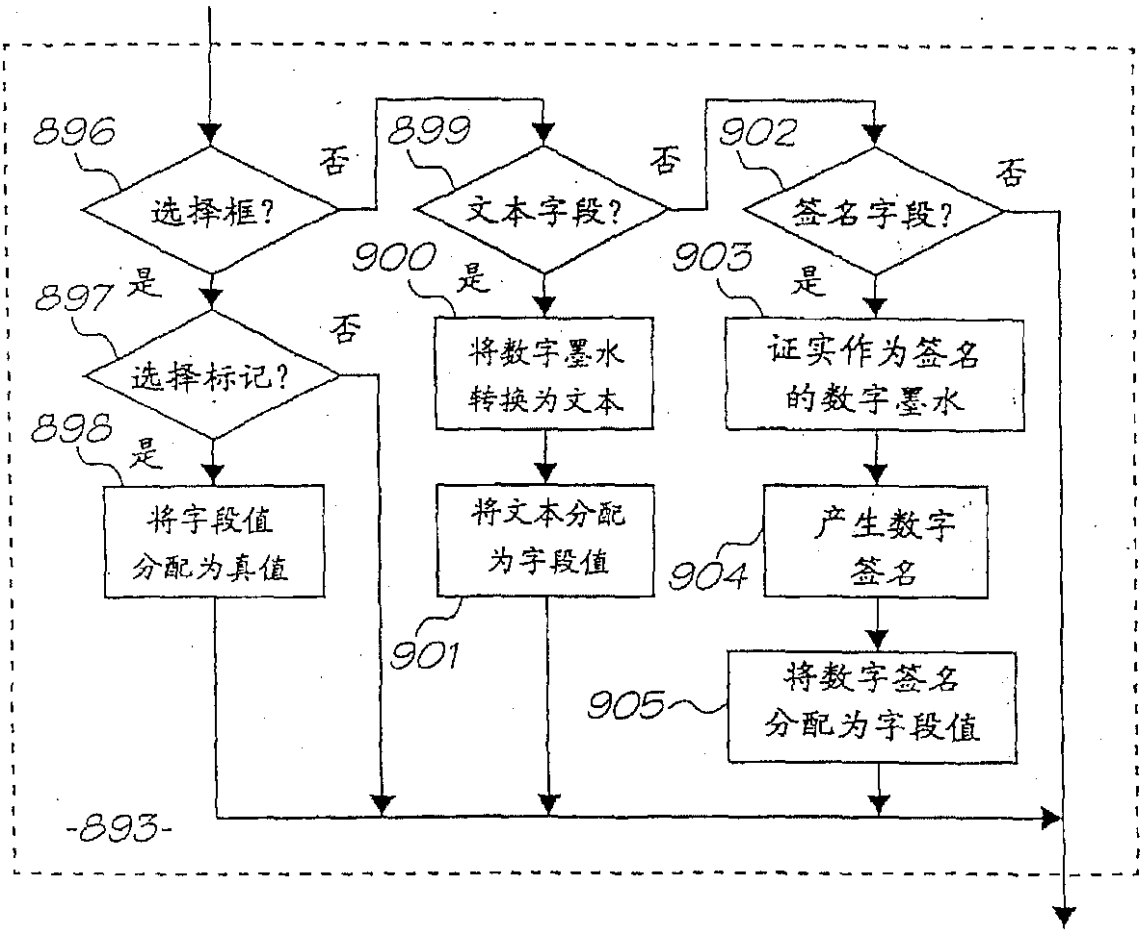

896
选择框?
否
899
文本字段?
否
902
签名字段?
否
897
是
选择标记?
否
900
是
将数字墨水
转换为文本
903
是
证实作为签名
的数字墨水
898
是
将字段值
分配为真值
将文本分配
为字段值
901
904
产生数字
签名
905
将数字签名
分配为字段值
-893-

图 38a

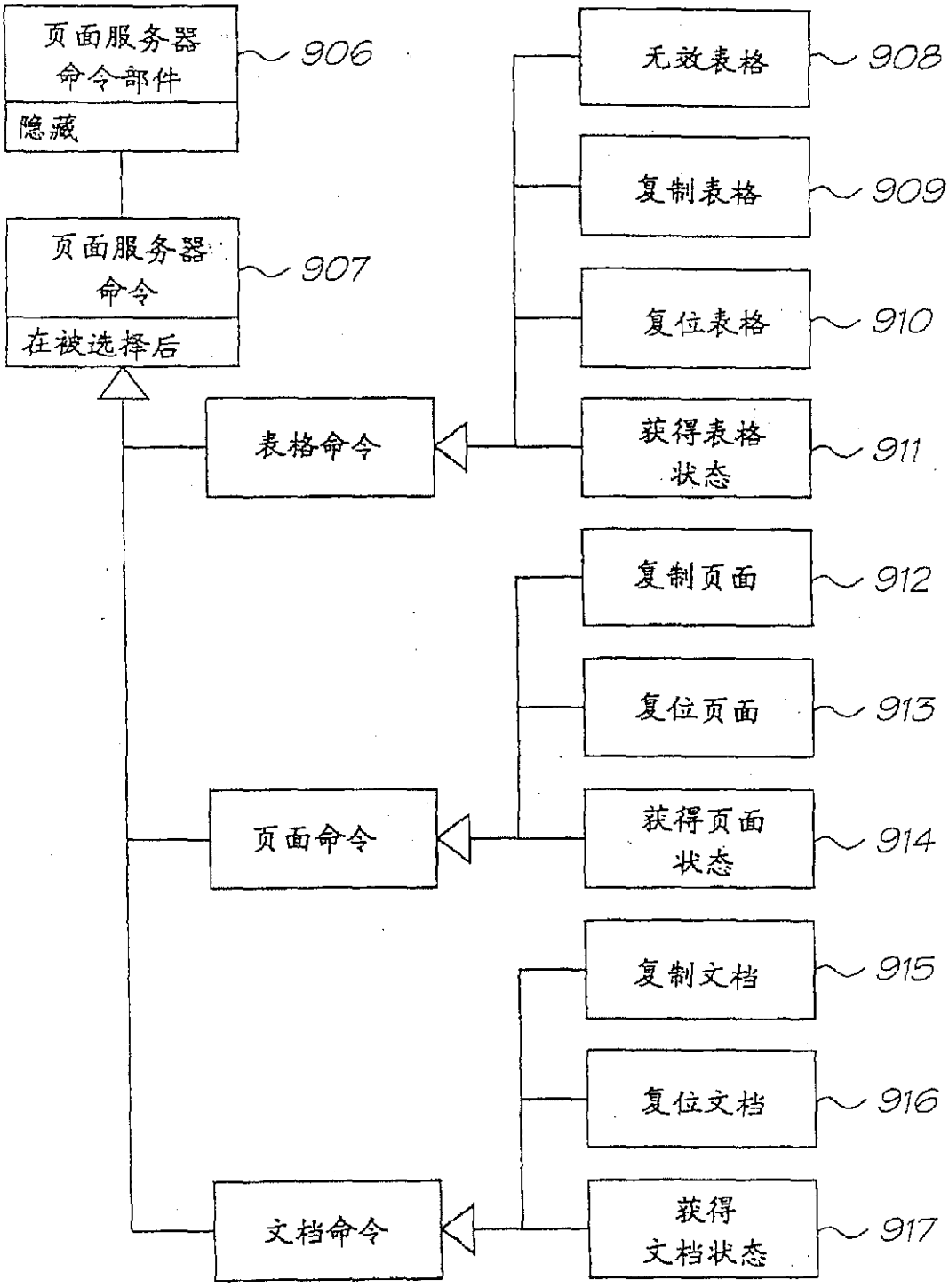

页面服务器
命令部件
隐藏
906
页面服务器
命令
在被选择后
907
表格命令
无效表格
908
复制表格
909
复位表格
910
获得表格
状态
911
页面命令
复制页面
912
复位页面
913
获得页面
状态
914
文档命令
复制文档
915
复位文档
916
获得
文档状态
917

图 39

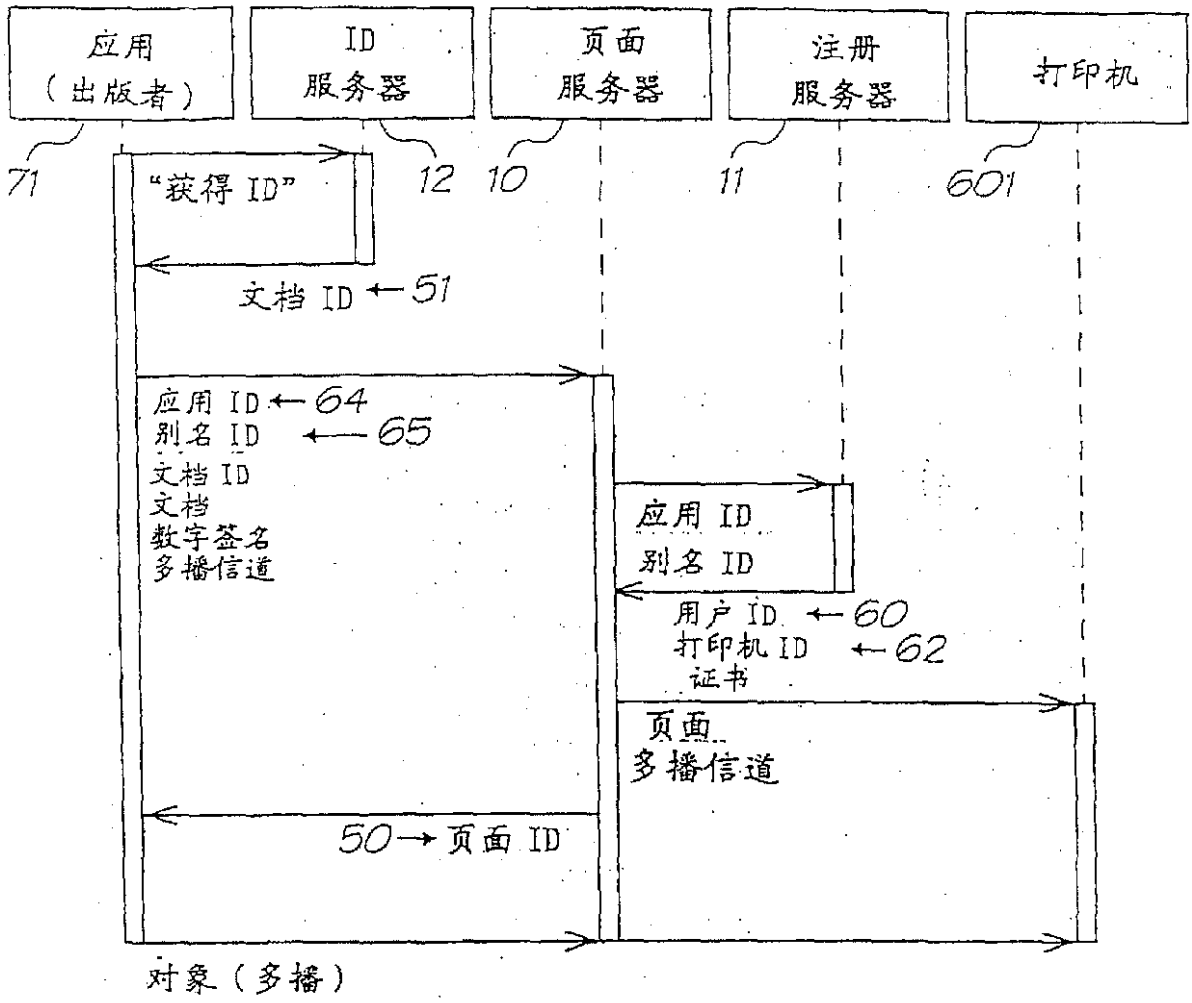

应用
（出版者）
ID
服务器
页面
服务器
注册
服务器
打印机
71
12
10
11
601
"获得 ID"
文档 ID ← 51
应用 ID ← 64
别名 ID ← 65
文档 ID
文档
数字签名
多播信道
应用 ID
别名 ID
用户 ID ← 60
打印机 ID ← 62
证书
页面
多播信道
50 → 页面 ID
对象（多播）

图40

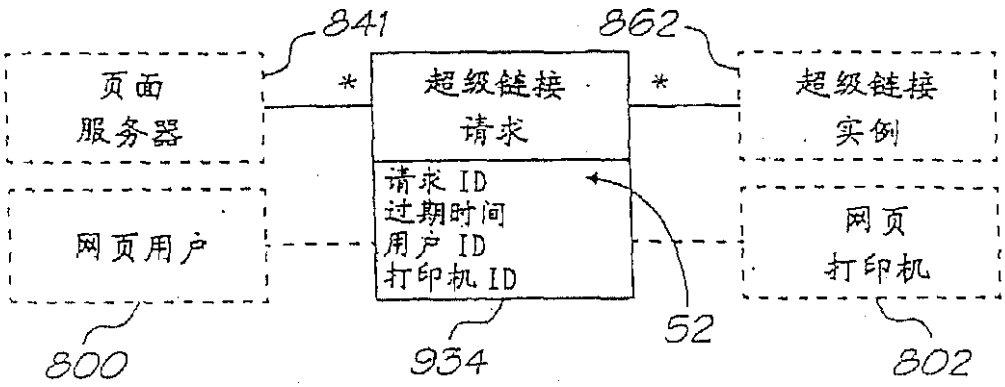

841
862
页面
服务器
*
超级链接
请求
*
超级链接
实例
请求 ID
过期时间
用户 ID
打印机 ID
网页用户
网页
打印机
800
954
52
802

图41

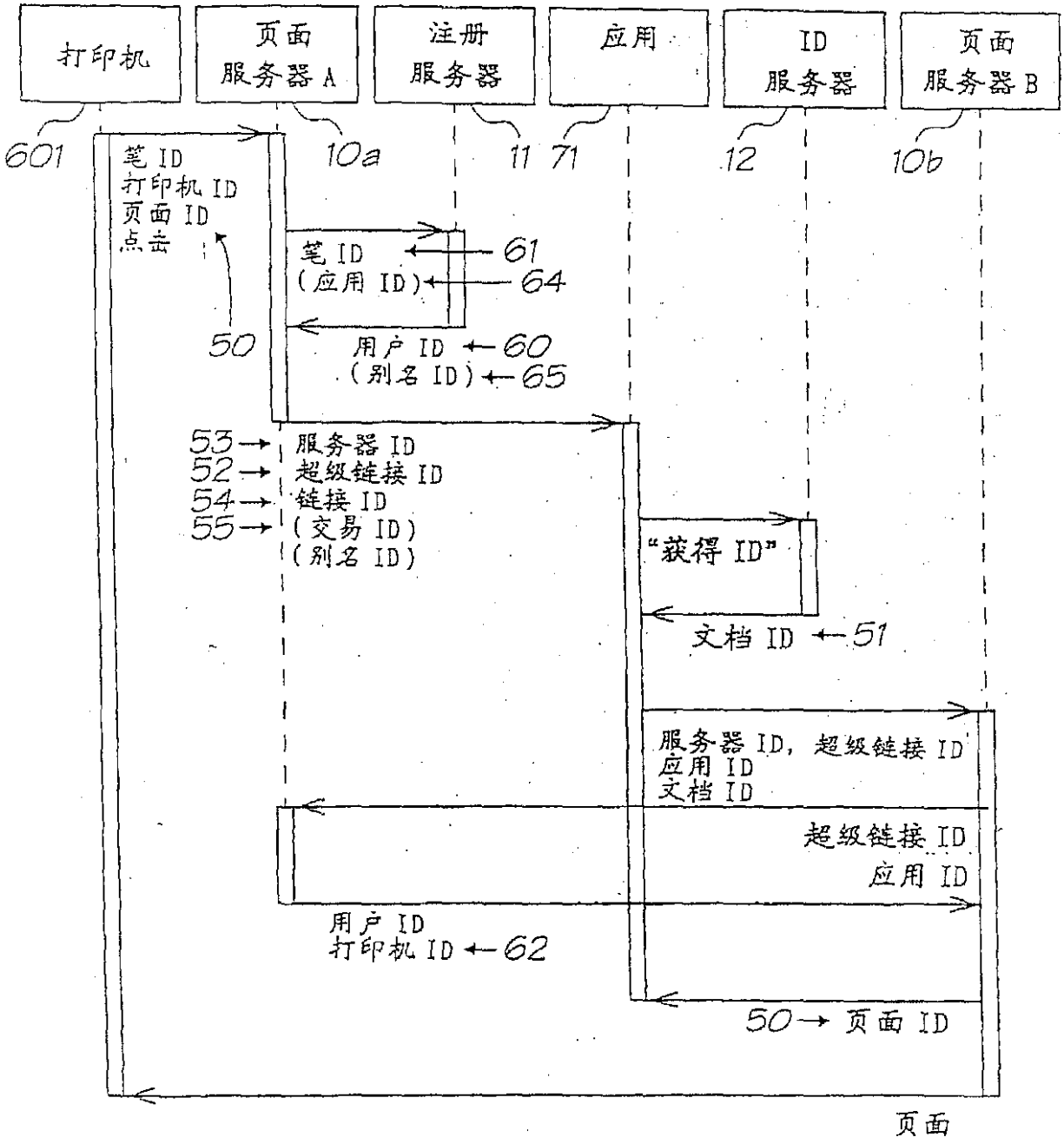

打印机
页面
服务器 A
注册
服务器
应用
ID
服务器
页面
服务器 B
601
10a
11
71
12
10b
笔 ID
打印机 ID
页面 ID
点击
50
笔 ID
(应用 ID)
61
64
用户 ID
(别名 ID)
60
65
53
52
54
55
服务器 ID
超级链接 ID
链接 ID
(交易 ID)
(别名 ID)
"获得 ID"
文档 ID
51
服务器 ID, 超级链接 ID
应用 ID
文档 ID
超级链接 ID
应用 ID
用户 ID
打印机 ID
62
50
页面 ID
页面

图42

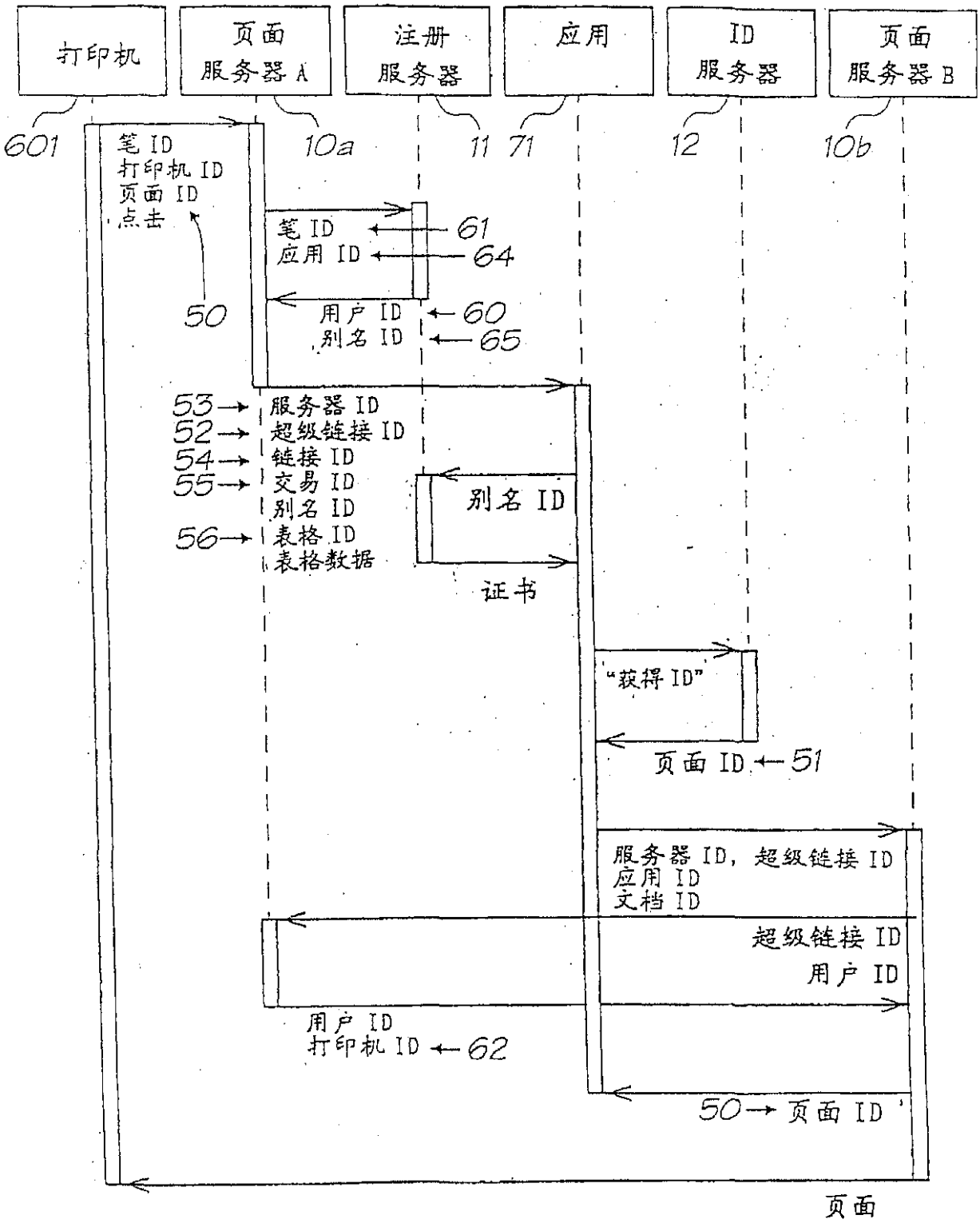

打印机
页面
服务器 A
注册
服务器
应用
ID
服务器
页面
服务器 B
601
10a
11
71
12
10b
笔 ID
打印机 ID
页面 ID
点击
50
笔 ID
61
应用 ID
64
用户 ID
60
别名 ID
65
53
52
54
55
56
服务器 ID
超级链接 ID
链接 ID
交易 ID
别名 ID
表格 ID
表格数据
别名 ID
证书
"获得 ID"
页面 ID
51
服务器 ID，超级链接 ID
应用 ID
文档 ID
超级链接 ID
用户 ID
用户 ID
打印机 ID
62
50
页面 ID
页面

图 43

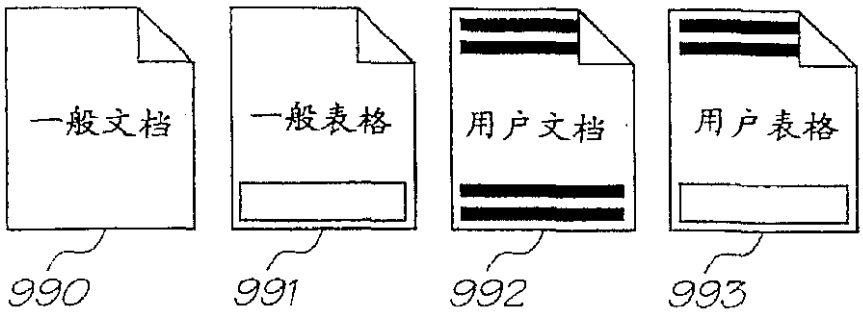

一般文档
一般表格
用户文档
用户表格
990
991
992
993

图 44

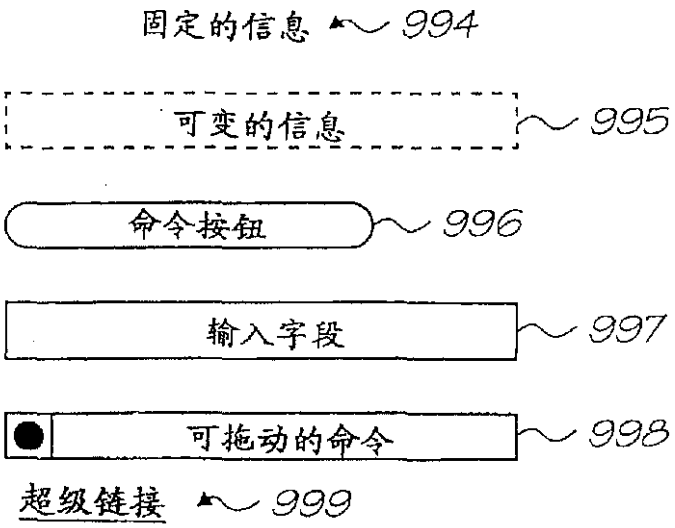

固定的信息
994
可变的信息
995
命令按钮
996
输入字段
997
可拖动的命令
998
超级链接
999

图 45

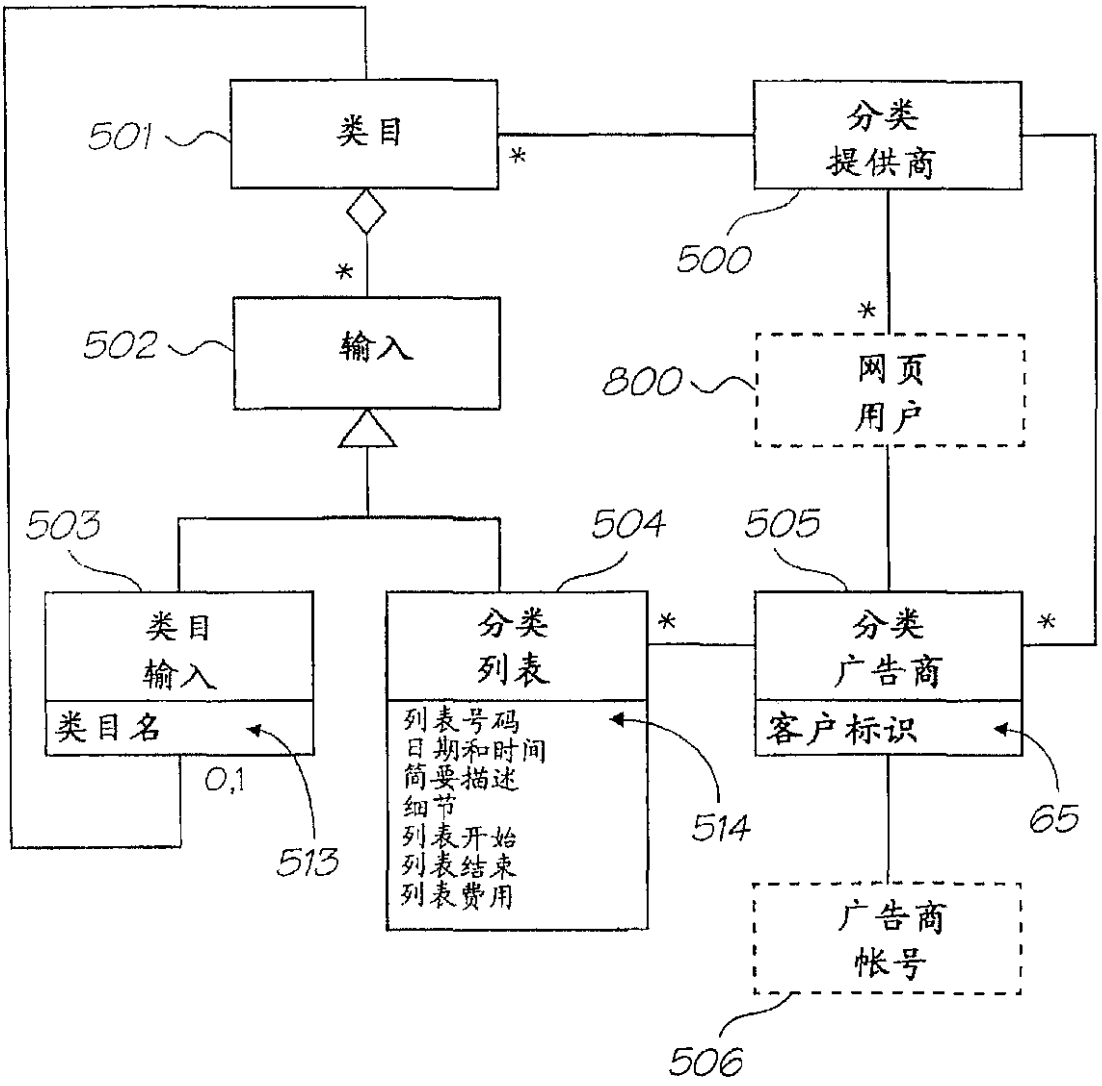

501
类目
*
分类
提供商
500
*
502
输入
*
800
网页
用户
503
504
505
类目
输入
类目名
0,1
513
分类
列表
列表号码
日期和时间
简要描述
细节
列表开始
列表结束
列表费用
514
*
分类
广告商
客户标识
65
*
广告商
帐号
506

图 46

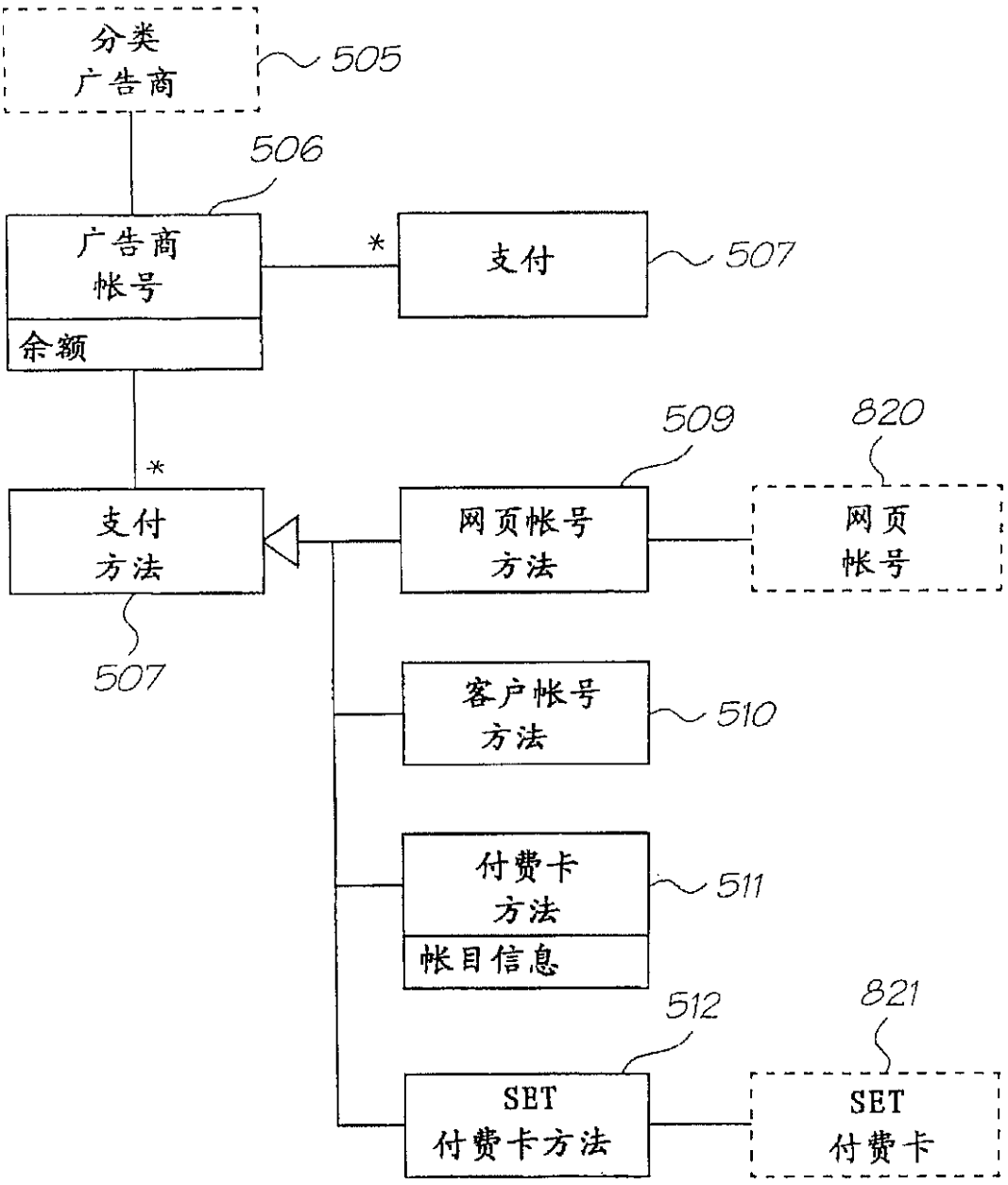

分类
广告商
505
506
广告商
帐号
余额
*
支付
507
*
支付
方法
507
509
网页帐号
方法
820
网页
帐号
客户帐号
方法
510
付费卡
方法
帐目信息
511
512
SET
付费卡方法
821
SET
付费卡

图 47

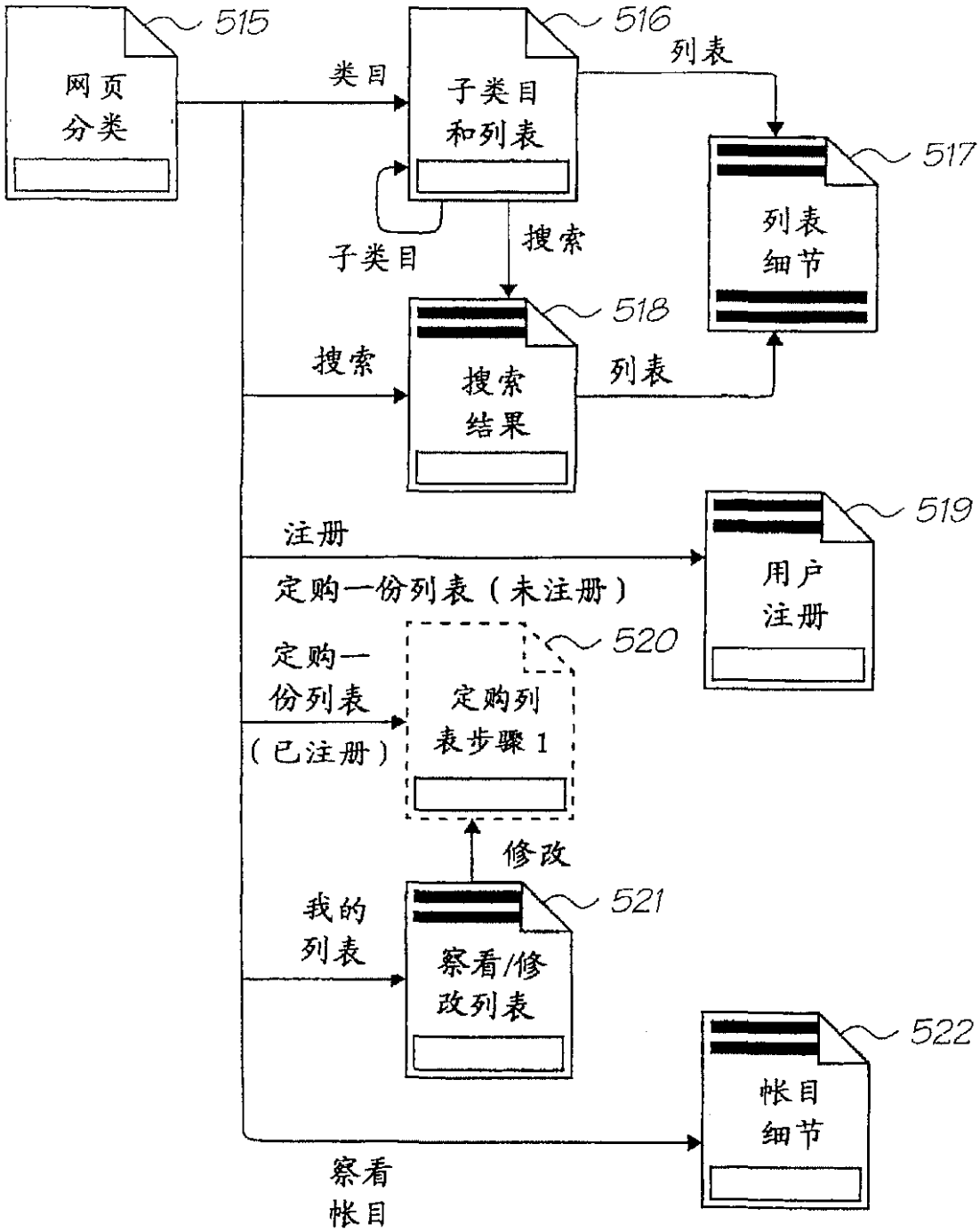

515
网页
分类
类目
516
子类目
和列表
列表
517
列表
细节
子类目
搜索
518
搜索
搜索
结果
列表
519
注册
用户
注册
定购一份列表（未注册）
520
定购一
份列表
（已注册）
定购列
表步骤 1
修改
我的
列表
521
察看/修
改列表
522
帐目
细节
察看
帐目

图 48

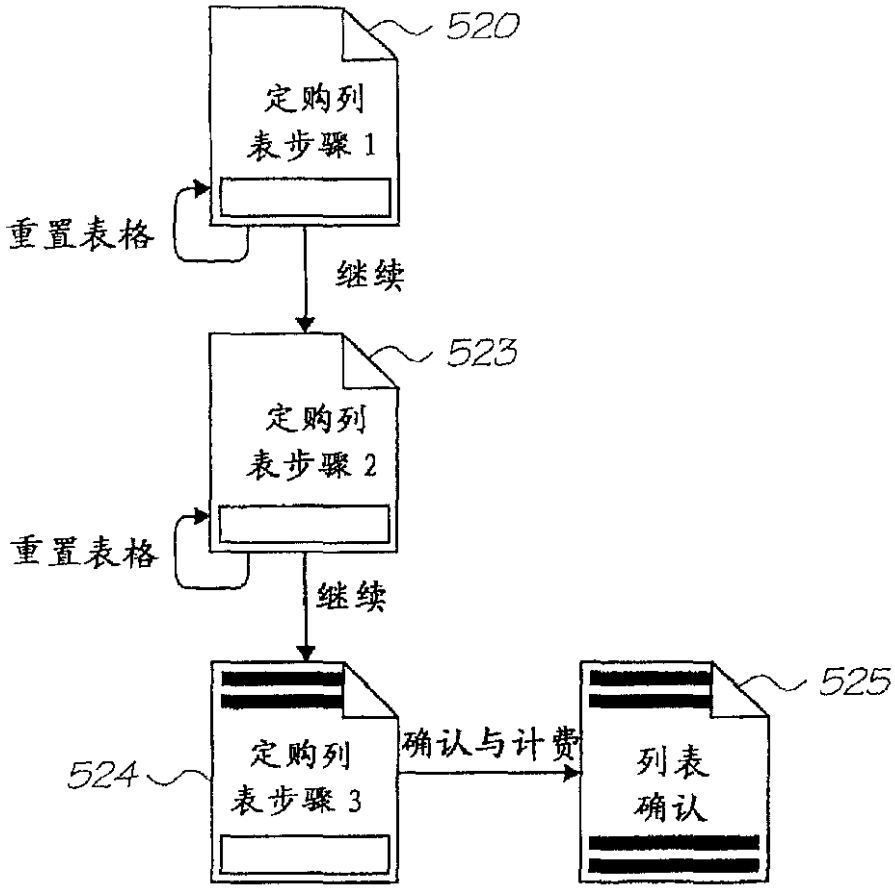

520
定购列
表步骤 1
重置表格
继续
523
定购列
表步骤 2
重置表格
继续
525
524
定购列
表步骤 3
确认与计费
列表
确认

图 49

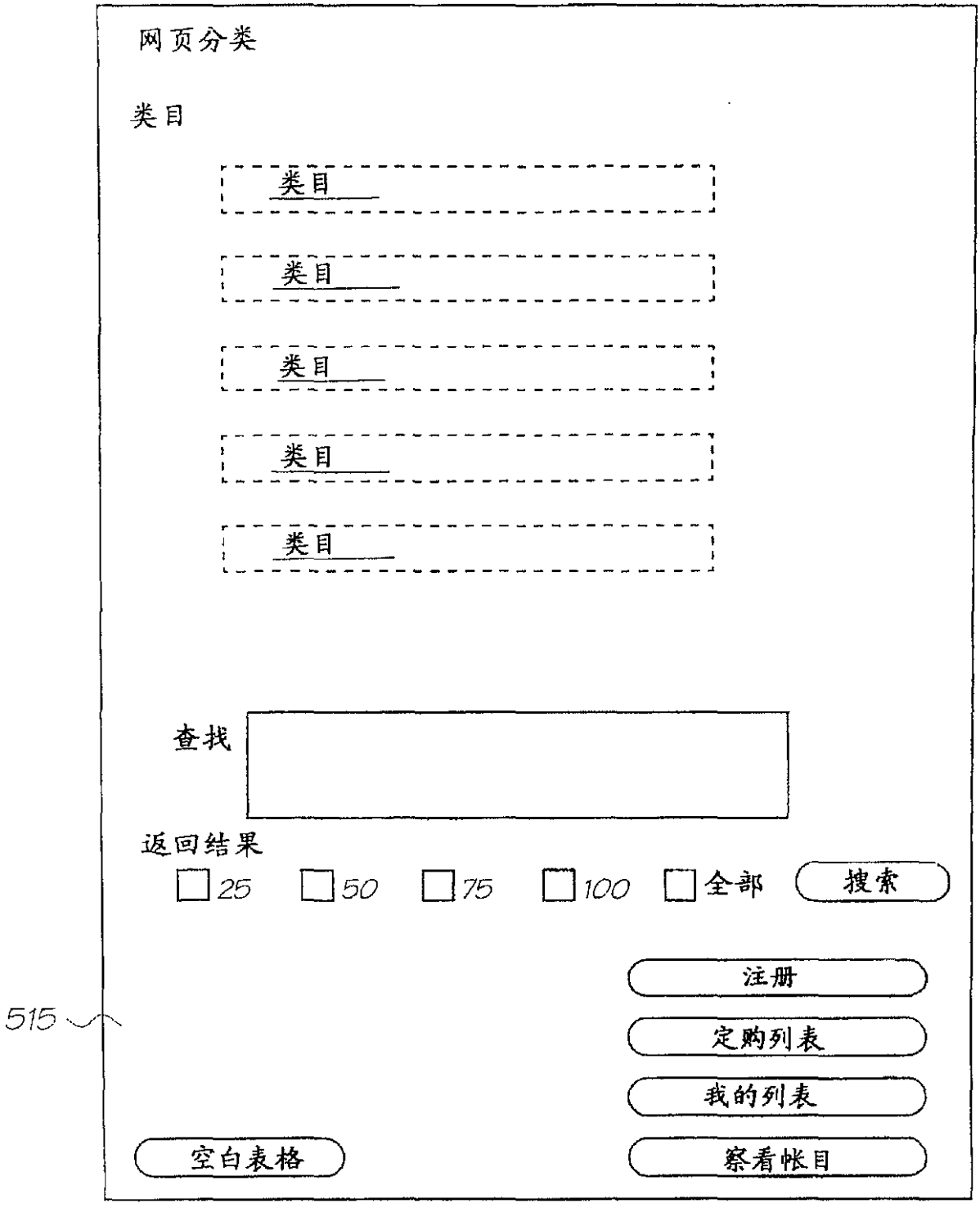

网页分类
类目
类目
类目
类目
类目
类目
查找
返回结果
25
50
75
100
全部
搜索
注册
定购列表
我的列表
空白表格
察看帐目
515

图 50

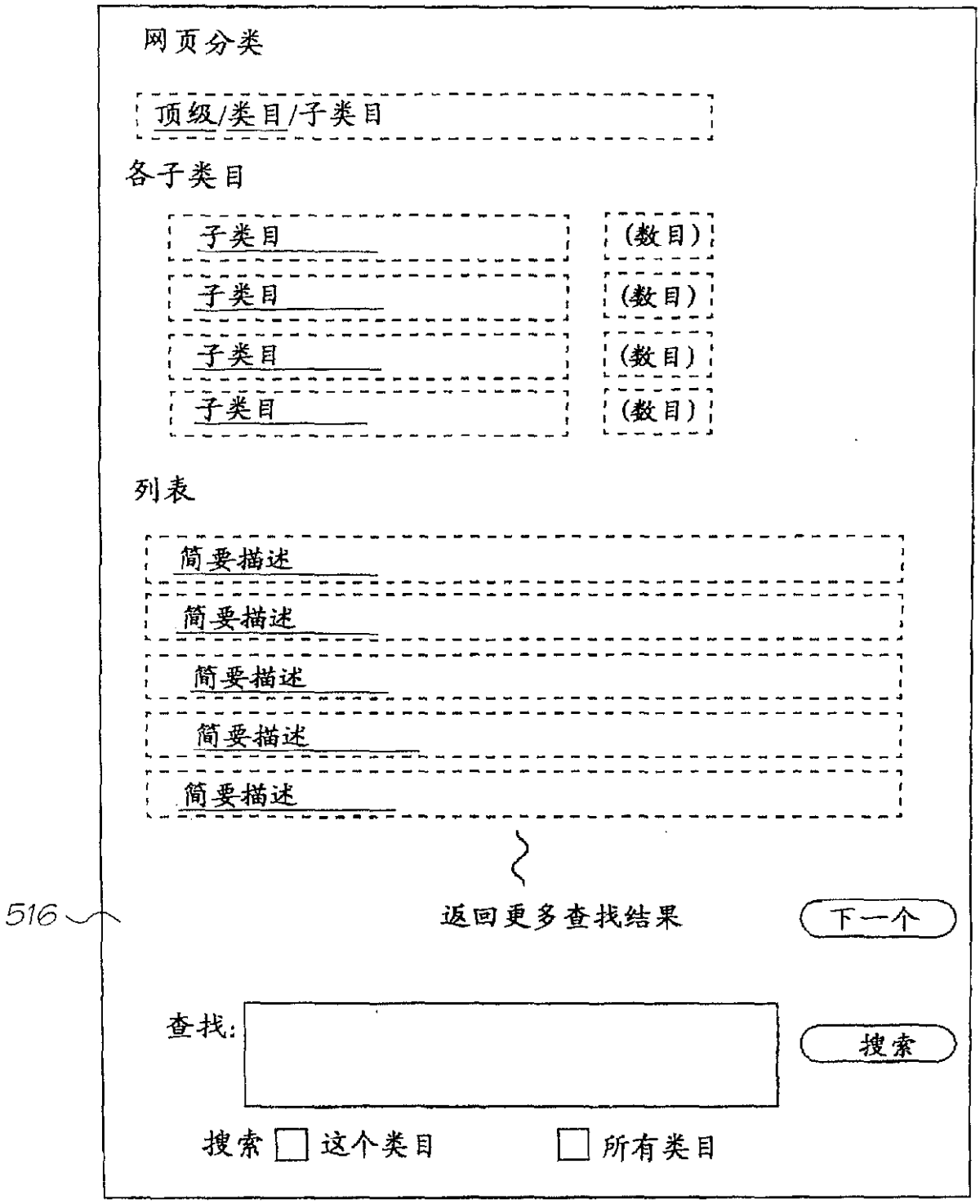

网页分类
顶级/类目/子类目
各子类目
子类目
(数目)
子类目
(数目)
子类目
(数目)
子类目
(数目)
列表
简要描述
简要描述
简要描述
简要描述
简要描述
516
返回更多查找结果
下一个
查找:
搜索
搜索
这个类目
所有类目

图 51

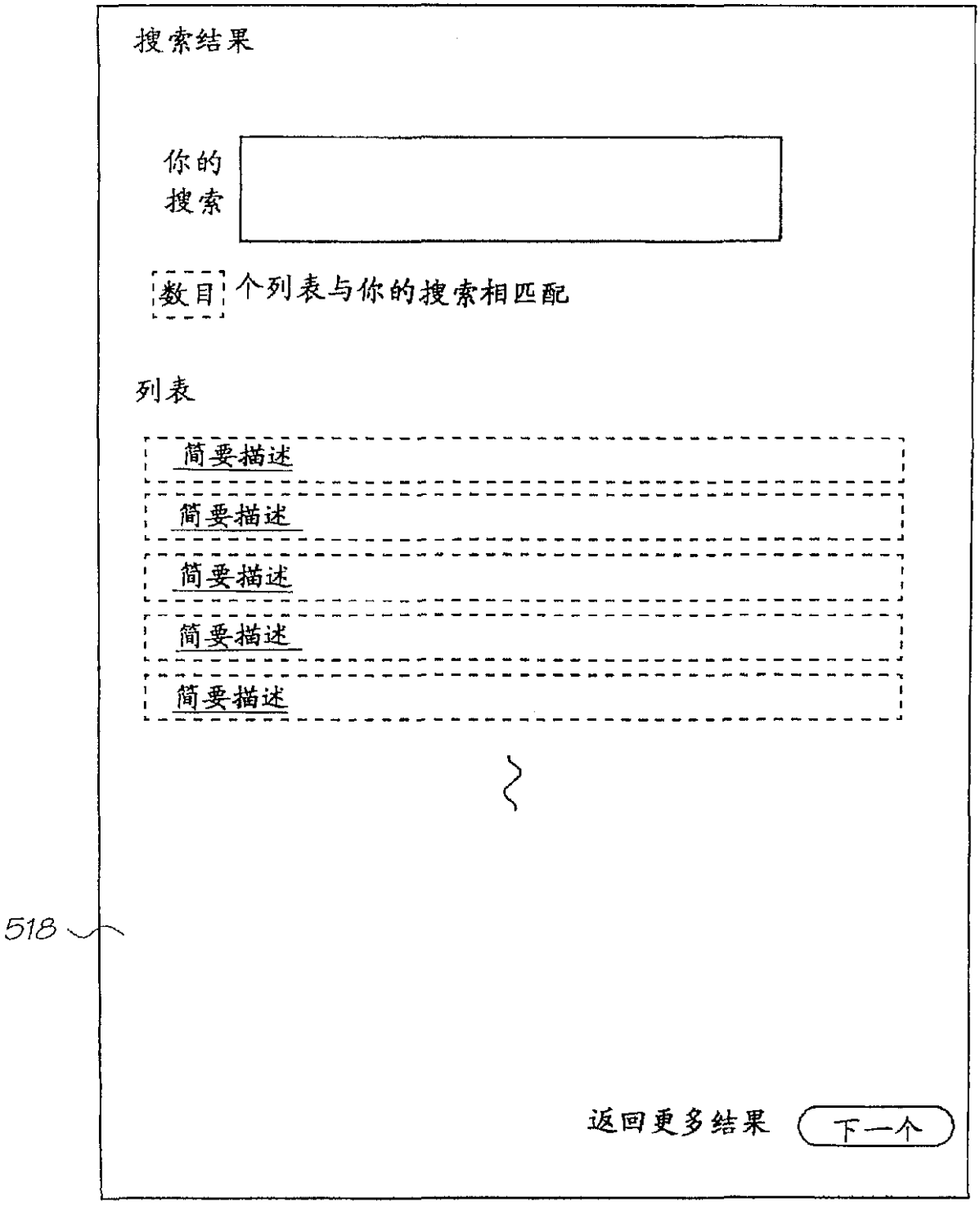

搜索结果
你的搜索
数目
个列表与你的搜索相匹配
列表
简要描述
简要描述
简要描述
简要描述
简要描述
518
返回更多结果
下一个

图 52

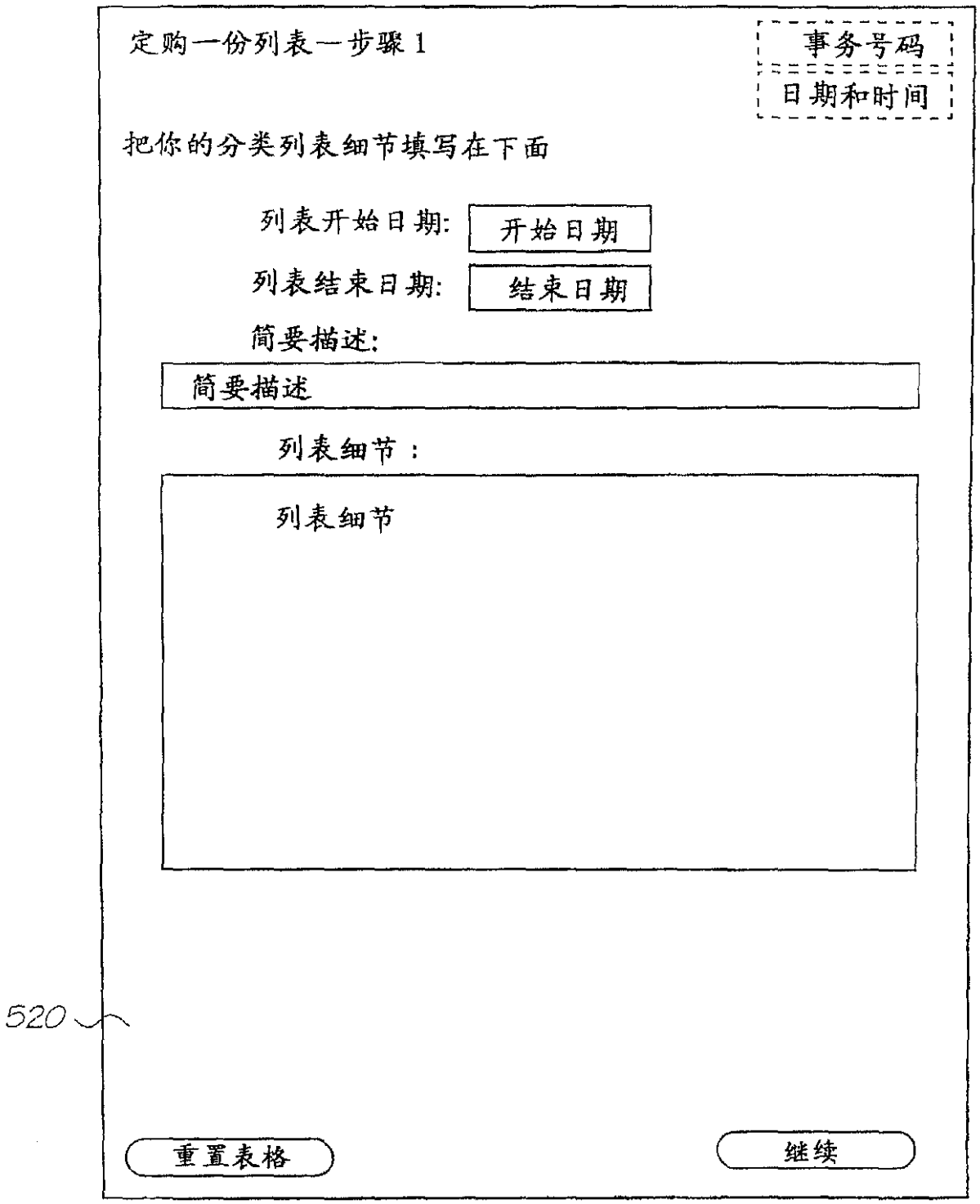

定购一份列表—步骤 1
事务号码
日期和时间
把你的分类列表细节填写在下面
列表开始日期:
开始日期
列表结束日期:
结束日期
简要描述:
简要描述
列表细节 :
列表细节
520
重置表格
继续

图 53

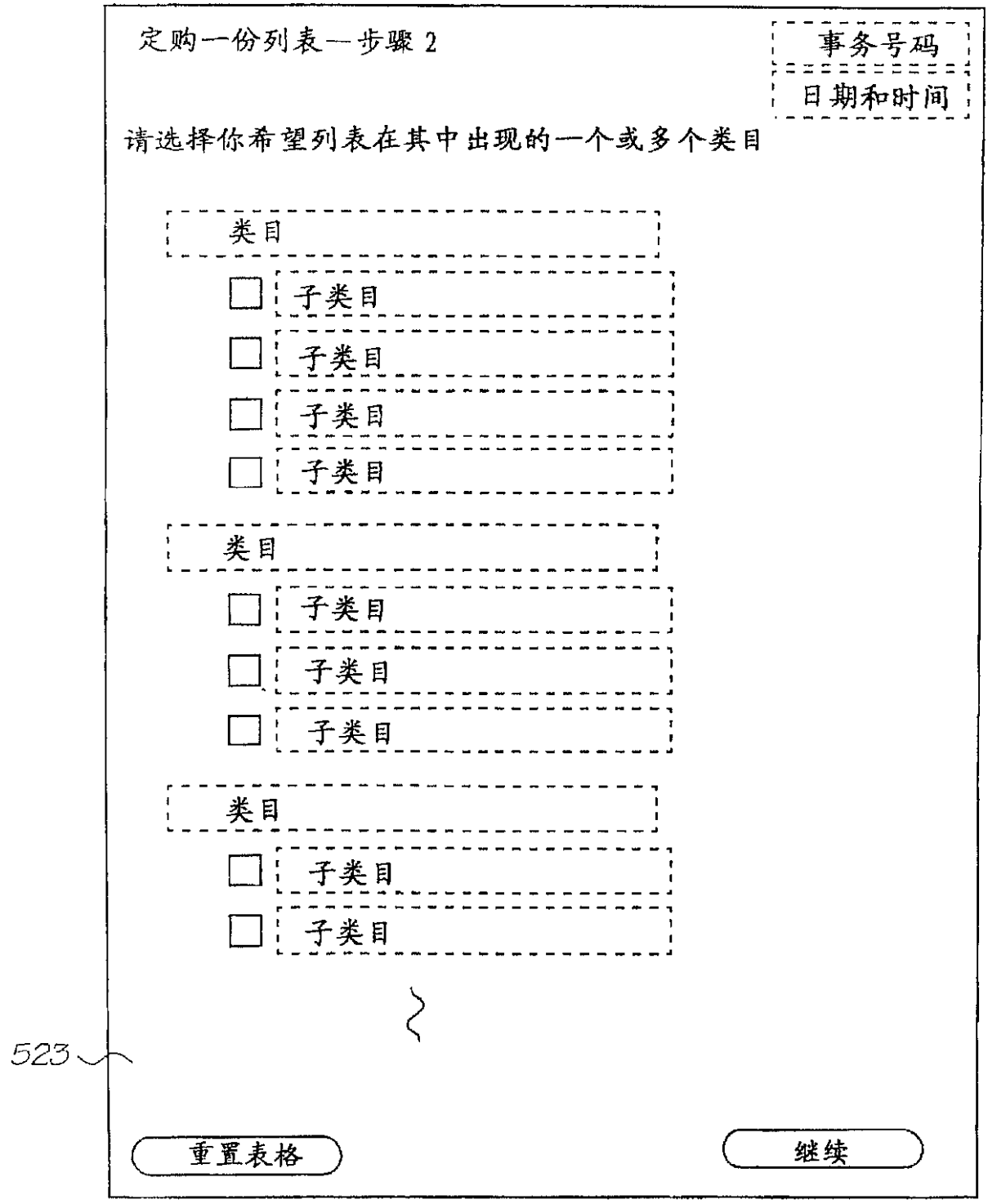

定购一份列表—步骤 2
事务号码
日期和时间
请选择你希望列表在其中出现的一个或多个类目
类目
子类目
子类目
子类目
子类目
类目
子类目
子类目
子类目
类目
子类目
子类目
523
重置表格
继续

图 54

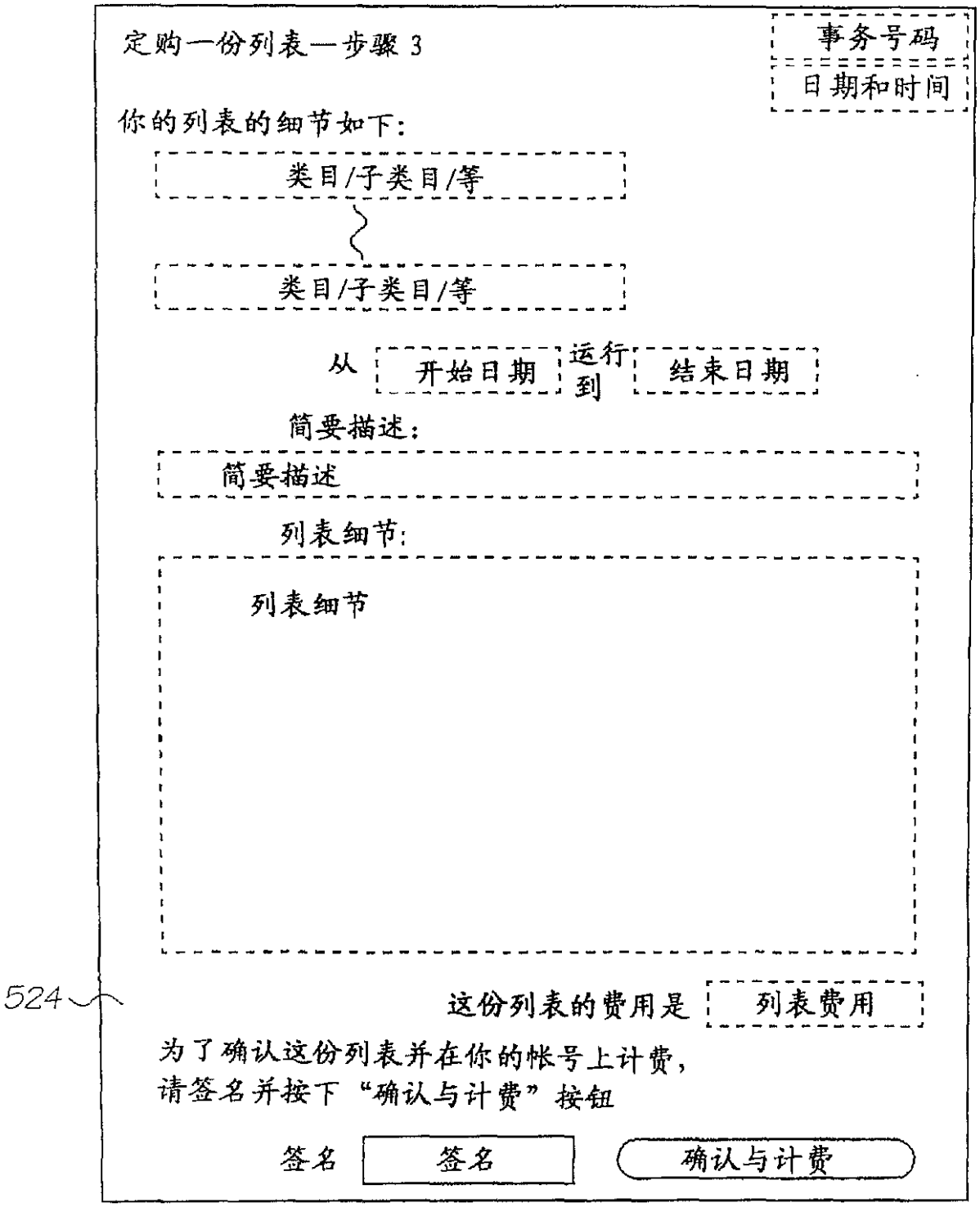

定购一份列表—步骤 3
事务号码
日期和时间
你的列表的细节如下:
类目/子类目/等
类目/子类目/等
从
开始日期
运行到
结束日期
简要描述:
简要描述
列表细节:
列表细节
524
这份列表的费用是
列表费用
为了确认这份列表并在你的帐号上计费,
请签名并按下“确认与计费”按钮
签名
签名
确认与计费

图 55

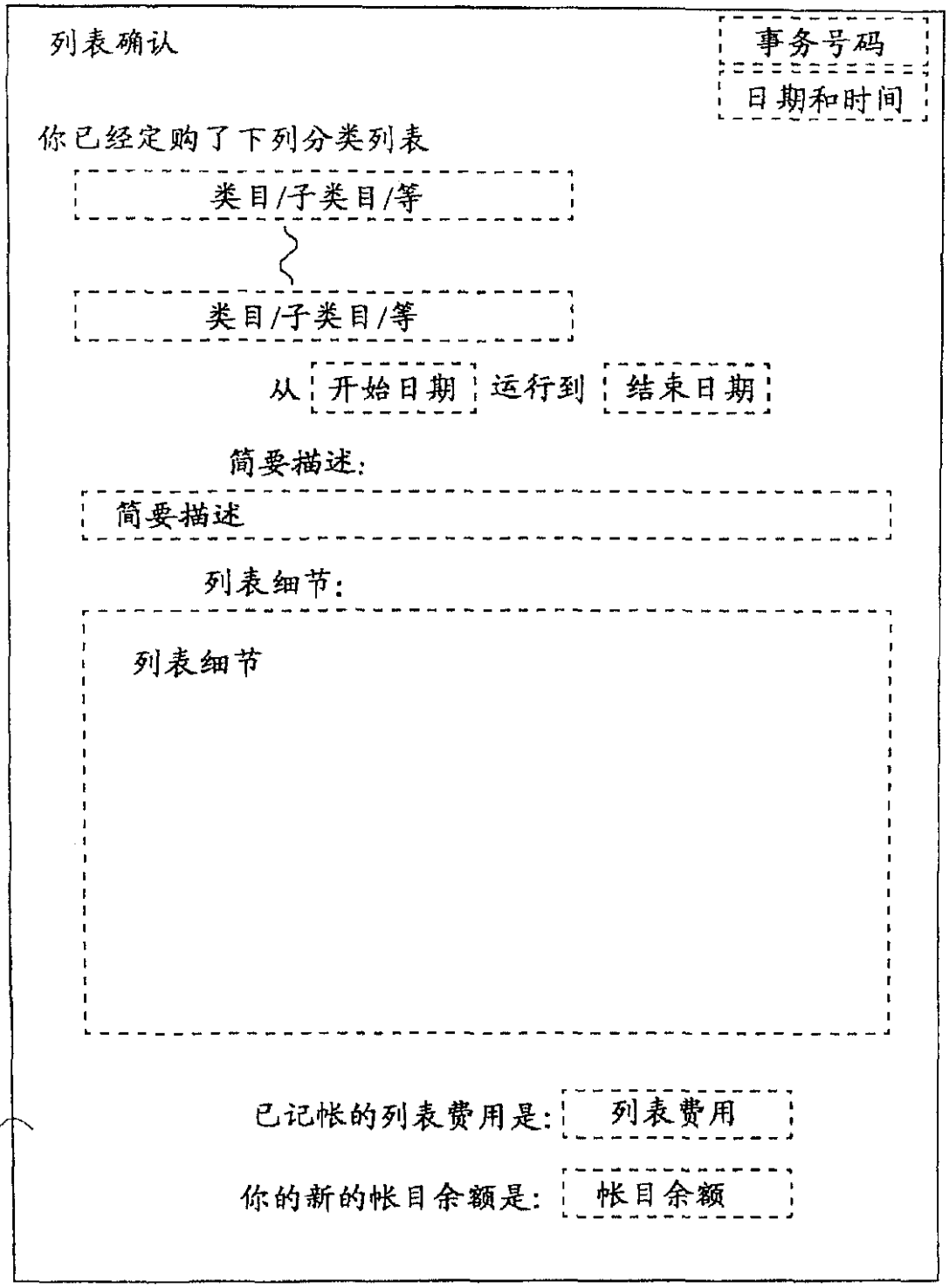

列表确认
事务号码
日期和时间
你已经定购了下列分类列表
类目/子类目/等
类目/子类目/等
从 开始日期 运行到 结束日期
简要描述:
简要描述
列表细节:
列表细节
525
已记帐的列表费用是: 列表费用
你的新的帐目余额是: 帐目余额

图 56