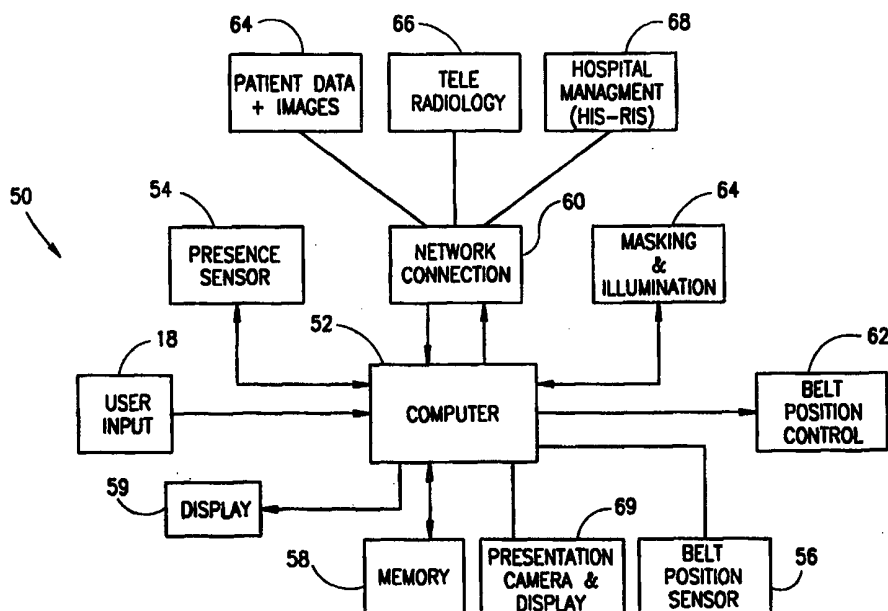




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(54) Title: TRANSPARENCY VIEWING SYSTEM



(57) Abstract

Apparatus for viewing a plurality of transparencies comprising: a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies; a conveyor which conveys transparencies to and from the viewing positions; a memory which contains information associating said transparencies into groups; and a controller which controls the backillumination of the viewing positions and the conveyor, wherein said controller, in response to said information stored in said memory, supplies backillumination suitable for viewing said transparencies only to those positions which contain transparencies from the group.

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TRANSPARENCY VIEWING SYSTEM

FIELD OF THE INVENTION

This invention is related to systems for viewing transparencies, in particular medical film transparencies. The invention relates in particular to alternator and other viewing systems for simultaneous viewing of a number of transparencies.

BACKGROUND OF THE INVENTION

Systems for viewing medical transparencies or medical films are well known in the art and are generally referred to as viewboxes. In particular, alternators or motorized viewer systems which allow for viewing a substantial number of transparencies at the same time and for changing the transparencies being viewed, are well known. In general, alternators comprise a transport means which transports transparencies for viewing on a large back lit viewing surface. Generally, a larger number of transparencies are stored in the alternator (either in a storage magazine or on the transport means itself) than can be viewed at one time. The user can operate the transport means such that those transparencies which he desires to view are brought to the viewing surface. In general, the user can control the motion of the transparencies and can stop and start the motion at will.

Generally, the transport means comprises a sheet of plastic or a series of wires to which transparencies can be attached. Motion of the sheet or wires moves the transparencies to positions overlaying the viewing surface at which the transparencies can be viewed.

Alternators typically operate in one of two ways. One type of alternator comprises a storage magazine in which a large number of transparencies are stored. These transparencies are serially transported from the storage magazine in order and are brought up to the large viewing surface on which they are displayed.

In a second type of alternator, transparencies are loaded directly onto a transport means, by mounting the transparencies on the means at the viewing surface. As the transparencies are mounted, the user operates the transport means to move the mounted transparencies away from the viewing surface and mounts other transparencies in their place. When it is desired to view the transparencies, the transport mechanism is operated to bring those transparencies which are of interest onto the viewing surface. When not being viewed, the transparencies remain mounted on the transport means and are generally above, beneath or behind the viewing surface.

In general, transparencies are pre-loaded by a technician or assistant, in accordance with studies or patients, and a physician (generally a radiologist or other diagnostician) operates the transport mechanism when he wishes to change the transparencies on view.

SUMMARY OF THE INVENTION

It is an object of some aspects of the present invention to provide an improved alternator or motorized viewer system in which a particular study may be viewed without distraction from images of another study.

5 It is an object of some aspects of the invention to provide an improved alternator system in which the transparencies in a study are displayed in a optimum position on the viewing surface.

It is an object of some aspects of the invention to provide an improved alternator in which a user can call up a study and in which the transparencies of the study are displayed in
10 response to the calling up of the study.

It is an object of some aspects of the invention to provide an alternator which has a data-base in which transparencies are identified as belonging to a particular study or are otherwise grouped in one or more groupings.

It is an object of some aspects of the invention to provide an alternator in which
15 information associated with the transparencies in the study are stored in a data-base such that the transparency or a part of the transparency is automatically masked when the transparency is viewed.

It is an object of some aspects of the invention to provide an alternator in which glare, especially during the period when transparencies are being transported, is reduced.

20 It is an object of some aspects of the invention to provide an improved method and apparatus for determining the presence of a transparency on an alternator.

It is an object of some embodiments of the invention to provide for an improved method and apparatus for determining the presence of a finger or other pointer on a transparency on a viewbox.

25 It is an object of some preferred embodiments of the invention to improve radiological diagnosis. Preferably, the diagnosis is improved by means of a two-way communication between a viewbox and hospital information management systems, preferably allowing a transparency study to be viewed in conjunction with patient data.

One broad aspect of some preferred embodiments of the invention relates to the
30 grouping of transparencies in a computer associated with a viewing system (such as an alternator) by association in one or more groups. These groups may be based on any one of a number of criteria, such as, grouping of transparencies of a particular study together, grouping transparencies of a particular patient together, grouping transparencies by whether and/or to whom the transparencies should be viewed and/or the patient treated, grouping by diagnosis,

including positive/negative diagnosis, grouping by agreement or disagreement with a previous diagnosis, grouping by previous diagnosis, groupings by reader, consultant, referring physician, etc.

These groupings may be made by the person loading the transparencies (for example, studies) or by the viewing device and/or its controller or computer (based on reading codes, such as bar codes or my comparisons with information in the computer) or by the reader (diagnosis, transfer of diagnosis, further consultation, remove transparencies, read-again). In general, a transparency (or a group of transparencies, such as a study) can be and preferably is, associated with more than one group.

The association of a transparency (or a group such as a study) with a group is that the grouping makes it simpler to perform repetitive tasks. Some examples of tasks that are controlled by groupings, in accordance with a preferred embodiment of the invention, are given below and they include illumination of all transparencies in a study (either individually or sequentially), sequential viewing of studies pertaining to a particular consultant/viewer or to a particular imaging modality, generation of form letters, especially useful for negative diagnosis and removal of transparencies from the device, automatic referrals for additional tests and/or treatment, etc.

One aspect of some preferred embodiments of the invention relates to associating information with transparencies or ROIs thereof on an alternator. In one preferred embodiment of the invention, the information is entered when the transparency is mounted. Alternatively or additionally, the information may be an annotation added during the viewing of the transparencies. The information may include a patient ID for retrieving data from a hospital information system or from a storage means, such as a disk, connected to the alternator; a graphical annotation, such as a marking or an arrow; a voice recording annotation; a text annotation; a previous diagnosis of the transparency or patient; a current diagnosis of the transparency or patient; one or more ROIs; preferred viewing and backillumination conditions; an associated previous study; an association with other transparencies or regions of interest on the viewer; a mapping between an object on one transparency and the same object on another transparency, in another image, such as a three dimensional image data set or mapping to generalized body coordinates, such as relative to fiducial locations and/or fiducial markers; a physician to refer the diagnosis to and/or an indication what to do with the transparency after the viewing.

In a preferred embodiment of the invention, when transparencies are removed from the alternator, the alternator indicates, for selected transparencies, that they must be sent to a

special location and/or dedicated instructions therefor. Preferably, the alternator is set into a transparency removal mode. Alternatively or additionally, removal of a transparency is automatically detected and the alternator is set, at least temporarily, into a transparency removal mode. In one preferred embodiment of the invention, the indication is simply a highlighting of the transparency. Alternatively or additionally, detailed instructions may be displayed. Alternatively or additionally, the indication may be acoustic, such as a tone or a recorded speech annotation.

Another aspect of some preferred embodiments of the invention relates to random access to transparencies on an alternator. As a result, an operator is not constrained to mount the transparencies in any particular order, except, that in some cases, certain mounting orders may provide a shorter average transparency transport time, for certain alternators and/or viewing orders. In accordance with one preferred embodiment of the invention, a user can manually instruct an alternator to randomly access (view) any selected transparencies and/or ROIs thereon. As a result of such an instruction, one or more transparencies are transported into a viewable position and backilluminated. In a preferred embodiment of the invention, a plurality of transparencies and/or ROIs thereof may be grouped into a set of transparencies. Such a set preferably has a preferred viewing order. Alternatively or additionally, a transparency may belong to more than set. Alternatively or additionally, a transparency may include more than one ROI, possibly each ROI in a different set. In a preferred embodiment of the invention, when a user views a set of transparencies, he simply requests a next or a previous transparency.

In a preferred embodiment of the invention, a set is associated with a particular physician and/or a particular patient. Thus, when a physician approaches the alternator, he enters his identification and only the transparencies relevant for him are displayed and/or backilluminated.

Alternatively or additionally, a user can define a set and/or a viewing order based on a query and/or sorting of information associated with the transparencies or ROIs. In one example, a user can request only those transparencies which require a diagnosis within the next hour. In another example, a supervisor can view all the transparencies to be diagnosed or already diagnosed by a group he is supervising.

In some preferred embodiments of the invention, an ROI in one transparency may be associated with one or more ROIs in the same and/or in one or more other transparencies. Preferably, when the ROI in the first transparency is displayed, the other transparencies and/or ROIs are also back-illuminated. Preferably, when the ROI in one transparency is moved,

resized, its backillumination modified and/or otherwise changed, by a user or by the alternator, the associated ROI may also be automatically changed. Preferably, changes in size and/or location are responsive to a mapping between the transparencies which include the ROIs. Preferably, changes in illumination are responsive to the local density and/or chromaticity at the ROIs. In general, such mapping of ROIs and automatic scanning of ROIs (described below) may utilize ROI modification tools, such as described in PCT applications listed below, for example, automatic ROI sizing and shaping, backillumination adjustment, soft masking and masking of bright areas.

In a preferred embodiment of the invention, a "momentary free-space" mode is provided, in which an alternator momentarily clears a portion of the viewing surface for the momentary mounting of transparencies. Such a mode is useful when, while a physician is viewing transparencies on an alternator, the physician is requested to "just take a look" at a newly arrived transparency. In a preferred embodiment of the invention, the physician operates a "free-space" control and the motorized viewer clears some space on the viewing surface, for example by moving belts to bring an empty space to the viewing area or by returning transparencies to a storage magazine. The amount of free space may be pre-set or selected between one of several pre-set values. Alternatively or additionally, the free-space control allows the specification of an amount of free space. Alternatively or additionally, the free space is provided responsive to an image of the new transparency, acquired as the transparency is placed in front of the viewing surface. In a preferred embodiment of the invention, once the "free-space" viewing is completed, the physician may return to the previous viewing session, for example using the same free-space control. In some cases, the momentarily viewed transparencies are first removed from the viewing device. In other cases, the transparencies may remain mounted on the viewing device, for example if a second opinion is required. In any case, the information associated with the transparencies and/or communication with remote computers may be applied to these transparencies, as described herein.

A "free-space" mode may also be implemented in a non-motorized viewbox, wherein a viewer is in dialog with the viewbox. Thus, in the middle of backillumination manipulation, data entry and/or other specific transparency related operations, a physician can save the current state of the system in order to view a different transparency (or study). The different transparency may be placed instead of the existing transparencies or in addition to them, on an unoccupied portion of the viewing surface. Usually however, it is undesirable for the existing transparencies to be backilluminated while viewing the different transparency. Also, the optimal ambient illumination conditions may be different. The "free space" mode may be

implemented as a stack, whereby the previous state is pushed and then popped back up when the intrusion is over. Alternatively or additionally, a plurality of viewing states may be stored, and selected between. If a transparency was removed and not returned at the end of the intrusion, the viewbox preferably indicates this to the viewer, for example by detecting that the number, size and/or position of the transparencies is changed. Alternatively or additionally, the viewbox, when returning to a previous viewing configuration, displays a list of all the previously displayed transparencies. Alternatively or additionally to intrusion due to an asynchronic viewing of a transparency, a viewing state may be stored when leaving the viewbox, for example, when going out to lunch.

Another aspect of some preferred embodiments of the invention relates to the integration of a computer display with backilluminated transparencies. In accordance with one preferred embodiment of the invention, the display is used to display information associated with the currently viewed transparency (s) and/or ROI (s). Alternatively or additionally, the display shows an electronic copy of a different radiological study. Alternatively or additionally, the display, in association with a suitable input device such as a keyboard and/or mouse, is used for entering information and associating it with one or more transparencies or ROIs. It should be appreciated that any entered information may immediately affect the back illumination of the transparencies. Alternatively or additionally, the display is used to aid in navigating between transparencies and ROIs. In one example, a user can select a transparency to view by indicating it on the display. The indication may include graphics, text and/or a reduced size image. Alternatively or additionally, the display may be used to monitor the process of studying the transparencies.

In a preferred embodiment of the invention, the display is remotely located from the alternator, so the data and/or diagnosis and/or annotations and/or supervision and/or selecting of what is to be diagnosed may be performed from a remote location.

In a preferred embodiment of the invention, the alternator includes two data terminals, one for entering information while loading transparencies and one for entering and/or displaying information while viewing them. Additionally or alternatively, the alternator may include a terminal for displaying and/or entering information while removing transparencies. Preferably, the alternator is configured so that it can perform at least two of the above three activities simultaneously. Thus, new transparencies can be added and/or removed while other transparencies are viewed. In one preferred embodiment of the invention, transparencies may be added to or removed from storage magazines of the alternator, while other transparencies from said magazines are being transported to the viewing surface.

Alternatively or additionally, a transparency may be added out of sequence, for example by physician attaching a transparency to the belt, on the viewing surface. Preferably, such a transparency is automatically detected and is entered into the database with any available information (size, diagnosis). In some cases, a physician may be prompted to enter at least a patient ID for the transparency. Alternatively, such an ID may be read off the transparency. Preferably, the alternator controls the camera to zoom in on an optical ID bearing portion, the portion is acquired and the ID is determined. Preferably, a bar code is used to identify the study. Such a bar code may also be marked on the envelope. Alternatively, the ID may be encoded using an electromagnetic transponder, which is read by the alternator. Such a transponder may also include thereon patient information such as a patient file and/or transparency related information, such as a previous diagnosis.

Another aspect of some preferred embodiments of the present invention relates to a communications connection between an alternator and external information systems. Such a connection may be by removable computer media. Preferably however, an on-line communication is provided. One type of connection is to tele-radiology systems, which can provide other radiological images, annotations, diagnostic information and/or the ability to update such information and images. Another type of connection is to a hospital/patient information system. This type of connection can be used to provide general patient data, such as age, stay in hospital, type of insurance coverage, patient medical history and/or previous diagnosis. In addition, such a system may provide a list of specialists available to provide a diagnosis for a certain problematic image and whether they can accept tele-radiology images. Another type of connection is to a management system, which can be used to read and/or update administrative data, such as scheduling (e.g., set up consulting appointments), billing, assign the diagnosis to particular doctors and/or prepare response letters to patients and/or their insurance company. Such an automated management system is especially useful for screening studies, such as mammography, where a large number of patients are screened and a simple yes/no/do biopsy is a satisfactory answer. It should be appreciated that often two or more of these types of systems are integrated as a single system. However, in most cases, the number of systems and their operation is handled by the alternator and is transparent to the user.

Another aspect of some preferred embodiments of the invention relates to providing comfortable viewing of transparencies and/or of ROIs thereon. In a preferred embodiment of the invention, a currently viewed transparency is moved to a comfortable viewing location, such as to the eye level. Other aspects of a comfortable viewing location include, neck angle, distance between eye and transparency and/or viewing angle (horizontal and/or vertical). It

should be appreciated that different viewers will have different optimal ergonomic viewing positions to which transparency viewing is preferably adjusted. Preferably, different physicians have associated with them different viewing positions and/or lighting and/or backillumination criteria. Alternatively or additionally, different positions are used when the physician is seated or standing. The posture of the physician may be determined using a pressure sensor in a chair, using the camera and/or by a user indication.

Another aspect of some preferred embodiments of the invention relates to the integration of an alternator or a viewbox with a camera. In a preferred embodiment of the invention, the camera is used to acquire an image of at least a portion of a transparency of interest. The image may be processed and then displayed, preferably on the display described above. The processing of the image may be responsive to any of the information associated with the image. In order to view a particular ROI of a particular transparency, the camera and/or the alternator move so that the ROI is within the field of view of the camera. Alternatively or additionally, the camera may change its direction of gaze. Alternatively or additionally, the camera may change its zoom. In accordance with a preferred embodiment of the invention, the camera is automatically pointed at a ROI to be viewed based on the known and/or stored positions of the transparencies and ROIs thereof. In a preferred embodiment of the invention, the camera is automatically pointed at a ROI to be viewed, responsive to a previously entered viewing sequence and a simple "next" command. Preferably, the sequence is defined in terms of studies. In one preferred embodiment of the invention, the camera has only one degree of freedom of motion and the transparencies are automatically transported into the field of view of the camera. Alternatively, the camera has two or more degrees of freedom of motion. In a preferred embodiment of the invention, the field of view of the camera is automatically changed to match the size of the ROI to be viewed.

In a preferred embodiment of the invention, the camera may be programmed or manually instructed to acquire a plurality of images and show them sequentially and/or side by side on the display. Alternatively or additionally, the display may show an acquired image alongside with a stored image. Alternatively or additionally, one image is an overview image and one or more other images comprise detail images. Alternatively or additionally, the camera may scan an ROI or a transparency, for example, top down. Preferably at least two associated ROIs are simultaneously scanned and/or their scanning is displayed simultaneously. Alternatively or additionally, the camera may serially scan a plurality of ROIs so as to provide a continuous scan of contiguous body parts shown on two or more ROIs or transparencies. Alternatively or additionally, the scanning is of two or more views of a single body part.

Preferably, the scanned portions are transmitted to a three-dimensional reconstruction tool to reconstruct a three-dimensional representation of the scanned ROI. Alternatively or additionally, the scanned ROIs are overlaid on a three-dimensional data set of the same body portion, optionally of the same patient.

5 In a preferred embodiment of the invention, the display includes two or more side-by-side displays. Preferably, one display is used for an overview image and one for a detailed image.

In a preferred embodiment of the invention, the display comprises a group display unit. In accordance with a preferred embodiment of the invention, an alternator includes a camera
10 which can selectively image portions of the viewing surface. The imaged portions are preferably displayed on a large display monitor, suitable for group viewing. Alternatively, the imaged portions may be transmitted, using means known in the art to a remote, tele-radiology, station.

In accordance with another preferred embodiment of the invention, the imaged portion
15 of the viewing surface is passed through an artificial vision portion of the alternator for processing prior to display on a group display. The artificial vision portion may also be used to detect transparencies, fingers (of the operator) and image characteristics, as described in PCT applications listed herein. In a tele-radiology situation, the captured image may be compressed and/or transmitted through a network connection of the alternator. In a preferred embodiment
20 of the invention, the processing includes, *inter alia*, windowing, image enhancement, addition of symbols, display of patient information, a comparison of two or more images, information from a computer aided diagnosis system and/or a cine sequence of previously acquired portions of transparencies.

In a preferred embodiment of the invention, where a camera is used for controlling the
25 backillumination, the camera used for imaging the viewing surface is the same camera used for controlling the backillumination. Alternatively, different cameras are used for the two functions.

In a preferred embodiment of the invention (for example, utilizing the second type of alternator described in the Background of the Invention) an alternator operates in either a
30 loading mode or a viewing mode. In the loading mode, a technician or other operator loads transparencies from a first study onto a portion of the transport means which is at the viewing surface, i.e., the operator loads the transparencies as though he would be viewing them. When the operator has finished loading all the transparencies in a given study, he presses a button or other indicator to indicate that he has finished loading transparencies associated with the first

study. The positions of the transparencies of the first study on the transport mechanism are preferably stored in a memory.

The operator then mounts the transparencies of the second study. He may, of course have to activate the transport mechanism to clear space for the second study. As for the first study, when he has finished mounting these transparencies, indicates to the alternator that all the transparencies in this second study have been mounted. The positions of these transparencies on the transport mechanism are also recorded.

Additional studies are mounted until all the studies to be viewed by a physician are mounted or until the entire transport or storage mechanism is full.

Alternatively, the studies are mounted directly into storage frames, in a frame-transport type alternator. Preferably, the operator indicates to the alternator a preferred viewing position and/or order and/or group association for the transparencies.

In a preferred embodiment of the invention, the studies may be grouped logically, but not necessarily mounted according to the specialty and/or identification of the physician who will later view the transparencies. Thus, during a later viewing session, only those studies which are to be viewed by the particular physician will be displayed on the viewing surface. Alternatively or additionally, a subset of the transparencies may be annotated. One type of annotation is highlighting, so that a particular subset of transparencies is visibly different. Highlighting (marking) may be performed by providing a more intense backillumination to the highlighted transparencies. Alternatively, the transparencies are surrounded by a border of light. Alternatively, a specially shaped and/or patterned backillumination pattern and/or ROI border is used, for example a circle or a checkerboard pattern. Alternatively or additionally, the highlighting is intensity based. In a preferred embodiment of the invention, marking with color is achieved by controlling backillumination hue. Alternatively or additionally, color effects are achieved by opening a front spatial masker in a system with two or more LCD spatial mask generators.

In some cases, the highlighted transparency is suitable for viewing and/or diagnosis, while it is highlighted; in others, not. In a preferred embodiment of the invention, a plurality of ROIs are simultaneously highlighted, preferably using different highlighting parameters for each set of ROIs.

In a preferred embodiment of the invention, one or more transparencies and/or studies may be physically annotated by the alternator, for example to mark that they were viewed and/or their diagnosis. In one example, a transparency is annotated on a paper covered portion thereof. Alternatively or additionally, the marking is directly onto the transparency.

Alternatively or additionally, the alternator may print out stickers which are then affixed to the transparency, manually or automatically.

In a viewing mode, a viewer activates the alternator and, using an interface mechanism, calls up a study. He may call the study by study number (assigned during the loading mode) or may view the studies seriatim. In either case, in accordance with a preferred embodiment of the invention, the transparencies associated with the study which is called up are transported to the viewing surface. At that time only those portions of the viewing surface which contain transparencies of the study which is called up are automatically illuminated and other transparencies, related to other studies which are also present at the viewing surface are not illuminated. This avoids both distraction and glare from the other transparencies, which reduce the ability of the physician to quickly perform his diagnosis. In a preferred embodiment of the invention, if it is not possible to show all the relevant transparencies/studies at the same time, a special indication is displayed. Preferably, a simple control is provided for viewing the non-displayed studies, for example, a within-study "next" control.

The illumination of only parts of the viewing surface may be accomplished, *inter alia*, by providing separate back illumination for separate sections of the viewing surface and/or by providing mechanical, optical or electro-optical shutters for blocking back-illumination of those portions of the viewing surface which either contain no transparencies or which contain transparencies related to a different study.

Additionally or alternatively, in a preferred embodiment of the invention, the viewing surface is further masked such that only the transparencies themselves are illuminated and the areas between the transparencies are not illuminated. In a further preferred embodiment of the invention, only that portion of the transparency that contains an image is illuminated or, alternatively, only a portion of the image which is of interest (ROI) is illuminated. The masking of the transparency may be pre-set during the loading mode either automatically or "manually" by the assistant. This pre-set masking is then saved together with the position information. When the study is viewed during the viewing mode, the transparencies are automatically masked in accordance with the stored pre-set masking information.

Alternatively or additionally, the masking is performed during the viewing phase or, alternatively, the pre-set mask is used as the starting point for a masking operation during the viewing phase. Thus, if the transparency shifts slightly during transport, the mask may be modified during the viewing phase. However, starting with a pre-set mask saves time and avoids glare.

In a preferred embodiment of the invention, new ROIs and/or annotations and/or images acquired by the camera may be stored for use during a consultation. In a consultation mode, a consultant views only those ROIs which require his special input. Although, of course, the consultant can view any transparency or ROI he desires. In one preferred
5 embodiment of the invention, the consultant is at a remote location and views the ROIs as images acquire by the camera and transmitted using a tele-radiology system. Preferably, the consultant can control the alternator directly from his remote location. Alternatively or additionally, to a consultant, the transparencies and ROIs may be displayed to a group, for instructional purposes. In some cases, the same original viewer, may act out the part of the
10 consultant.

In a preferred embodiment of the invention, the viewer may mark some of the transparencies, ROIs and/or studies as being symptom free and others as requiring further study or follow up. Preferably, when the studies are removed reporting letters may be automatically generated, by an associated computer. The reporting letters may include a
15 positive report and/or may suggest follow-up. Alternatively or additionally, the letters are electronic letters which set up appointments for the follow-up. In a preferred embodiment of the invention, the physician and/or other viewer, such as a technician may designate specific viewing parameters and/or highlighting parameters for one or more transparencies and/or studies.

20 Additionally, since transparencies often fall off the transport means when the transparencies are behind the viewing surface, in a preferred embodiment of the invention, the alternator includes means for warning the user when a transparency has been so removed. This indication can consist of a warning light or other warning means, or can consist of the illumination of the area of the transparency which is missing. This determination and
25 indication of missing transparencies is easily performed by the alternator, since it learned, during the loading mode, which areas should contain transparencies.

In a preferred embodiment of the invention, the stored information related to the presence of a transparency is updated only when a transparency is properly removed, i.e., if it removed when the transparency is at the viewing surface.

30 In accordance with a preferred embodiment of the invention, the viewing surface is not illuminated during transport of the transparencies to their positions on the viewing surface. Alternatively, the viewing surface is illuminated with a low level light which allows for faster acclimatization of the viewer when the transparencies are in place and illuminated and for faster orientation of the viewer.

In a preferred embodiment of the invention, transparencies are optimally positioned on the viewing surface. In general, alternators show two to four rows of transparencies at the same time. Some of the rows are above normal eye level and occasionally, some are below normal eye level. In this embodiment of the invention, the transport mechanism automatically
5 positions the study such that as much as possible of the study is at the row closest to eye level, for ease of viewing.

Another aspect of some preferred embodiments of the invention relates to using a computerized alternator for training and/or testing. As can be appreciated, an alternator as described herein includes the ability to selectively and automatically display transparency
10 studies, accept, act on and store a user's commands and apply a set of predefined viewing commands. Thus, a viewer being tested can be shown one or more transparencies to set viewing parameters for and/or to diagnose. Once the viewer has completed the task, a correct diagnosis and/or viewing setting may be shown. In addition, the effects of various viewing parameters and/or a plurality of studies of similar test cases may be shown, to enhance a
15 teaching effect. Furthermore, any action, including timing of such actions may be stored, for example, to assess a progress of a viewer.

While in certain preferred embodiments of the invention the viewing surface can be masked, as for example described in one or more of PCT/EP94/03968, filed November 28, 1994, published as WO 95/14949; PCT/EP95/04693 filed November 27, 1995, published as
20 WO 96/17269; PCT/EP94/03971, filed November 28, 1994, published as WO 95/14950; PCT/EP91/01310, Filed July 11 1991, published as WO93/01564; PCT/EP91/00065, filed December 28, 1990, published as WO91/10152; PCT/IL97/00361, filed November 10, 1997; PCT/EP94/04228, filed December 15, 1994, published as WO95/16934; PCT/IL96/00163, filed November 24, 1996, published as WO97-19371; PCT/IL97/00441, filed December 31,
25 1997; PCT/EP96/01878, filed may 2, 1996, published as WO97/35138; PCT/IL96/00023, filed June 20, 1996, published as WO97/01126; PCT/IL96/00026, filed June 20, 1996, published as WO97/01127; US application serial number 07/862,982 filed April 6, 1992; and US application serial number 08/890,408, filed July 9, 1997, the specifications of which are incorporated herein by reference, in other preferred embodiments the masking can be
30 mechanical, as described for example in PCT application PCT/IL96/00023 and as known in the art. In some aspects of the invention, no masking is used.

Furthermore, while the invention is described herein mainly with reference to an alternator without a storage magazine, i.e., one in which the transparencies are mounted on a sheet or wires and remain mounted on the sheet or wires until removed by the operator, most

aspects of the invention are also applicable to alternators which utilize a magazine for storage of transparencies. When such an alternator is used, the identification of the transparencies with a study is performed manually, preferably during a preview of the transparencies in the magazine by a technician or assistant. In a preferred embodiment of the invention, the order in which the transparencies are displayed and their physical grouping on the alternator is determined by the grouping assigned to the transparencies in the preview and is not necessarily the same as the order in which they are loaded in the magazine.

It should be appreciated that many of the features described herein may also be applied to non-alternator viewboxes, in which the transparencies are statically positioned on a display surface. In one example, a plurality of studies may be backilluminated and manipulated as described herein on a multiple-viewing-surface viewbox. In another example, a non-motorized viewbox may also include a "load" mode and a "view" mode. In a preferred embodiment of the invention, each transparency is individually identifiable by the viewbox, for example, using a bar code printed thereon. When a transparency is "loaded" and/or "viewed", various information may be associated therewith, for example, preferred viewing parameters, a highlighting and/or an ROI. Then, the transparency is removed. When the transparency is again placed on the viewbox, it is identified, preferably automatically, and the associated information is used to control the viewing. In a preferred embodiment of the invention, the viewbox also keeps track of which transparencies/studies were loaded. Alternatively or additionally, the viewbox prompts an operator to place a particular viewbox.

In a preferred embodiment of the invention a sensor determines the presence of a transparency based on reflection from the transparency. In this method, the transparency is illuminated from behind the viewing surface utilizing a light source, preferably having a wavelength outside the visible range. The presence of the transparency is determined by the output of a sensor, adjacent the transparency. Preferably, the light source and sensor are packaged together. The transparency, which is generally made of plastic film, has the effect of reflecting a portion of the illumination, even if the transparency is dense, such that a signal is generated by the sensor when the transparency is present.

When the transparency is mounted on a (plastic) belt, the effect of the belt is similar to that of the transparency, such that a signal would be generated, similar to that generated by a transparency, when the belt is present. Therefore, in a preferred embodiment of the invention, the belt is provided with holes near the attachment points of the transparencies, which holes line up with the light source/sensor when the transparencies are in position for viewing on the viewing surface. Determinations of the presence of transparencies are made only at those

positions of the sheet. Alternatively or additionally, the belt, at least in some portions thereof, is made of a light absorbing material.

An additional problem in determining the presence of a transparency is the large amount of ambient light which is received by the sensor. While it is possible to reduce the interference caused by this light using narrow band illumination and pre-filtering of the sensor, performing synchronous detection on pulsed light and other such means, it has been found that the effects of daylight and light modulated with a low frequency can be eliminated or greatly reduced utilizing base line restoration of a signal generated by the sensor, if the illumination produced by the light source is pulsed and has a high enough rate of change of intensity. Of course, this requires that the sensor be designed to operate over a range which is large enough to encompass the total range of light which may be expected, under varying illumination conditions. This amount of light can be several orders of magnitude greater than that of the signal which is being measured. Base line restoration is preferably used alone, but may be used in addition to others of the above enumerated methods of reducing the effects of varying background illumination.

In a preferred embodiment of the invention, a baseline restorer, preferably a Robinson baseline restorer, is used to ignore variations in a baseline, caused for example by slowly varying ambient light.

There is thus provided in accordance with a preferred embodiment of the invention apparatus for viewing a plurality of transparencies comprising:

- a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;

- a conveyor which conveys transparencies to and from the viewing positions;

- a memory which contains transparency information associated with individual ones of said transparencies.

There is also provided in accordance with a preferred embodiment of the invention, apparatus for viewing a plurality of transparencies comprising:

- a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;

- a conveyor which conveys transparencies to and from the viewing positions;

- a memory which contains transparency information associated with groups of said transparencies.

Preferably, the apparatus comprises a controller which operates in at least two distinct modes, a viewing mode and a loading mode, wherein at least some of said transparency

information is inputted in said loading mode. Preferably, at least some of said transparency information may be entered during a viewing mode. Alternatively or additionally, wherein said loading mode is optimized for loading a large number of transparencies on said apparatus and wherein said viewing mode is optimized for high throughput viewing of transparencies on said apparatus.

5 In a preferred embodiment of the invention, said transparency information comprises an association of said transparencies into groups. Alternatively or additionally, said transparency information comprises at least one highlighting parameter for at least one ROI on said transparencies. Alternatively or additionally, said transparency information comprises
10 viewing parameters for at least ROIs on said transparencies. Preferably, said viewing parameters comprises backillumination parameters. Alternatively or additionally, said viewing parameters comprises ambient light viewing conditions. Alternatively or additionally, said viewing parameters are utilized when backilluminating a transparency.

In a preferred embodiment of the invention, said transparency information comprises a
15 list of transparency loci, which loci may be selectively brought to said viewing surface. Alternatively or additionally, said transparency information comprises position information regarding the viewing positions of said transparencies, and the apparatus comprises:

a camera which selectively images portions of the viewing surface;
a controller which controls at least one parameter of a field of view of the camera,
20 wherein said controller, in response to said transparency information stored in said memory, changes said at least one parameter of the camera. Preferably, said at least one characteristic comprises a zoom-factor of the field of view. Alternatively or additionally, said at least one characteristic comprises at least one spatial coordinate relative to said viewing surface. Preferably, said controller controls said conveyer to align said transparencies with said
25 field of view.

In a preferred embodiment of the invention, said controller controls said backillumination responsive to signals from said camera. Alternatively or additionally, a plurality of said transparencies are associated as a group with a viewing order and wherein said controller controls camera to sequentially view said grouped transparencies.

30 In a preferred embodiment of the invention, said transparency information comprises annotations for said transparencies.

In a preferred embodiment of the invention, the apparatus comprises an image display for displaying said images. Preferably, said image display comprises a group display. Alternatively or additionally, said image display comprises a remote display.

In a preferred embodiment of the invention, said apparatus comprises a user input for selecting certain ones of said transparencies. Preferably, said controller selectively controls said camera to view at least portions of said selected transparencies.

5 In a preferred embodiment of the invention, said controller selectively controls said camera to view at least portions transparencies, responsive to said transparency information. Preferably, said controller is operable in at least a film mounting mode and a film viewing mode and said user input is operative to select certain ones of said transparencies during said film viewing mode. Preferably, said user input is operative to select during said film mounting mode.

10 In a preferred embodiment of the invention, the apparatus comprises an image processor which processes said imaged portions. Preferably, said image processor corrects geometric distortions in said imaged portions. Alternatively or additionally, said image processor processes said imaged portion responsive to said information stored in said memory.

15 In a preferred embodiment of the invention, said transparency information comprises grouping information which associates said transparencies into groups and the apparatus comprises:

a controller which controls the backillumination of the viewing positions and the conveyor,

20 where said controller, in response to said transparency information, supplies backillumination suitable for viewing said transparencies only to those positions which contain transparencies from a particular group of said groups. Preferably, said grouping information associating the transparencies into groups is acquired by the memory responsive to the placement of said transparencies on the viewing surface. Preferably, the apparatus comprises a user interface by which an operator indicates that transparencies belonging to a new group are
25 being placed on the viewing surface. Alternatively or additionally, the apparatus comprises a user interface by which a user indicates that the transparencies are associated with a group to be viewed. Alternatively or additionally, the controller positions transparencies in a group in a viewing position on the viewing surface, responsive to said transparency information. Preferably, said viewing position comprises a comfortable viewing position.

30 In a preferred embodiment of the invention, said transparency information comprises an association of at least one of said transparencies with a particular reader. Alternatively or additionally, said transparency information comprises an association of at least one of said transparencies with a particular specialty. Alternatively or additionally, said transparency information comprises an order of viewing of a plurality of said transparencies. Preferably,

said transparency information comprises a second order of viewing of said plurality of said transparencies.

In a preferred embodiment of the invention, said transparency information comprises a current diagnosis of at least one of said transparencies. Alternatively or additionally, said transparency information comprises a previous diagnosis of at least one of said transparencies. Alternatively or additionally, said transparency information comprises a current diagnosis of said patient. Alternatively or additionally, said transparency information comprises patient information. Preferably, said transparency information comprises examination results for said patient. Alternatively or additionally, said transparency information comprises clinical information. Alternatively or additionally, said transparency information comprises demographic information.

In a preferred embodiment of the invention, said transparency information comprises a referral of at least one of said transparencies to a another clinical body.

In a preferred embodiment of the invention, the apparatus comprises a network connection for communicating between at least one remote computer and said apparatus. Preferably, said apparatus transmits at least some of said transparency information over said network. Alternatively or additionally, said apparatus receives at least some of said transparency information over said network. Preferably, said information is requested by said apparatus in association with backillumination of particular transparencies.

In a preferred embodiment of the invention, the apparatus comprises a second user interface for entering at least some of said transparency information.

In a preferred embodiment of the invention, the apparatus comprises a display. In a preferred embodiment of the invention, said controller displays at least some of said transparency information on said display. Preferably, said displayed transparency information is associated with a currently backilluminated transparency.

In a preferred embodiment of the invention, said controller generates grouping information associating said transparencies into groups from said transparency information.

In a preferred embodiment of the invention, at least one of said groups has a display order defined thereon, within a the group, and wherein said controller supplies backillumination to transparencies responsive to said order.

In a preferred embodiment of the invention, said controller highlights at least a portion of one of said transparencies. Preferably, the apparatus comprises a memory associating highlighting parameters with said at least a portion of one of said transparencies.

In a preferred embodiment of the invention, said groups comprises studies. Alternatively or additionally, said groups are defined across studies. Alternatively or additionally, at least one transparency simultaneously belongs to more than one group.

In a preferred embodiment of the invention, the apparatus comprises a pointing device
5 for controlling at least some functions of said apparatus. Alternatively or additionally, the apparatus comprises a plurality of manual controls for controlling at least some functions of said apparatus. Alternatively or additionally, the apparatus comprises a graphical interface for controlling at least some functions of said apparatus.

In a preferred embodiment of the invention, said transparencies comprise medical
10 transparencies.

There is also provided in accordance with a preferred embodiment of the invention, apparatus for viewing a plurality of transparencies comprising:

a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;
15 a conveyor which conveys transparencies to and from the viewing positions;
a camera which selectively images portions of the viewing surface;
a controller which controls the backillumination of the viewing positions and the conveyor; and
an image processor,
20 wherein said image processor processes images from said camera, for display and wherein said image processor analyses at least one acquired image of transparencies on said viewing surface, to determine a suitable backillumination.

Preferably the apparatus comprises a memory associating transparency information with said transparencies. Preferably, said image processor processes said images responsive to
25 said transparency information to generate at least one processed image. Preferably the apparatus comprises a display for displaying said at least one processed image.

In a preferred embodiment of the invention, said image processor corrects geometric distortion in said imaged portions. Preferably, said distortion correction is responsive to at least the location of the viewing position imaged by the camera.

30 There is also provided in accordance with a preferred embodiment of the invention, a method of transparency viewing, comprising:

providing a plurality of transparencies on a motorized transparency viewer;
providing a list of loci of at least ROIs associated with selected ones of said transparencies; and

selectively viewing individual ones of said loci, by selecting at least one of said loci from said list. Preferably, the method comprises controlling viewing parameters for said selected loci, responsive to a set of viewing parameters associated with said loci. Alternatively or additionally, said at least ROIs comprise complete image bearing portions of transparencies.

5 There is also provided in accordance with a preferred embodiment of the invention, a method of detecting a pulsed light signal comprising:

supplying a composite signal comprising a pulsed light signal having a particular rate of change together with a background of slowly changing light levels; and

applying base line restoration to the composite signal, said base line restoration being
10 operative to remove signals having a rate of change lower than said particular rate of change. Preferably, the method comprises generating said composite signal by measuring the reflection of a pulsed light source off of a transparency. Preferably, said transparency is mounted on a belt and wherein said pulsed light source is directed at an aperture in said belt, through which said transparency is visible to said light source.

15 In a preferred embodiment of the invention, said base-line restoration comprises electrical base line restoration. Alternatively or additionally, said base-line restored signal comprises an analog black signal.

There is also provided in accordance with a preferred embodiment of the invention, a method of determining the existence of a transparency on a belt, comprising:

20 mounting a transparency on a belt having apertures defined thereon;
illuminating said transparency through said apertures; and
measuring said illumination after it interacts with said transparency.

Preferably, said interaction comprises reflection. Alternatively or additionally, said interaction comprises transmission. Alternatively or additionally, the method comprises
25 baseline restoring said measured illumination.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency management for a plurality of transparencies mounted on a viewing device, comprising:

30 sequentially backilluminating a plurality of transparencies; and
associating information with individual ones of said transparencies.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency management for a plurality of transparencies mounted on a viewing device, comprising:

sequentially backilluminating a plurality of transparencies; and

associating information with groups of said transparencies.

In a preferred embodiment of the invention, the method comprises receiving said information from a remote computer. Alternatively or additionally, the method comprises transmitting said information to a remote computer. Alternatively or additionally, the method
5 comprises manually entering at least an indication of said information. Alternatively or additionally, said information comprises a visual annotation of at least one of said transparencies.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency management for a plurality of transparencies mounted on a viewing
10 device, comprising:

annotating at least one selected ones of said transparencies; and

displaying an indication responsive to said annotations, when removing ones of said transparencies from said viewing device.

Preferably, said viewing device comprises a motorized viewing device. Alternatively or
15 additionally, said indication comprises a backillumination of said removed transparencies. Alternatively or additionally, said viewing device has several operating modes and comprising changing the mode of said viewing device to a transparency removal mode, prior to said removal of transparencies. Alternatively or additionally, said indication indicates an action to be performed with said at least one transparency. Preferably, said action comprises referring
20 the at least one transparency to an additional reading.

In a preferred embodiment of the invention, said at least one transparency comprises a group of transparencies.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency management for a plurality of transparencies mounted on a viewing
25 device, comprising:

annotating selected ones of said transparencies; and

transmitting an indication responsive to said annotations, to a remote computer. Preferably, said viewing device comprises a motorized viewing device. Alternatively or additionally, said remote computer automatically generates a report responsive to said
30 indication. Preferably, said report comprises a diagnosis. Alternatively or additionally, said report comprises a referral to a future study. Alternatively or additionally, said report comprises a referral to a future patient care.

In a preferred embodiment of the invention, said report comprises a letter.

In a preferred embodiment of the invention, said remote computer stores said indication. Alternatively or additionally, said remote computer utilizes said indication to track usage of said transparencies. Alternatively or additionally, said indication comprises at least part of said annotation. Alternatively or additionally, said annotation comprises a diagnosis.

5 There is also provided in accordance with a preferred embodiment of the invention, a method of transparency management for a plurality of transparencies mounted on a viewing device, comprising:

 annotating selected ones of said transparencies; and
 automatically generating a paper print out responsive to said annotations.

10 Preferably, said printout is generated locally to said viewing device. Alternatively or additionally, said viewing device comprises a motorized viewing device. Alternatively or additionally, said printout is generated at a location associated with a viewer who performs said annotations. Alternatively or additionally, said print out comprises a letter of referral. Alternatively or additionally, said print out comprises a diagnosis letter.

15 There is also provided in accordance with a preferred embodiment of the invention, a method of transparency viewing on a viewing device, comprising:

 transporting at least one transparency to a viewing surface of said viewing device; and
 automatically retrieving information associated with said transparency, from a remote location, in association with said transport.

20 Preferably, a user requests said transport and said automatically retrieving comprises retrieving said information responsive to said user's request. Alternatively or additionally, said transparencies are mounted in said viewing device by an assistant, for later transport to the viewing surface and wherein said retrieving comprises retrieving said information responsive to said mounting.

25 In a preferred embodiment of the invention, said transparencies are grouped into studies and wherein said information is associated with a group of transparencies. Alternatively or additionally, the method comprises:

 viewing said transported transparency; and
 transmitting information from said viewing device to a remote computer responsive to
30 said viewing.

 There is also provided in accordance with a preferred embodiment of the invention, a method of transparency data management, comprising:

 displaying at least one transparency on a viewing device; and

transmitting information from said viewing device to a remote computer responsive to said displaying.

In a preferred embodiment of the invention, said remote computer comprises a hospital data system. Alternatively or additionally, said transmitted information comprises an indication that the transparency was displayed. Alternatively or additionally, said transmitted information comprises an indication of a person who viewed the transparency. Alternatively or additionally, wherein said transmitted information comprises information associated with said transparency. Preferably, said transmitted information comprises a diagnosis of said transparency.

10 In a preferred embodiment of the invention, said at least one transparency comprises a group of transparencies.

In a preferred embodiment of the invention, said plurality of transparencies are mounted on an alternator. Alternatively or additionally, said transparencies comprises medical transparencies.

15 There is also provided in accordance with a preferred embodiment of the invention, a n alternator comprising:

a plurality of locations for mounting transparencies thereon for transport to a viewing surface;

a memory storing therein locations having transparencies mounted therein; and

20 an indicator which provides an indication when one of the locations stored in said memory do not contain a transparency when said location is transported to said viewing surface.

Preferably, the alternator comprises at least one sensor associated with at least one of said locations for determining the presence of a transparency therein. Alternatively or additionally, the alternator comprises a second sensor which detects the presence of transparencies at locations of said viewing surface.

25 There is also provided in accordance with a preferred embodiment of the invention, a n alternator comprising:

a viewing surface;

30 a transport for moving transparencies on said viewing surface;

a backillumination source which selectively illuminates only a portion of said viewing surface, behind at least a portion of at least one of said transparencies; and

a controller which controls said transport to position said at least a portion of a transparency to a viewing position which is comfortable for a viewer of said transparency.

Preferably, said viewing position corresponds to an eye height of said viewer. Alternatively or additionally, said at least a portion of a transparency comprises a group. Alternatively or additionally, said viewing position comprises an ergonomically optimal viewing position. Alternatively or additionally, said at least a portion of a transparency is
5 vertically positioned. Alternatively or additionally, said at least a portion of a transparency is horizontally positioned.

There is also provided in accordance with a preferred embodiment of the invention, a method of viewing transparencies, comprising:

10 mounting a plurality of transparencies onto a viewing device;
first viewing at least some of said transparencies during a first viewing session;
selecting at least one of said first viewed transparencies for a second viewing; and
second viewing said selected at least one transparency during a second viewing session,

15 wherein, said first viewing and said second viewing comprise selective backillumination of said viewed transparencies.

Preferably, the method comprises entering a reader identification and wherein said selective backillumination is responsive to said reader identification. Alternatively or additionally, the method comprises a third viewing, during a third viewing session by a third reader, of at least a second transparency selected during said second viewing. Alternatively or
20 additionally, said first viewing comprises setting ROIs and wherein said set ROIs are utilized by said second viewing. Alternatively or additionally, said viewing device comprises an alternator. Alternatively or additionally, a same reader performs said first and said second viewings. Alternatively, a first reader performs said first viewing and a second, different, reader performs said second viewings.

25 In a preferred embodiment of the invention, the method comprises highlighting at least a portion of said at least one of the first viewed transparencies, during said first viewing. Preferably, the method comprises reproducing said highlighting during said second viewing.

There is also provided in accordance with a preferred embodiment of the invention, apparatus for viewing a plurality of transparencies comprising:

30 a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;
a conveyor which conveys transparencies to and from the viewing positions; and
a controller which controls the backillumination of the viewing positions and the conveyor,

wherein said controller, differently backilluminates said viewing surface when said transparencies are being conveyed and when said transparencies are positioned.

Preferably, said backillumination tracks a progress of said transparencies across said viewing surface. Alternatively or additionally, said viewing surface is backilluminated with a lower, but non-zero, intensity during said conveying as compared to when the transparencies are positioned.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency viewing on an alternator, comprising:

loading a plurality of transparencies on said alternator, by a first alternator operator;
and
simultaneously viewing, by a second alternator operator, a plurality of transparencies previously loaded on said alternator.

Preferably, said loading comprises associating information with said transparencies being loaded. Alternatively or additionally, said simultaneously viewing comprises viewing responsive to information associated with said previously loaded transparencies.

There is also provided in accordance with a preferred embodiment of the invention, a method of alternator use, comprising:

conveying and backilluminating one or more transparencies to a viewing surface;
presenting a question to an operator of said alternator, which question is associated with said backilluminated transparencies; and
recording a response of said operator.

There is also provided in accordance with a preferred embodiment of the invention, a method of alternator use, comprising:

conveying and backilluminating one or more transparencies to a viewing surface;
recording an interpretation entered by an operator of said alternator, entered responsive to said backilluminated transparencies; and
storing said response in association with a previously entered interpretation.

Preferably, said previously entered interpretation comprises a competent final interpretation. Alternatively, said previously entered interpretation comprises a competent tentative interpretation. Preferably, the method comprises storing a disagreement between said tentative interpretation and the later entered interpretation.

In a preferred embodiment of the invention, the method comprises displaying a correct interpretation, in response to said operator's response. Alternatively or additionally, the method comprises modifying said backillumination with a correct backillumination, in response to said

operator's response. Alternatively or additionally, the method comprises generating a range of viewing conditions for said transparency in response to said operator's response. Alternatively or additionally, the method comprises conveying and backillumination a at least a second transparency, responsive to said operator's response.

5 There is also provided in accordance with a preferred embodiment of the invention, a method of alternator use, comprising:

loading a plurality of transparencies onto an alternator;
programming a sequence of showing said transparencies; and
conveying and backillumination said transparencies to a viewing surface of said
10 alternator, responsive to said programmed sequence. Preferably, the method comprises associating transparency information to be displayed with each of said transparencies; and
displaying said associated information when a particular transparency is conveyed according to the sequence.

There is also provided in accordance with a preferred embodiment of the invention, a
15 method of viewing device use, comprising:

registering the presentation of one or more transparencies;
receiving at said viewing device an indication of an interpretation of said at least one transparency; and
storing at least an elapsed time between said presentation and said indicated
20 interpretation.

Preferably, said viewing device comprises a motorized viewing device.

There is also provided in accordance with a preferred embodiment of the invention, a method of viewing device use comprising:

receiving a plurality of commands at said viewing device from an operator of said
25 viewing device; and
recording at least said commands. Preferably, said viewing device comprises a motorized viewing device.

In a preferred embodiment of the invention, the method comprises recording at least an indication of a response of said viewing device to said commands. Preferably, said response
30 comprises a highlighting of at least a portion of a transparency. Alternatively or additionally, the method comprises recording at least an indication of information received by said viewing device from a remote computer.

There is also provided in accordance with a preferred embodiment of the invention, a method of transparency viewing, comprising:

displaying at least one transparency to a first viewer;
receiving a first interpretation of said first viewer;
displaying said transparency to a second viewer;
receiving a second interpretation of said second viewer; and
5 automatically recording an agreement or disagreement between the first and second
interpretations.

There is also provided in accordance with a preferred embodiment of the invention, a
method of viewing transparencies, comprising:

viewing at least one transparency on a viewing device;
10 interrupting the viewing;
storing a viewing configuration at the time of the interruption; and
restoring the viewing configuration at a later time.

Preferably, said interruption comprises a momentary interruption. Alternatively or
additionally, said interruption comprises a viewing of at least a second transparency on said
15 viewing device. Preferably, said viewing device comprises a motorized viewer. Preferably,
said viewing device automatically clears a portion of a viewing surface of said viewing device,
responsive to said indication. Preferably, said viewing device comprises a belt-based device,
comprising moving said belt so that a transparency-free portion of said belt is at said viewing
surface.

20

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more clearly understood from the following description
of non-limiting examples of preferred embodiments of the invention, which should be read in
conjunction with the figures in which:

Fig. 1 is an isometric drawing of an alternator, in accordance with a preferred
25 embodiment of the invention;

Fig. 2 is a schematic cross-sectional view of the alternator of Fig. 1;

Fig. 3 is a block diagram of electrical circuitry associated with an alternator in
accordance with a preferred embodiment of the invention;

Figs. 4A and 4B are schematic illustrations of front and side views respectively of a
30 transparency detection apparatus, in accordance with a preferred embodiment of the invention;

Figs. 5 is a schematic circuit drawing of sensor circuitry associated with the
transparency detection apparatus of Figs. 4A and 4B, in accordance with a preferred
embodiment of the invention;

Fig. 6 is an illustration of apparatus for uniformly illuminating selectable portions of a viewing surface while providing little spill-over of illumination to adjoining sections; and

Fig. 7 is an isometric drawing of an alternator, including a group display, in accordance with a preferred embodiment of the invention.

5 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figs. 1 and 2 show perspective and partial cross-sectional views, respectively, of an alternator (also referred to as a motorized viewer) 10 in accordance with a preferred embodiment of the invention. Alternator 10 has a viewing surface 12 conveniently divided into eight viewing sections 13 on two levels of four sections each. Typically, each section is used
10 to view a single transparency; however, when small transparencies (such as mammograms) are viewed, two or more transparencies may be viewed in a single section. A hood 14 having an overhang 15 is provided to partially shield viewing surface 12 from ambient light and to provide a mounting surface for certain other components of alternator 10. A shelf 16, including a user interface 18, preferably mounted on the shelf (user interface 18 may include a number of
15 keyboards or other input and display devices). is also provided in alternator 10. Preferably, a foot pedal 31 is provided as part of user interface 18. While, in a preferred embodiment of the invention, the alternator is of the type which does not utilize a magazine, many of the principles of the invention may be applicable to alternators which use a magazine.

In use, medical transparencies are preferably mounted on a belt 20 one end of which is
20 wound on a lower drum 22 and the other end of which is wound on an upper drum 24. Intermediate upper drum 24 and lower drum 22, belt 20 passes in front of viewing surface 12. In general, belt 20 or a plurality of such belts cover substantially the entire width and/or height of the viewing surface. Alternatively or additionally to a vertical belt, a horizontal belt may be similarly utilized.

25 Viewing surface 12 is backilluminated by a source of backillumination 26. The source of backillumination can be any convenient source as is known in the art, but preferably is a segmented light source, each segment of which illuminates one of the viewing sections. Most preferably, it is a segmented light source of the type shown in and described below in conjunction with Fig. 6.

30 In a preferred embodiment of the invention, alternator 10 also includes at least one camera 32 which views all or part of viewing surface 12 via a mirror 34. Preferably, the alternator includes two cameras, one of which views the left side of viewing surface 12 and the other of which views the right side of viewing surface 12. The two cameras are preferably

situated at the 1/4 and 3/4 points along the long dimension of overhang 15. It should be understood that for larger or smaller alternators more or fewer cameras may be employed.

In accordance with a further preferred embodiment of the invention, a light source (not shown) is situated at the midpoint of overhang 15, although, as will become evident below, it can be situated at other locations.

Figs. 4A and 4B shows front and side views illustrating details of belt 20 and of a detection apparatus 36, both in accordance with a preferred embodiment of the invention. Belt 20 includes along its width a series of clips 38 for attachment of transparencies 40 thereon. Preferably, intermediate clips 38, belt 20 is formed with small apertures 42, which, when belt 20 is in a position at which a transparency mounted on clips 38, is in a viewing position over one of viewing sections 13, is aligned with detection apparatus 36. Preferably, separate light sources are provided for detector 36, such as providing detector 36 having a light source 37 and a detector 39 in a single package. When so aligned, detection apparatus 36 detects the presence or absence of a transparency in clips 38 by analysis of the light detected by detector 39, as described below. Alternatively, the presence of transparencies in clips 38 may be determined by other, conventional, means such as belt mounted switches, capacity detectors, etc. Preferably, belt 20 has a row of clips 38 and apertures 42 at spacings along the length of belt 20, equal to the center to center spacing of the upper and vertical sections 13 of viewing surface 12.

Thus, it is possible to detect the existence, size and/or location of a transparency on the viewing surface. Additionally or alternatively, it is possible to detect such information prior to the film being displayed. Additionally or alternatively, it is possible to determine for each portion of the display, whether or not it is covered by a transparency portion and/or the density of the covering portion. It should be appreciated that the determination of the presence of a transparency is also useful for alternators without automatic masking capabilities, for example, to provide backillumination to a panel of the alternator only if there is a transparency on it.

Fig. 3 shows a block diagram of exemplary electronics 50 useful for operating alternator 10, in accordance with a preferred embodiment of the invention. Electronics 50 comprises a computer 52 which receives information related to the presence or absence of a transparency at a given position on belt 20 from a presence detector 54, which may be, for example, detector 39. Alternatively, the presence of the transparency can be determined from images acquired by camera 32. In conjunction with determining the position of the transparency on the belt, an indication of the placement of belt 20 on the viewing surface is received from a belt position sensor 56, which may be, for example, an encoder which

measures the movement of belt 20. Information regarding the placement and/or location of transparencies on belt 20 is stored in a memory 58. In addition, information as to the study to which these transparencies are related is also stored, based on information received from user interface 18. Computer 52 also controls the position of the belt, e.g., moving the portion of the belt which contains transparencies to the viewing surface when the study to which they pertain is called for via a belt position control 62. Illumination of viewing surface 12 and preferably, masking of the portions 13 are also preferably controlled, via a masking and illumination controller, based on the information stored in the memory, which may include masking information determined in the manner described below. Alternatively or additionally, memory 58 may associate other viewing parameters, for example, hue, e.g., for controlling pupil size, color, e.g., for correcting for transparency color distortion, ambient light levels, direction of lighting, highlighting and/or ROI definitions, masking parameters, such as using a soft mask, transparency type parameters, such as the transparency being a chest x-ray, where masking of the sternum may be desirable and/or backillumination intensity. Thus, in some cases, the viewing parameters may be at least partially calculated on the fly, responsive, for example, to transparency type, sensed ambient viewing conditions, required diagnosis and/or additional information provided by the viewing operator and/or remote computer.

It should be appreciated that in some cases, at least some of the information, for example ROI position, may be associated with virtual positions on the belt, rather than with the identification of particular transparencies. This is especially the case in belt-type alternators, where a transparency is generally not moved relative to a belt once it is positioned thereon.

In a preferred embodiment of the invention, an operator, for example, an assistant mounts transparencies on belt 20 for later viewing by a physician. In general, the assistant will mount the transparencies according to studies, each study having at least one transparency, but usually including a plurality of transparencies to be viewed together. The studies are mounted on belt 20 in positions which are over the viewing surface, as the physician will view them. Generally, each study has fewer transparencies than can be mounted for viewing at one time on viewing surface 12.

As the operator mounts the transparencies in a study, presence sensors 54 indicates to computer 52, the positions on the viewing surface at which the transparencies are mounted. This, combined with information received by the computer from belt position sensor 56, allows the computer to compute the position of the transparencies on belt 20, which position (occupancy) is stored in memory 58. When the operator completes the mounting of all the

transparencies in the study, he indicates that this to computer 52, either by pressing a button provided for this purpose on user interface 18 or by some other means, such as pressing foot-pedal 31. In a preferred embodiment of the invention, the user interface utilizes display 59. Alternatively or additionally it utilizes a microphone and/or a speaker (not shown). In one
5 preferred embodiment of the invention, a plurality of user interfaces are provided, for different types of users. Alternatively, a single user interface is used by all the users of the alternator. The operator may enter additional information into the memory, such as some other identification of the study, for example by patient name, ID, and/or type of study. This information is stored in memory 58 as well. To this end, the alternator also includes a display
10 59, such as a CRT display or an LED or LCD display to indicate, to the operator, the study number.

From this point on, computer 52 associates transparencies which are mounted on belt 20 with a second study. In response to the indication that a new study is to be mounted, the computer instructs belt position control 62 to wind the belt onto upper drum 24 or lower drum
15 22, as appropriate. Alternatively, the operator may supply a command to reposition the belt in this manner. The operator then mounts the transparencies of the second study onto belt 20 as before and again indicates to the computer that he has finished mounting the transparencies of the second study. This mounting of studies continues until the operator has mounted all the studies to be mounted or the belt 20 is full.

20 It should be understood that the operator may occasionally decide not to use some of the mounting positions, as for example when a study with three transparencies is followed by a study with four transparencies. In such case, computer 52 notes, and memory 58 stores the fact that the position is empty.

In a preferred embodiment of the invention, user interface 18 also includes provision
25 for recording one or more of the type of study, the physician who will view the study and the specialty of the physician. This information is used, as described below, in an optional feature of the invention, during viewing of the transparencies by the physician.

In a preferred embodiment of the invention, the alternator includes a network connection 60 for retrieving information from remote computers and/or for sending
30 information thereto. In one preferred embodiment of the invention, the remote computers comprise a patient data and image database 64. Preferably, images and patient information are read from database 64. Alternatively or additionally, the alternator sends acquired images, annotations, diagnosis and/or other information directly or indirectly entered into the alternator by the physician or other operators. In a preferred embodiment of the invention, data retrieved

from a remote computer is used to enhance a diagnosis, for example by providing a patient history and/or diagnosis based on other tests. Preferably, the radiology diagnosis is fed back to the remote computer.

Alternatively or additionally, the remote computers include a tele-radiology system 66.
5 Such a system may be used to diagnose images acquired by the alternator, to provide diagnosis of associated images and/or to control the alternator.

Alternatively or additionally, the remote computers comprise a hospital information management system 68, for example a HIS/RIS system (Hospital information system/Radiology information system). Such a system may be used to generate reporting
10 letters, set up consulting meeting, refer certain indicated transparencies to specialists and/or track the output of each physician. In a preferred embodiment of the invention, the alternator may be used to transmit information to system 68. Alternatively or additionally, the alternator may receive information from system 68. In a preferred embodiment of the invention, diagnosis letters are generated by and/or printed by the alternator. Preferably, the alternator
15 includes a (local) printer for that purpose. Alternatively or additionally, such letters are sent to the viewer's office to be signed.

In a further preferred embodiment of the invention, the sections 13 of viewing surface 12 comprise masking viewing surfaces as described in the above referenced PCT and US applications. These applications describe *inter alia* apparatus and methods for improved
20 discernability for example by means of adaptive illumination, ambient light and/or masking the viewing surface such that only a portion of the surface is back-illuminated. This portion may encompass the entire transparency, the portion of the transparency which contains an image or a region of interest which contains information especially important to the physician, such as a suspicious shadow or the like on an x-ray film.

25 Camera 32 is then used in conjunction with the masking viewing surfaces and the user interface (where applicable) to determine a masking pattern for the transparency, which pattern is stored in memory 58 together with the other information related to the position of the transparency.

Alternatively, each section may have mechanical masking as known in the art (and
30 preferably as described in PCT application PCT/IL96/00023, the disclosure of which is incorporated herein by reference), which may perform automatic masking of the transparencies or manual positioning of masking elements. In either case, in a preferred embodiment of the invention, the masking information associated with each transparency (which may include

ROI information) is stored in memory 58. Alternatively, masking may be achieved utilizing the lighting structure illustrated in Fig. 6 and described below.

After all the transparencies are mounted on belt 20, the system is ready for viewing of the mounted transparencies by a physician. Alternatively, the alternator may be a continuous machine, where transparencies can be mounted in parallel to other transparencies being diagnosed. In one example, the alternator includes two belts, one belt being loaded while the other is viewed. Alternatively or additionally, a belt may be loaded when it is off the alternator and then mounted on the alternator. Preferably, any required information is associated, possibly via a second computer, with a bar-code which is imprinted on each transparency. In another example, the alternator is a magazine type alternator, and new transparencies are placed into unoccupied slots in the magazine and/or into a second magazine. Preferably, in such a continuous alternator, data entry by the loader may be performed by a remote terminal. Alternatively or additionally, the loader utilizes a small portion of the viewing surface. Alternatively or additionally, the alternator is loaded during breaks between viewing sessions.

If the studies have been designated by study type (or if the alternator determined the study type automatically based on the size of the transparencies (such as for mammograms) or by the layout of images on the transparencies, such as for ultrasound or nuclear medicine images), specialty, patient name or physician identification, the physician indicates, via the user interface, which sets of studies he wishes to view. In a preferred embodiment of the invention, the information associated with the transparencies and sets thereof is organized in a database. Preferably, the physician can query the database to generate a subset of transparencies and/or ROIs to view. He then selects, preferably via the same interface, whether he wishes to view a particular study (as identified during the loading phase) or to view the studies seriatim. As indicated above, user interface 18 preferably includes display 59 to display information regarding available studies or the study being viewed to the physician. Alternatively, the information may be transmitted to a remote computer, as described above.

In a preferred embodiment of the invention, the transparencies may be grouped in response to data stored in the database, for example, based on one or more of diagnosis type, diagnosis result (e.g. positive negative), type and/or availability of supporting information, identification of referring physician, identification of diagnosing physician, identification of second diagnosing physician, study identification, association between studies, agreement with previous diagnosis, existence and/or degree of agreement between diagnosing physicians and/or the transparencies requiring additional reading and/or additional tests, which are not yet performed. As can be appreciated, a single transparency may belong to more than one group.

When the transparencies are viewed by group, individual transparencies within that group may be treated differently (e.g., viewing parameters), based on them belonging to other groups. In a preferred embodiment of the invention, the groups may be hierarchically defined, for example, the upper tier of such a hierarchy may be an association with a reader, with a lower tier being the type of diagnosis required.

Computer 52, in response to the physician's inputs via user interface 18, activates belt position control 62 to rotate drums 22 and 24 such that the transparencies associated with a study are placed over viewing surface 12. In response to the stored information as to which positions on belt 20 contain transparencies in the study, the computer back illuminates those sections 13 of viewing surface 12 which, according to information stored in memory 58, contain transparencies, for example by shutting off the light sources which back illuminate the other sections or by masking them with electronic or mechanical masks as appropriate.

It should be understood that transparencies may be removed, accidentally, from belt 20 during transport to and from drums 22 and 24. In a preferred embodiment of the invention, when the area of the belt which should contain this missing transparency reaches the viewing surface, the operator is warned that the transparency is missing. One very effective way to do this is to highlight (mark) the empty space from which the transparency was accidentally removed, preferably with low level light and/or with a pattern, even though there is no transparency there. Other methods, such as flashing a warning light or other methods which will occur to a person of skill in the art, may also be used. When a transparency is properly removed from belt 20, e.g., at a position on the viewing surface, the memory is notified to remove that transparency from the study.

In a preferred embodiment of the invention, computer 52 analyzes the placement of transparencies in the study and positions the transparencies on the viewing surface such that most of the transparencies (or ROIs) are at eye level or at a different convenient viewing angle. This is especially useful for alternators which allow for viewing of transparencies at three vertical levels. Alternatively or additionally, the positioning of the transparencies may be a horizontal positioning, for example on very wide viewbox, it is desirable that a current study will always be in front of viewer and not at an off-angle. Preferably, the viewing is optimized for a "current" transparency and/or study. In a preferred embodiment of the invention, once the viewing of a particular transparency and/or study is complete, the positions of the other transparencies are adjusted so that a next transparency/study is at an ergonomically optimal viewing position.

In a preferred embodiment of the invention, the transparencies are automatically masked based on information stored in memory 58. Alternatively, masking is performed only during the viewing mode. If appropriate the alternator may determine, based on method taught in the above referenced publications, whether a transparency has shifted during transportation, and performs a re-masking process only on those transparencies which have shifted.

There is also provided, in some preferred embodiments of the invention, a provision for designation of a region of interest (and its masking). This can be performed by the methods described in the above referenced applications and patent publications or by other means known in the art. The ROI may also be designated by the physician for later viewing by the physician himself or by a consultant when the study is called up later. In a preferred embodiment of the invention, when a same ROI is viewed at a later time, a last previous set of viewing parameters are used for the current viewing. Alternatively or additionally, a specific set of viewing parameters may be asserted for the ROI. Alternatively or additionally, a limited range of allowed viewing parameter values is associated with the ROI and/or study.

In a preferred embodiment of the invention, such annotation can include text annotation, graphical annotation and/or speech annotations. In a preferred embodiment of the invention, such annotation prompts certain future activities responsive to the transparency. In one preferred embodiment of the invention, when transparencies are removed, transparencies which require special treatment are marked, for example, by back illumination, by an acoustic tone or by display on the display of the alternator. Thus, a technician or other alternator operator who removes the transparencies can be informed of a desired destination for the transparency and/or study. In some cases the annotation may include instructions to the technician, such as to mark the ROI with a grease pencil. The destination of the study may be a specialist within the hospital or another package dispatch location. Preferably, a transparency can be annotated so that when the transparency is removed, an indication is displayed or sounded to the operator removing the transparency. Thus, the operator can separate transparencies to be stored from transparencies to be forwarded to a specialist. Preferably, when a technician removes a transparency he indicates to the system what he will be doing with it and/or his ID. The ID is preferably entered using a bar code and/or a magnetic card. Alternatively or additionally, when a viewer or other alternator operator accesses the alternator, he is presented with a list of log on names. Preferably, the list is a limited list responsive to the current work plan. Preferably, also physicians and other viewers enter their ID in a similar manner, preferably at a beginning of a viewing session. Alternatively or additionally to manual post-diagnosis operations, the annotations are passed to an automated

system which can then generate appointments between the patient and a specialist or send a positive or negative diagnosis to a patient or his representative. In a preferred embodiment of the invention, the information that a transparency has been viewed, by whom they were viewed, their diagnosis, and or an indication they were forwarded to a specialist is sent to hospital management 68.

In a preferred embodiment of the invention, a physician enters an indication that he has viewed diagnosed and/or is done with a particular image and/or a study. Alternatively or additionally, such an indication may be generated automatically by the alternator, for example based on the length of time the physician viewed it, either the physician modified the ROI and/or backillumination and/or whether the physician entered any information to be associated with the transparency. Alternatively or additionally, the alternator can indicate to the physician that he might have missed a transparency or a study and/or not exercised enough effort in its diagnosis. In a preferred embodiment of the invention, different criteria for analyzing the physicians diagnosis are associated with each image, image type, specialist, type of diagnosis and/or physician. Preferably, the measurements of what the physician did and how long it took him are tracked over time, to assess his progress and/or quality of work. Alternatively or additionally to sending analyzing such measurements by the alternator, the measurements may be transmitted to a remote computer, such as system 68, which analyses them.

In a preferred embodiment of the invention, the backillumination of the viewing surface is reduced in intensity or extinguished during movement of belt 20 and the transparencies mounted on it. In particular, a low level of back illumination is preferably provided to improve accommodation of the eye of the viewer during illumination of the transparencies and also to provide improved orientation of the viewer. Alternatively or additionally, the backillumination masking tracks the movement of the transparency across the display.

In a preferred embodiment of the invention, the physician may override the automatic illumination features and illuminate each section, or portion of a section as desired.

Fig. 5 shows a circuit schematic of a light detector portion 70 of detection apparatus 36, with source 37 and detector 39, in accordance with a preferred embodiment of the invention. Belt 20 (and aperture 42) are also shown. Also shown are transparency 40 mounted on clips 38. A current, preferably a pulsed current, is fed to source 37, which is preferably a LED, more preferably a LED which produces infra-red light. Preferably the pulsed light has a rise time which is substantial as described below. Light which is reflected from the transparency is detected by detector (photo-transistor) 39.

The current at the emitter of photo-transistor 39 varies with the intensity of the light which is detected (by 27 mv per decade) such that, if 5 volts Vdd is supplied, the transistor is linear over about 10 or more orders of magnitude. This is sufficient to accommodate the range of signals generated by ambient light sources and by detection of light emitted by LED 37. The detected signal is amplified and passed through a baseline restorer generally indicated by dotted box 76.

Detector 36 is preferably a proximity sensor, such as a type P5589 photo-reflector sensor manufactured by Hamamatsu.

In a preferred embodiment of the invention, a baseline restorer is provided in order to suppress ambient light, such as daylight, reflections and/or light from other viewboxes.

The theory of operation of a Robinson baseline restorer 76 is as follows. Vss and R43 constitute a current source which supply a current I_o and Vcc and R44 constitute a current source of current $2I_o$. When no signal is generated by the amplifier, the voltage at 78 is zero. In the presence of a change in voltage having a rate of change slower than $dV/dt = I_o/C$, the current sources can supply enough current such that all of the change is clamped to ground potential by conducting diodes D1 and D2. Higher rates of change will cause diode D1 to show a high impedance and a change in the voltage at point 78. Thus, if pulsed light is superimposed on slow changing ambient light the signal at 78 will consist of a signal derived from the pulsed light, whose baseline will be zero, having been restored to zero by base line restorer 76.

When no transparency covers aperture 42, (and the belt is in a viewing position) the pulsed signal is not reflected and only a very small or no pulsed voltage is generated. When a transparency is present at aperture 42, the transparency partially reflects the pulsed light which illuminates photo-transistor 39. This increase in signal is present even if transparency 73 has a low reflection.

In a preferred embodiment of the invention, LEDs 37 are pulsed seriatim and the outputs of the individual circuits of Fig. 4A associated with each of the holes are multiplexed and fed to an A/D converter which changes the analog signals into digital signals for processing by computer 52 for determination of the presence of a transparency.

Alternatively or additionally, to using such sensors to determine the existence and/or the density of mounted transparencies, a camera may be used to view the display surface and determine the existence of transparencies and/or determine average and/or local optical densities thereof. Such a camera preferably operates on the transparencies after they are conveyed to the viewing surface but before they are backilluminated with an intense light. The presence of transparencies may be compared to a memory containing expected transparency

loci, *inter alia*, in order to signal an error and/or avoid backilluminating an uncovered portion of the viewing surface.

While, as indicated above, backillumination for viewing surface 12 may be provided by any conventional means, Fig. 6 shows, in cross section, a novel backillumination system 26, for use with alternator 10, or with other, non-alternator viewboxes, in accordance with a preferred embodiment of the invention.

Fig. 6 represents a cross section of a backillumination system for a single segment 13 of viewing surface 12. Backillumination source 26 comprises a plurality of compartments 80 formed of light reflecting or light diffusing walls 82. Each compartment contains one or more light sources 84. Compartments 80 may be square, such that they form a square or rectangular matrix of lighting elements for section 13, or they may be elongated such that each compartment runs the entire length of the segment.

The light distribution at the right of the compartments is fairly uniform within the confines of the compartment, but typically reduced at the edges of the compartments. In a preferred embodiment of the invention, backillumination source 26 includes a diffuser plate 86 which diffuses the light supplied from compartments 80 so as to smooth the light distribution intensity within the compartments and, by diffusing light from the center of the openings of the compartments to the edges (and past the edge, somewhat into the area of the opening of adjacent compartments) makes the field more uniform. Alternatively or additionally a compensating plate 88, preferably a spatially varying neutral density filter, is provided which provides selective attenuation to the light produced by the array of compartments to equalize the light at its output (right) face. Plate 88 may be individually configured for each production alternator.

In principle, it may be possible to achieve a uniform light output with either one of the plates 86 or 88, however, the combination allows for a uniform amount of light without high local attenuation and without substantial spill over of light from one compartment to the other. Of course, the functions of plates 86 and 88 may be combined in a single structure.

In operation, in accordance with a preferred embodiment of the invention, backillumination source 26 can be used to provide selective illumination (and thus masking) with a resolution which is sufficient to mask the edges of transparencies. In order to mask an area of a transparency, it is sufficient to extinguish the light in the compartments which are not to be illuminated. While this does not give as high a spatial resolution as does an LCD faceplate, it is often sufficient.

In a further preferred embodiment of the invention an array of light gates, such as an LCD array, can be used in conjunction with the backillumination source 26 shown in Fig. 6. In this case backillumination source 26 is utilized to provide a first level of masking which may not be overly precise, but which provides complete masking in a large area outside the transparency. The LCD array is then used to provide a second level of relatively low contrast, higher resolution masking which is mainly effective to better define the edge of the mask, with a relatively smooth light transition. Since only a relatively low contrast is required, a single layer of LCD is generally sufficient, in contrast to the multi-layer LCD structures which are generally necessary to achieve sufficient contrast, if LCD masking is used alone.

In many cases it is desirable to display a portion of a transparency which is on an alternator, to a group of radiologists, such as at a conference. Since it is not usually possible to comfortably view a transparency by more than two or three radiologists, it is known in the art to acquire an image of a portion of the transparency and display it on a large viewing surface. Fig. 7 is an isometric drawing of an alternator 100, including a group display 112, in accordance with a preferred embodiment of the invention. A camera 104, preferably mounted on alternator 100, selectively views portions 106, 106' and 106" of transparencies 13. In accordance with one preferred embodiment of the invention, images acquired through camera 104 are processed using an image processor integral with alternator 100, preferably, the same image processor used to analyze images of the viewing surface and control the backillumination. The processed images may be displayed on display 112 or transmitted using a tele-radiology protocol, to a remote location. Alternatively, the enlarged image may be displayed on alternator 100 itself, using the mask generator to generate an image. Alternatively or additionally, alternator 100 has a dual type display, for data and for display of transparencies, such as described in PCT application PCT/EP94/03971.

Processing of the image of portion 106 may include any type of image processing, *inter alia*:

- (a) addition of symbols and/or marks;
- (b) overlay of data, such as patient data or data from other tests;
- (c) additional images, such as a previously acquired image and/or an image supplied from another source and/or from a reference study;
- (d) information from a computer aided diagnosis system;
- (e) a comparison between two images, such as subtraction or an indication of corresponding portions;

- (f) image enhancement;
- (g) correction of image distortion caused by a non-optimal viewing angle of the camera;
- (h) windowing;
- 5 (i) showing a cine sequence of acquired images;
- (j) overlaying on other images, especially three-dimensional image data sets; and/or
- (k) reconstructing a 3D image from acquired image slices.

In a preferred embodiment of the invention, patient data is provided by network connection 60. Alternatively, it may be provided using a diskette or a patient information card.

10 In accordance with another preferred embodiment of the invention, display 112 may include a reference image, selected responsive to the particular body portion being view in ROI 106. Preferably, the reference image and transparency 13 are pre-registered. Alternatively, computer 110, correlates the two images. This embodiment is especially useful when ROI 106 is manually moved, either using hand control or by manually positioning the camera. Thus, a
15 reference image displayed on display 112 may track the motion of ROI 106.

In accordance with an additional or alternative preferred embodiment of the invention, the field of view of camera 104 is automatically controlled by a computer 110, responsive to information regarding the positions of the transparencies. Preferably, computer 110 is integral with the central processing unit of alternator 100. In one preferred embodiment of the
20 invention, camera 104 is mounted on a rail 102 and includes means (not shown) for moving camera 104 along the rail. Thus, the field of view may be moved in one dimension relative to the viewing surface of alternator 100. Motion in the other dimension may be achieved by rotating camera 104 around rail 102. Alternatively, camera 104 views a fixed strip portion of the viewing surface, such as a viewing portion 114. Motion along rail 102 supplied one
25 dimension of motion, while transport of the ROI 106 into viewing portion 114 supplies the other dimension of motion.

In an alternative embodiment of the invention, the film transport system is operative to transport film in two dimensions, obviating the need for substantially any camera motion. Alternatively or additionally, camera 104 may be mounted on a robotic arm, whose position
30 and orientation in space are controlled by computer 110. Alternatively or additionally, camera 104 is not mounted on alternator 100, but is either free-standing or attached to a ceiling or a wall. Camera 104 is then oriented, using angular actuators, at the desired portion of the viewing surface. Alternatively or additionally, camera 104 is fixed and the field of view is moved by controlling an optical path of camera 102, such as by rotating a mirror. It should be

appreciated, that calibration of the positioning system for camera 104 is made simple by the ability to control the illumination of the display and by the ability to analyze the pattern of light acquired by camera 104 responsive to such illumination and to a particular set of parameters of positioning of camera 102.

5 Alternatively or additionally to controlling the spatial location of the field of view of camera 104, control of the extent of the field of view may be exercised. In a preferred embodiment of the invention, camera 104 includes a controllable motorized zoom lens 108. The extent of the field of view is preferably controlled such that the region of interest to be viewed fills the entire display 112. Such control may be automatic, since the size and locations
10 of the regions of interest are preferably entered when the transparencies are grouped into studies and/or by physician, when he controls viewing and ROI parameters during viewing. Alternatively or additionally, camera 104 is automatically controlled to follow a moving region of interest, such as a region of interest which scans a cervical spine image or a mammography. Alternatively or additionally, the camera it self may be programmed to scan a
15 static region of interest. In a preferred embodiment of the invention, when a moving ROI is selected by a user the camera and/or the ROI start moving immediately or after a preset delay. Alternatively, the physician indicates to the alternator to start the scan.

 In accordance with a preferred embodiment of the invention, camera 104 scans one or more transparencies 13, preferably, in a predetermined sequence. Alternatively, camera 104
20 may scan the entire image portion of transparency 13, utilizing known size and location of the transparencies. Such size and locations may be automatically determined by methods as described above and/or may be entered by a technician while grouping the transparencies and/or studies.

 In accordance with another preferred embodiment of the invention, where camera 104
25 is used for a presentation, a sequence of regions of interest are defined. During the presentation, the radiologist can move between such regions of interest, similarly to the way slides are used in slide shows, using simple "next" and "back" commands. In addition, a non-linear, hyper-text type, organization of the regions of interest is possible, such that from a particular region of interest it is possible to side track to one of several sub-sequences. The
30 selection of the sub-sequence may be based on operator input and/or on the location of a pointer symbol relative to ROI 106. The pointer symbol may be displayed only on display 112. Alternatively, it is a pointer which shows up on the viewing surface of alternator 100. The motion of the pointer is preferably controlled using a mouse or a trackball, preferably wireless. Preferably, some of the sub-sequences only contain one regions of interest. Alternatively or

additionally, the sub-sequences may include computer generated data, such as a diagnosis. In some cases, the sub-sequence may contain only computer generated imagery and no region of interest 106. In a preferred embodiment of the invention, such an alternator is used to prepare and/or edit an image sequence to be used during surgery and/or to be send using tele-radiology systems. It should be noted that alternator 100 may be remotely controlled, especially for tele-radiology uses. Thus, there is no need to digitize the transparencies prior to a tele-radiology sequence. Rather, the required portions of the transparencies are digitized at the required resolution, by camera 104, only when needed. Such a tele-radiology system may be used for very long distance radiology. Alternatively, alternator 100 may be controlled by a radiologist in a different room of the same hospital. Remote control of alternator 100 is preferably provide using a graphical interface on a standard-type work station, which may also be used for displaying the images.

Alternatively to displaying single transparencies on single displays, a plurality of transparencies and/or ROIs thereof or a single ROI may be displayed. Optionally, the alternator comprises a plurality of image displays. An ROI may be shown after the whole transparency is shown. Alternatively, they may be shown side by side, possibly on different image displays. Patient information may be shown overlaid on the transparency, in a separate window and/or display and/or possibly at the beginning and/or end of each study or transparency. Optionally, the backillumination is spatially and/or temporally modulated to display patient information and/or annotations.

In accordance with another preferred embodiment of the invention, other parameters of camera 104 are controlled, so as to provide an optimal image. In one aspect of the invention, the gain control and/or iris of camera 104 are controlled, response to the level of backillumination to provide an optimal image. It should be noted that control of the camera and provision of the backillumination are preferably provided by the same computer. In one preferred embodiment of the invention, the intensity and/or chromaticity of the backillumination are controlled to enable camera 104 to operate better. Preferably, the intensity and/or chromaticity are modulated at a high frequency and synchronized to the operation of camera 104, such that a human operator does not notice the modulation. Alternatively or additionally, the ambient light level is modified to enhance image acquisition by camera 104.

As listed above, processing the image acquired by camera 104 may include distortion correction. Such distortion is especially common when camera 104 is limited to move along fewer than two axes. Then, the FOV of camera 104 is generally achieved by viewing at an

oblique angle. In a preferred embodiment of the invention, errors caused by this oblique viewing are corrected for by processing. The processing is preferably based on correction values determined during a calibration stage. The corrections may include corrections for one or more of geometric distortion, intensity distortion and/or noise caused by reflections.

5 Preferably, during other calibration phases of the alternator, intensity, reflectivity and/or geometric distortion values for a transparency-free viewing surface, are acquired. Alternatively or additionally, distortion correction, for example, may be achieved based on a knowledge of an aspect ratio of a transparency and/or its exact dimensions. The geometric information may be gleaned from the type of transparency and/or other identifying information associated with

10 the transparency. Alternatively or additionally, the distortion correction utilizes a known geometry of the camera. In a preferred embodiment of the invention, the calibration is used to determine camera parameters which are suitable for viewing ROIs of various desired resolutions, on different parts of the viewing surface.

In a preferred embodiment of the invention, the above described alternator, preferably

15 with modifications described below, is used for training and/or testing of viewing operators. It should be appreciated that testing and training are closely related. In both tasks, a viewing operator is tested on certain subject matter and his responses stored and analyzed. Typically, the correct answer is also displayed. However, training systems usually follow a program of increasing difficulty, while a testing program is usually designed to assure that an operator has

20 at least a minimum competence. A training alternator in accordance with a preferred embodiment of the invention preferably exhibits one or more of the following aspects.

One aspect of using an alternator as a training system is the ability to select which transparencies, studies and/or ROI are presented, and at what order. As can be appreciated, an alternator and/or alternator belts and/or magazines may need to be dedicated to training, rather

25 than to diagnostic purposes. Alternatively or additionally, electronic information, such as available from a HIS/RIS system or softcopy images, may be downloaded and displayed at will.

Another aspect of a training alternator is the ability to record the operation of the alternator. Such recording preferably includes the manipulation of viewing parameters, data

30 entered as part of a diagnosis step and/or answers to questions which are posed as part of the training. In a preferred embodiment of the invention, the time required to perform various activities is also recorded. In a preferred embodiment of the invention, these recorded data are then analyzed using well-known statistical methods, for example to determine progress.

Another aspect of a training alternator is the ability to display the correct answer to a problem. Additionally, it is possible to display a partial answer, for example by displaying hints.

Another aspect of a training alternator is the ability to show the superiority of a correct answer. In one example, when the subject matter is optimal viewing parameters for a particular diagnosis, the alternator can illuminate a same transparency/study with a plurality of viewing parameter sets, so that the effect of non-optimal viewing is clear. In another example, a plurality of different studies may be displayed, possibly associated with results of supplementary tests, to elucidate a diagnostic method.

Another aspect of a training alternator is the ability to show interactive or non-interactive presentations, for example presentations which explain how to diagnose a particular x-ray image, such as a chest x-ray. Such presentations are also useful for keeping radiologists up to date, by requiring them to view certain presentations. Any radiologist who did not view a particular presentation and/or who did not pass a test, may be called upon for an explanation. In a preferred embodiment of the invention, such presentations may include non-transparency information, for example, sound text and/or video segments, which may be displayed using the viewing surface, a separate display and/or a group display. In some preferred embodiments of the invention, such segments are associated with individual transparencies and/or studies, so that if an operator selects a transparency, a study and/or performs a particular activity on the transparency, such as selecting an ROI or inputting a diagnosis, the segments may be displayed, possibly in association with a backillumination and/or highlighting of the transparency. In a preferred embodiment of the invention, the segments and/or transparencies are linked in a hyper-text like manner, so that a viewing a particular ROI may prompt the viewing of a text segment, while selecting a particular text segment may prompt conveying and/or backillumination of a particular ROI. Such a hyper text linking scheme may also be used for accessing patient records, in a production use of the alternator. For example, a list of patients is displayed, selecting a particular patient will convey the patient's study to the viewing surface. Selecting information which is displayed in association with the study, for example, suspected diagnosis, may be used to bring up studies of patient's with a related suspected pathology.

Another aspect of a training alternator is the ability of a trainee to work by himself without a trainer on hand. Alternatively, a trainer may be provided. In some cases, the trainer is provided at a remote location, where he can respond to a trainee's actions, for example by

providing test cases having characteristics which the trainer believes that the trainee has not assimilated.

In a preferred embodiment of the invention, the training alternator includes a camera and/or a microphone to view the workspace, so that it is possible to record and/or analyze all the activities of the trainee, and not just those which are performed using alternator controls. Camera 104 may be utilized for this purpose, by modifying its range of viewing angles.

In a preferred embodiment of the invention, one or more of the above aspects may be used in a non-training alternator, for example for the purpose of analyzing work habits of alternator operators. Such analysis may include comparing the viewing commands, response times and/or diagnoses of two doctors to the same or similar studies. Preferably, the responses of the alternator are also recorded, so it is possible to verify that the alternator responded in an expected fashion to input commands. One or more exemplary cases may be stored for use in training. Preferably, the transparencies are properly marked, so that they or a copy thereof are kept in a training file.

The present invention has been described above mainly with reference to an alternator without a storage magazine, i.e., one in which the transparencies are mounted on a sheet or wires and remain mounted on the sheet or wires until removed by the operator. However, most aspects of the invention are also applicable to alternators which utilize a magazine for storage of transparencies. When such an alternator is used, the identification of the transparencies with a study is performed manually, preferably during a preview of the transparencies in the magazine by an assistant. In a preferred embodiment of the invention, the order in which the transparencies are displayed and their physical grouping on the alternator is determined by the grouping assigned to the transparencies in the preview and is not necessarily the same as the order in which they are loaded in the magazine.

Alternatively, the alternator operates in a preview mode as described above. However, instead of the transparencies remaining on the belt or wire after the study is mounted on the alternator that are transported to the magazine and stored therein, in positions or in an order which identifies them as belonging to a particular study. This identification is stored in a memory such as memory 58. The viewing mode is very similar to that described above, except that the alternator identifies the transparencies as belonging to a study by their location in the magazine rather than by their position on the belt.

It should be understood that the present invention has been described utilizing a best mode for the realization thereof. The invention comprises features, not all of which are practiced in all preferred embodiments of the invention. In addition, where methods have been

described, apparatus for performing those methods is also considered to be within the scope of the invention. Where apparatus having certain features have been described, methods for utilizing those features are also considered to be within the scope of the invention. As will also be appreciated, implementations may include various combinations of hardware, software and electronic circuitry. Many variations and combinations of features described herein will occur to a person of skill in the art and are considered to be within the scope of the invention, which scope is limited only by the following claims. When the terms "comprising", "comprise", "include", "including", or the like are used in the claims they mean "including but not necessarily limited to".

CLAIMS

1. Apparatus for viewing a plurality of transparencies comprising:
a backilluminated viewing surface having a plurality of viewing positions for viewing a
5 plurality of said transparencies;
a conveyor which conveys transparencies to and from the viewing positions;
a memory which contains transparency information associated with individual ones of
said transparencies.
- 10 2. Apparatus for viewing a plurality of transparencies comprising:
a backilluminated viewing surface having a plurality of viewing positions for viewing a
plurality of said transparencies;
a conveyor which conveys transparencies to and from the viewing positions;
a memory which contains transparency information associated with groups of said
15 transparencies.
3. Apparatus according to claim 2, wherein said groups comprises studies.
4. Apparatus according to claim 2 or claim 3, wherein said groups are defined across
20 studies.
5. Apparatus according to any of claims 2-4, wherein at least one transparency
simultaneously belongs to more than one group.
- 25 6. Apparatus according to any of claims 2-5, wherein said apparatus includes means for
performing functions responsive to said grouping.
7. Apparatus according to any of claims 1-6, comprising:
a controller which operates in at least two distinct modes, a viewing mode and a
30 loading mode, wherein at least some of said transparency information is inputted in said
loading mode.
8. Apparatus according to claim 7, wherein at least some of said transparency information
may be entered during a viewing mode.

9. Apparatus according to claim 7 or claim 8, wherein said loading mode is optimized for loading a large number of transparencies on said apparatus and wherein said viewing mode is optimized for high throughput viewing of transparencies on said apparatus.

5 10. Apparatus according to any of claims 1-9, wherein said transparency information comprises an association of said transparencies into groups.

10 11. Apparatus according to any of claims 1-10, wherein said transparency information comprises at least one highlighting parameter for at least one ROI on said transparencies.

12. Apparatus according to any of claims 1-11, wherein said transparency information comprises viewing parameters for at least ROIs on said transparencies.

15 13. Apparatus according to claim 12, wherein said viewing parameters comprises backillumination parameters.

14. Apparatus according to claim 12 or claim 13, wherein said viewing parameters comprises ambient light viewing conditions.

20 15. Apparatus according to any of claims 12-14, wherein said viewing parameters are utilized when backilluminating a transparency.

25 16. Apparatus according to any of claim 1-15, wherein said transparency information comprises a list of transparency loci, which loci may be selectively brought to said viewing surface.

30 17. Apparatus according to any of claims 1-16, wherein said transparency information comprises position information regarding the viewing positions of said transparencies, and comprising:

- a camera which selectively images portions of the viewing surface;
- a controller which controls at least one parameter of a field of view of the camera,
- wherein said controller, in response to said transparency information stored in said memory, changes said at least one parameter of the camera.

18. Apparatus according to claim 17, wherein said at least one characteristic comprises a zoom-factor of the field of view.
- 5 19. Apparatus according to claim 17 or claim 18, wherein said at least one characteristic comprises at least one spatial coordinate relative to said viewing surface.
20. Apparatus according to claim 19, wherein said controller controls said conveyer to align said transparencies with said field of view.
- 10 21. Apparatus according to any of claims 17-20, wherein said controller controls said backillumination responsive to signals from said camera.
22. Apparatus according to any of claims 17-21, wherein a plurality of said transparencies
15 are associated as a group with a viewing order and wherein said controller controls camera to sequentially view said grouped transparencies.
23. Apparatus according to any of claims 17-22, comprising an image display for displaying said images.
- 20 24. Apparatus according to claim 23, wherein said image display comprises a group display.
- 25 25. Apparatus according to claim 23 or claim 24, wherein said image display comprises a remote display.
26. Apparatus according to any of claims 17-25, wherein said apparatus comprises a user input for selecting certain ones of said transparencies.
- 30 27. Apparatus according to claim 26, wherein said controller selectively controls said camera to view at least portions of said selected transparencies.

28. Apparatus according to any of claims 17-26, wherein said controller selectively controls said camera to view at least portions transparencies, responsive to said transparency information.

5 29. Apparatus according to claims 26 or claim 27, wherein said controller is operable in at least a film mounting mode and a film viewing mode and wherein said user input is operative to select certain ones of said transparencies during at least one of said film viewing mode and said film mounting mode.

10 30. Apparatus according to claim 29, wherein said user input is operative to select during said film viewing mode.

31. Apparatus according to claim 29 or claim 30, wherein said user input is operative to select during said film mounting mode.

15

32. Apparatus according to any of claims 17-31, comprising an image processor which processes said imaged portions.

33. Apparatus according to claim 32, wherein said image processor corrects geometric
20 distortions in said imaged portions.

34. Apparatus according to claim 32 or 33, wherein said image processor processes said imaged portion responsive to said information stored in said memory.

25 35. Apparatus according to any of claims 1-34, wherein said transparency information comprises grouping information which associates said transparencies into groups, comprising:
a controller which controls the backillumination of the viewing positions and the conveyor,
wherein said controller, in response to said transparency information, supplies
30 backillumination suitable for viewing said transparencies only to those positions which contain transparencies from a particular group of said groups.

36. Apparatus according to claim 35, wherein at least one of said groups has a display order defined thereon, within the group, and wherein said controller supplies backillumination to transparencies responsive to said order.

5 37. Apparatus according to any of claims 35-36, wherein said controller highlights at least a portion of one of said transparencies.

38. Apparatus according to claim 37, comprising a memory associating highlighting parameters with said at least a portion of one of said transparencies.

10

39. Apparatus according to any of claims 35-38 in which said grouping information associating the transparencies into groups is acquired by the memory responsive to the placement of said transparencies on the viewing surface.

15 40. Apparatus according to claim 39 and including a user interface by which an operator indicates that transparencies belonging to a new group are being placed on the viewing surface.

20 41. Apparatus according to any of claims 35-39 and including a user interface by which a user indicates that the transparencies are associated with a group to be viewed.

42. Apparatus according to any of claims 35-41 wherein the controller positions transparencies in a group in a viewing position on the viewing surface, responsive to said transparency information.

25

43. Apparatus according to claim 42, wherein said viewing position comprises a comfortable viewing position.

30 44. Apparatus according to any of claims 1-43, wherein said transparency information comprises an association of at least one of said transparencies with a particular reader.

45. Apparatus according to any of claims 1-44, wherein said transparency information comprises an association of at least one of said transparencies with a particular specialty.

46. Apparatus according to any of claims claim 1-45, wherein said transparency information comprises annotations for said transparencies.

47. apparatus according to any of claims 1-46, wherein said transparency information
5 comprises an order of viewing of a plurality of said transparencies.

48. apparatus according to claim 47, wherein said transparency information comprises a second order of viewing of said plurality of said transparencies.

10 49. Apparatus according to any of claims 1-48, wherein said transparency information comprises a current diagnosis of at least one of said transparencies.

50. Apparatus according to any of claims 1-49, wherein said transparency information comprises a previous diagnosis of at least one of said transparencies.

15

51. Apparatus according to any of claims 1-50, wherein said transparency information comprises a current diagnosis of said patient.

52. Apparatus according to any of claims 1-51, wherein said transparency information
20 comprises patient information.

53. Apparatus according to claim 52, wherein said transparency information comprises examination results for said patient.

25 54. Apparatus according to claim 52 or claim 53, wherein said transparency information comprises clinical information.

55. Apparatus according to claim 52 or claim 53, wherein said transparency information comprises demographic information.

30

56. Apparatus according to any of claims 1-55, wherein said transparency information comprises a referral of at least one of said transparencies to a another clinical body.

57. Apparatus according to any of claims 1-56, comprising a network connection for communicating between at least one remote computer and said apparatus.
58. Apparatus according to claim 57, wherein said apparatus transmits at least some of said
5 transparency information over said network.
59. Apparatus according to claim 57 or claim 58, wherein said apparatus receives at least some of said transparency information over said network.
- 10 60. Apparatus according to claim 59, wherein said information is requested by said apparatus in association with backillumination of particular transparencies.
61. Apparatus according to any of claims 1-60, comprising a user interface for entering at least some of said transparency information.
- 15 62. Apparatus according to any of claims 1-61, comprising a display.
63. Apparatus according to claim 62, wherein said controller displays at least some of said transparency information on said display.
- 20 64. Apparatus according to claim 63, wherein said displayed transparency information is associated with a currently backilluminated transparency.
65. Apparatus according to any of claims 1-64, wherein said controller generates grouping
25 information associating said transparencies into groups from said transparency information.
66. Apparatus according to any of claims 35-65, comprising a pointing device for controlling at least some functions of said apparatus.
- 30 67. Apparatus according to any of claims 35-66, comprising a plurality of manual controls for controlling at least some functions of said apparatus.
68. Apparatus according to any of claims 35-67, comprising a graphical interface for controlling at least some functions of said apparatus.

69. Apparatus according to any of claims 1-68, wherein said transparencies comprise medical transparencies.

5 70. Apparatus for viewing a plurality of transparencies comprising:
a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;
a conveyor which conveys transparencies to and from the viewing positions;
a camera which selectively images portions of the viewing surface;
10 a controller which controls the backillumination of the viewing positions and the conveyor; and
an image processor,
wherein said image processor processes images from said camera, for display and wherein said image processor analyses at least one acquired image of transparencies on said
15 viewing surface, to determine a suitable backillumination.

71. Apparatus according to claim 70, comprising a memory associating transparency information with said transparencies.

20 72. Apparatus according to claim 71, wherein said image processor processes said images responsive to said transparency information to generate at least one processed image.

73. Apparatus according to claim 72, comprising a display for displaying said at least one processed image.

25

74. Apparatus according to any of claims 70-73, wherein said image processor corrects geometric distortion in said imaged portions.

75. Apparatus according to claim 74, wherein said distortion correction is responsive to at
30 least the location of the viewing position imaged by the camera.

76. A method of transparency viewing, comprising:
providing a plurality of transparencies on a motorized transparency viewer;

providing a list of loci of at least ROIs associated with selected ones of said transparencies; and

selectively viewing individual ones of said loci, by selecting at least one of said loci from said list.

5

77. A method according to claim 76, comprising controlling viewing parameters for said selected loci, responsive to a set of viewing parameters associated with said loci.

78. A method according to claim 76 or 77, wherein said at least ROIs comprise complete image bearing portions of transparencies.

10

79. A method of detecting a pulsed light signal comprising:

supplying a composite signal comprising a pulsed light signal having a particular rate of change together with a background of slowly changing light levels; and

15

applying base line restoration to the composite signal, said base line restoration being operative to remove signals having a rate of change lower than said particular rate of change.

80. A method according to claim 79, comprising generating said composite signal by measuring the reflection of a pulsed light source off of a transparency.

20

81. A method according to claim 80, wherein said transparency is mounted on a belt and wherein said pulsed light source is directed at an aperture in said belt, through which said transparency is visible to said light source.

82. A method according to any of claims 79-81, wherein said base-line restoration comprises electrical base line restoration.

25

83. A method according to any of claims 79-82, wherein said base-line restored signal comprises an analog black signal.

30

84. A method of determining the existence of a transparency on a belt, comprising:
mounting a transparency on a belt having apertures defined thereon;
illuminating said transparency through said apertures; and
measuring said illumination after it interacts with said transparency.

85. A method according to claim 84, wherein said interaction comprises reflection.
86. A method according to claim 84 or claim 85, wherein said interaction comprises
5 transmission.
87. A method according to any of claims 81-86, comprising baseline restoring said measured illumination.
- 10 88. A method of transparency management for a plurality of transparencies mounted on a viewing device, comprising:
sequentially backilluminating a plurality of transparencies; and
associating information with individual ones of said transparencies.
- 15 89. A method of transparency management for a plurality of transparencies mounted on a viewing device, comprising:
sequentially backilluminating a plurality of transparencies; and
associating information with groups of said transparencies.
- 20 90. A method according to claim 88 or claim 89, comprising receiving said information from a remote computer.
91. A method according to any of claims 88-90, comprising transmitting said information to a remote computer.
- 25 92. A method according to any of claims 88-91, comprising manually entering at least an indication of said information.
93. A method according to any of claims 88-92, wherein said information comprises a
30 visual annotation of at least one of said transparencies.
94. A method of transparency management for a plurality of transparencies, comprising:
mounting said transparencies on a viewing device; and
annotating at least a selected one of said transparencies.

95. A method according to claim 94, wherein said viewing device comprises a motorized viewing device.

5 96. A method according to claim 94 or claim 95, wherein said at least one transparency comprises a group of transparencies.

97. A method according to any of claims 94-96 and including:
displaying an indication responsive to said annotations, when removing ones of said
10 transparencies from said viewing device.

98. A method according to claim 97, wherein said indication comprises a backillumination of said removed transparencies or positions from which they are removed.

15 99. A method according to claim 97 or claim 98, wherein said viewing device has several operating modes and comprising changing the mode of said viewing device to a transparency removal mode, prior to said removal of transparencies.

100. A method according to any of claims 97-99, wherein said indication indicates an action
20 to be performed with said at least one transparency.

101. A method according to claim 100, wherein said action comprises referring the at least one transparency to an additional reading.

25 102. A method according to any of claims 94-101, comprising:
transmitting an indication responsive to said annotations, to a remote computer.

103. A method according to claim 102 wherein said remote computer automatically generates a report responsive to said indication.

30 104. A method according to claim 103, wherein said report comprises a diagnosis.

105. A method according to claim 103 or 104, wherein said report comprises a referral to a future study.

106. A method according to claim 103 or 104, wherein said report comprises a referral to a future patient care.

5 107. A method according to any of claims 103-106, wherein said report comprises a letter.

108. A method according to any of claims 97-107, wherein said remote computer stores said indication.

10 109. A method according to any of claims 97-108, wherein said remote computer utilizes said indication to track usage of said transparencies.

110. A method according to any of claims 95-109, wherein said indication comprises at least part of said annotation.

15

111. A method according to any of claims 95-109, wherein said annotation comprises a diagnosis.

112. A method of transparency according to any of claims 95-109 comprising:
20 automatically generating a paper print out responsive to said annotations.

113. A method according to claim 112, wherein said printout is generated locally to said viewing device.

25 114. A method according to claim 112 or claim 113, wherein said printout is generated at a location associated with a viewer who performs said annotations.

115. A method according to any of claims 112-114, wherein said print out comprises a letter of referral.

30

116. A method according to any of claims 112-115, wherein said print out comprises a diagnosis letter.

117. A method of transparency viewing on a viewing device, comprising:

transporting at least one transparency to a viewing surface of said viewing device; and
automatically retrieving information associated with said transparency, from a remote
location, in association with said transport.

5 118. A method according to claim 117, wherein a user requests said transport and wherein
said automatically retrieving comprises retrieving said information responsive to said user's
request.

10 119. A method according to claim 117, wherein said transparencies are mounted in said
viewing device by an assistant, for later transport to the viewing surface and wherein said
retrieving comprises retrieving said information responsive to said mounting.

120. A method according to any of claims 117-119, wherein said transparencies are grouped
into studies and wherein said information is associated with a group of transparencies.

15

121. A method according to any of claims 117-120, comprising:
viewing said transported transparency; and
transmitting information from said viewing device to a remote computer responsive to
said viewing.

20

122. A method of transparency data management, comprising:
displaying at least one transparency on a viewing device; and
transmitting information from said viewing device to a remote computer responsive to
said displaying.

25

123. A method according to claim 121 or claim 122, wherein said remote computer
comprises a hospital data system.

30 124. A method according to any of claims 121- 123, wherein said transmitted information
comprises an indication that the transparency was displayed.

125. A method according to any of claims 121-124, wherein said transmitted information
comprises an indication of a person who viewed the transparency.

126. A method according to any of claims 121-125, wherein said transmitted information comprises information associated with said transparency.

127. A method according to claim 126, wherein said transmitted information comprises a
5 diagnosis of said transparency.

128. A method according to any of claims 121-127, wherein said at least one transparency comprises a group of transparencies.

129. A method according to any of claims 94-128, wherein said plurality of transparencies
10 are mounted on an alternator.

130. A method according to any of claims 94-129, wherein said transparencies comprises
15 medical transparencies.

131. An alternator comprising:

a plurality of locations for mounting transparencies thereon for transport to a viewing
surface;

a memory storing therein locations having transparencies mounted therein; and

20 an indicator which provides an indication when one of the locations stored in said
memory do not contain a transparency when said location is transported to said viewing
surface.

132. An alternator according to claim 131, comprising at least one sensor associated with at
25 least one of said locations for determining the presence of a transparency therein.

133. An alternator according to claim 131 or claim 132, comprising a second sensor which
detects the presence of transparencies at locations of said viewing surface.

30 134. An alternator comprising:

a viewing surface;

a transport for moving transparencies on said viewing surface;

a backillumination source which selectively illuminates only a portion of said viewing
surface, behind at least a portion of at least one of said transparencies; and

a controller which controls said transport to position said at least a portion of a transparency to a viewing position which is comfortable for a viewer of said transparency.

135. An alternator according to claim 134, wherein said viewing position corresponds to an eye height of said viewer.

136. An alternator according to claim 134 or claim 135, wherein said at least a portion of a transparency comprises a group.

137. An alternator according to any of claims 134-136, wherein said viewing position comprises an ergonomically optimal viewing position.

138. An alternator according to any of claims 134-137, wherein said at least a portion of a transparency is vertically positioned.

139. An alternator according to any of claims 134-138, wherein said at least a portion of a transparency is horizontally positioned.

140. A method of viewing transparencies, comprising:
mounting a plurality of transparencies onto a viewing device;
first viewing at least some of said transparencies during a first viewing session;
selecting at least one of said first viewed transparencies for a second viewing; and
second viewing said selected at least one transparency during a second viewing session,

wherein, said first viewing and said second viewing comprise selective backillumination of said viewed transparencies.

141. A method according to claim 140, comprising entering a reader identification and wherein said selective backillumination is responsive to said reader identification.

142. A method according to claim 140 or claim 141, comprising a third viewing, during a third viewing session by a third reader, of at least a second transparency selected during said second viewing.

143. A method according to any of claims 140-142, wherein said first viewing comprises setting ROIs and wherein said set ROIs are utilized by said second viewing.

144. A method according to any of claims 140-143, wherein said viewing device comprises
5 an alternator.

145. A method according to any of claims 140-144, wherein a same reader performs said first and said second viewings.

10 146. A method according to any of claims 140-144, wherein a first reader performs said first viewing and a second reader performs said second viewings.

147. A method according to any of claims 140-146, comprising highlighting at least a portion of said at least one of the first viewed transparencies, during said first viewing.

15

148. A method according to claim 147, comprising reproducing said highlighting during said second viewing.

149. Apparatus for viewing a plurality of transparencies comprising:
20 a backilluminated viewing surface having a plurality of viewing positions for viewing a plurality of said transparencies;
a conveyor which conveys transparencies to and from the viewing positions; and
a controller which controls the backillumination of the viewing positions and the conveyor,

25 wherein said controller, differently backilluminates said viewing surface when said transparencies are being conveyed and when said transparencies are positioned.

150. Apparatus according to claim 149, wherein said backillumination tracks a progress of said transparencies across said viewing surface.

30

151. Apparatus according to claim 149 or claim 150, wherein said viewing surface is backilluminated with a lower, but non-zero, intensity during said conveying as compared to when the transparencies are positioned.

152. A method of transparency viewing on an alternator, comprising:
loading a plurality of transparencies on said alternator, by a first alternator operator;
and
simultaneously viewing, by a second alternator operator, a plurality of transparencies
5 previously loaded on said alternator.
153. A method according to claim 152, wherein said loading comprises associating
information with said transparencies being loaded.
- 10 154. A method according to claim 152 or claim 153, wherein said simultaneously viewing
comprises viewing responsive to information associated with said previously loaded
transparencies.
155. A method of alternator use, comprising:
15 conveying and backilluminating one or more transparencies to a viewing surface;
presenting a question to an operator of said alternator, which question is associated
with said backilluminated transparencies; and
recording a response of said operator.
- 20 156. A method of alternator use, comprising:
conveying and backilluminating one or more transparencies to a viewing surface;
recording an interpretation entered by an operator of said alternator, entered responsive
to said backilluminated transparencies; and
storing said response in association with a previously entered interpretation.
- 25 157. A method according to claim 156, wherein said previously entered interpretation
comprises a competent final interpretation.
158. A method according to claim 156, wherein said previously entered interpretation
30 comprises a competent tentative interpretation.
159. A method according to claim 158, comprising storing a disagreement between said
tentative interpretation and the later entered interpretation.

160. A method according to claim 155 or claim 156, comprising displaying a correct interpretation, in response to said operator's response.

161. A method according to any of claims 155-160, comprising modifying said
5 backillumination with a correct backillumination, in response to said operator's response.

162. A method according to any of claims 155-161, comprising generating a range of viewing conditions for said transparency in response to said operator's response.

10 163. A method according to any of claims 155-162, comprising conveying and backillumination a at least a second transparency, responsive to said operator's response.

164. A method of alternator use, comprising:
loading a plurality of transparencies onto an alternator;
15 programming a sequence of showing said transparencies; and
conveying and backillumination said transparencies to a viewing surface of said alternator, responsive to said programmed sequence.

165. A method according to claim 164, comprising associating transparency information to
20 be displayed with each of said transparencies; and
displaying said associated information when a particular transparency is conveyed according to the sequence.

166. A method of viewing device use, comprising:
25 registering the presentation of one or more transparencies;
receiving at said viewing device an indication of an interpretation of said at least one transparency; and
storing at least an elapsed time between said presentation and said indicated interpretation.

30 167. A method according to claim 166, wherein said viewing device comprises a motorized viewing device.

168. A method of viewing device use comprising:

receiving a plurality of commands at said viewing device from an operator of said viewing device; and
recording at least said commands.

5 169. A method according to claim 168, wherein said viewing device comprises a motorized viewing device.

170. A method according to claim 168 or claim 169, comprising recording at least an indication of a response of said viewing device to said commands.

10

171. A method according to claim 170, wherein said response comprises a highlighting of at least a portion of a transparency.

172. A method according to claim 170 or claim 171, comprising recording at least an
15 indication of information received by said viewing device from a remote computer.

173. A method of transparency viewing, comprising:
displaying at least one transparency to a first viewer;
receiving a first interpretation of said first viewer;
20 displaying said transparency to a second viewer;
receiving a second interpretation of said second viewer; and
automatically recording an agreement or disagreement between the first and second
interpretations.

25 174. A method of viewing transparencies, comprising:
viewing at least one transparency on a viewing device;
interrupting the viewing;
storing a viewing configuration at the time of the interruption; and
restoring the viewing configuration at a later time.

30

175. A method according to claim 174, wherein said interruption comprises a momentary interruption.

176. A method according to claim 174 or claim 175, wherein said interruption comprises a viewing of at least a second transparency on said viewing device.

177. A method according to claim 176, wherein said viewing device comprises a motorized
5 viewer.

178. A method according to claim 177, wherein said viewing device automatically clears a portion of a viewing surface of said viewing device, responsive to said indication.

10 179. A method according to claim 178, wherein said viewing device comprises a belt-based device, comprising moving said belt so that a transparency-free portion of said belt is at said viewing surface.

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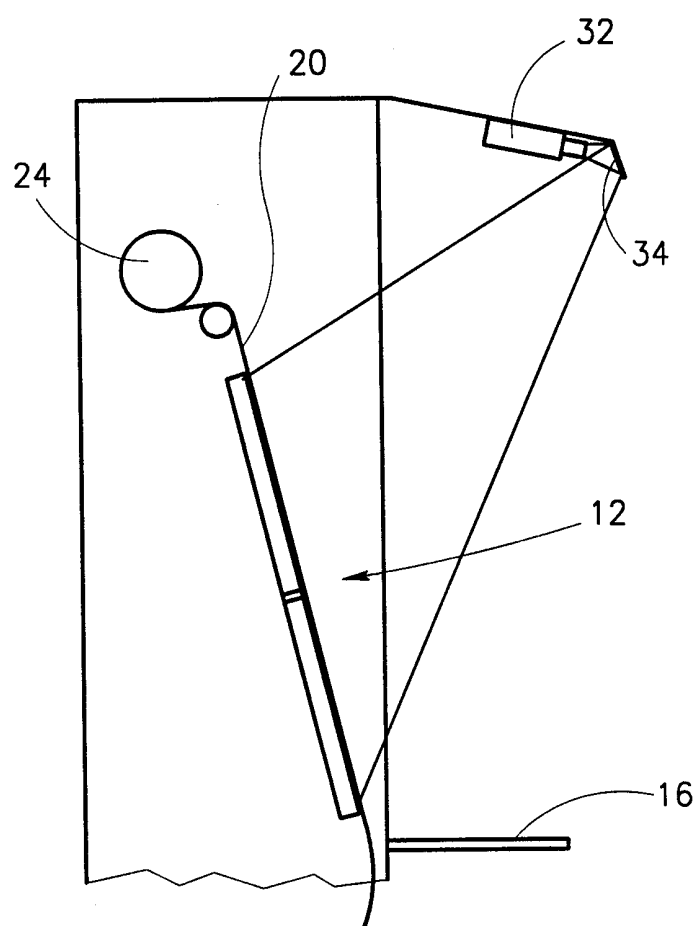


FIG. 2

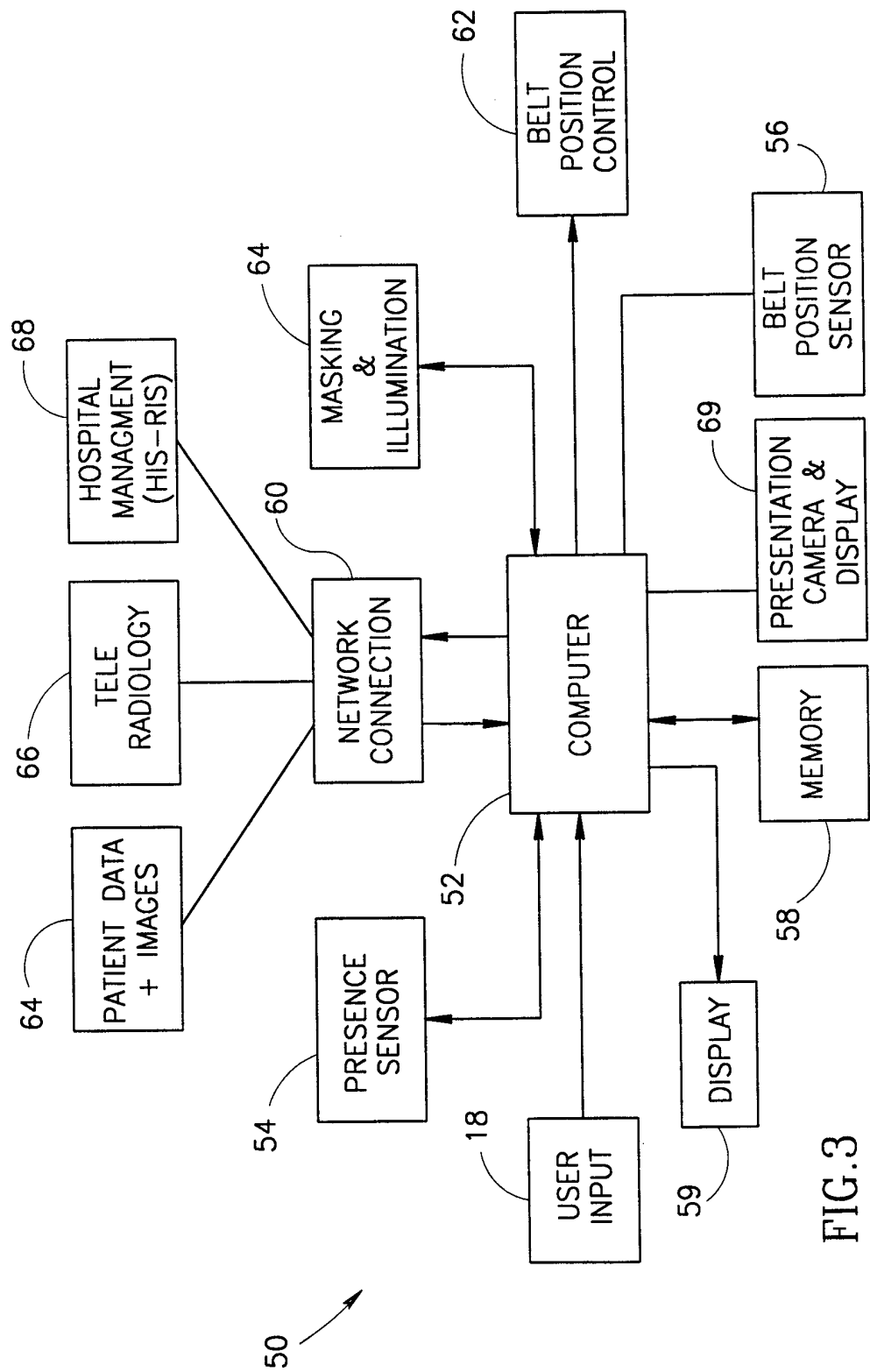


FIG.3

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FIG. 4A

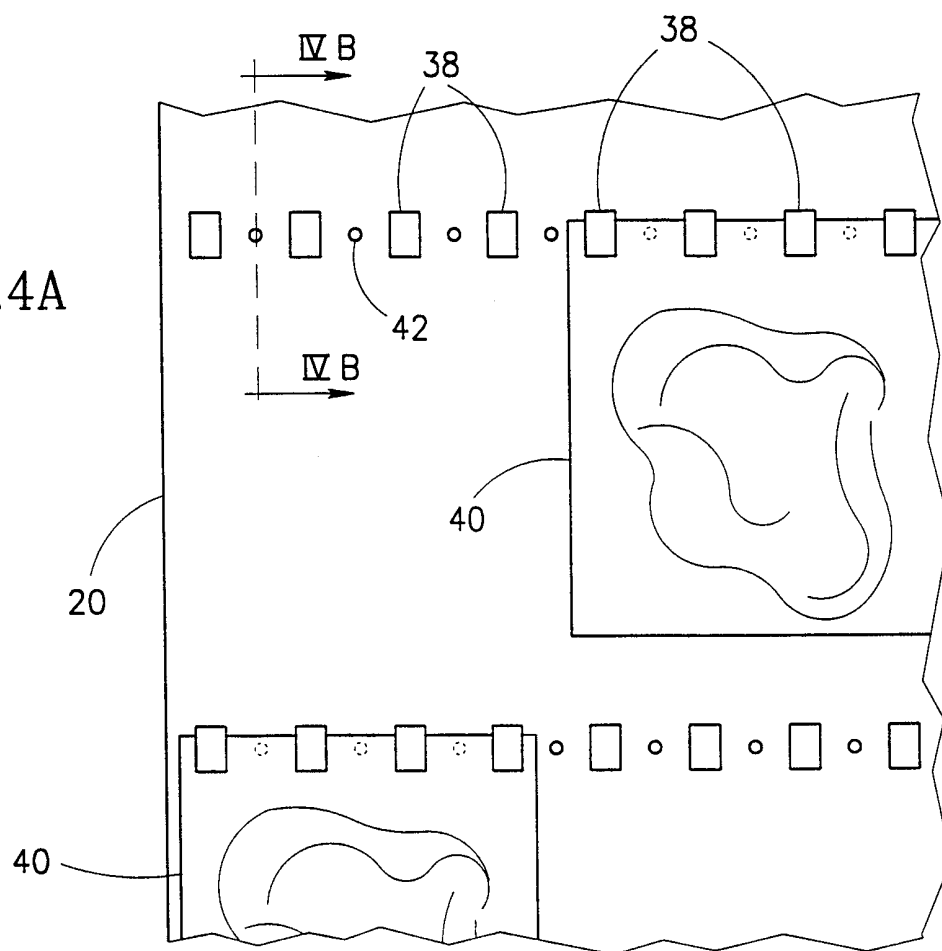
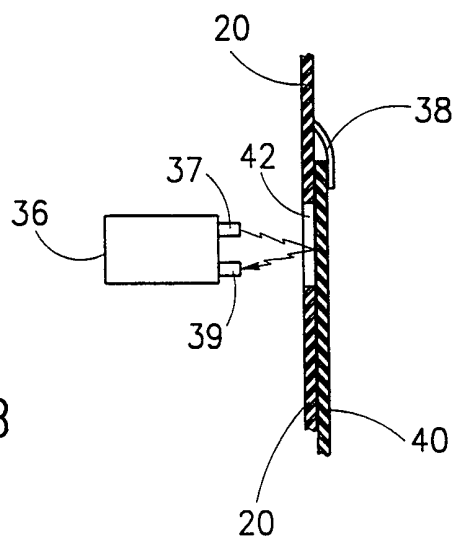


FIG. 4B



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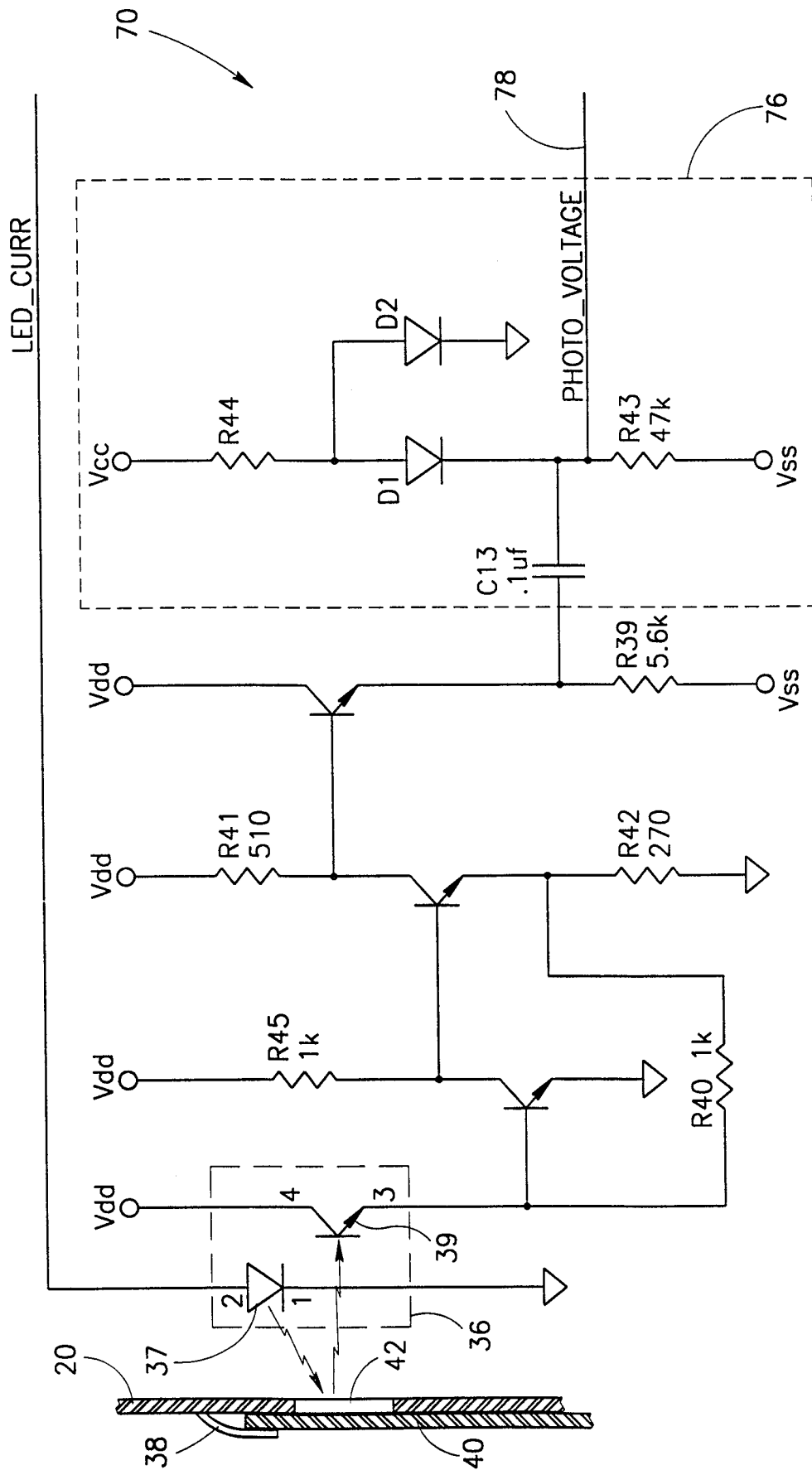


FIG.5

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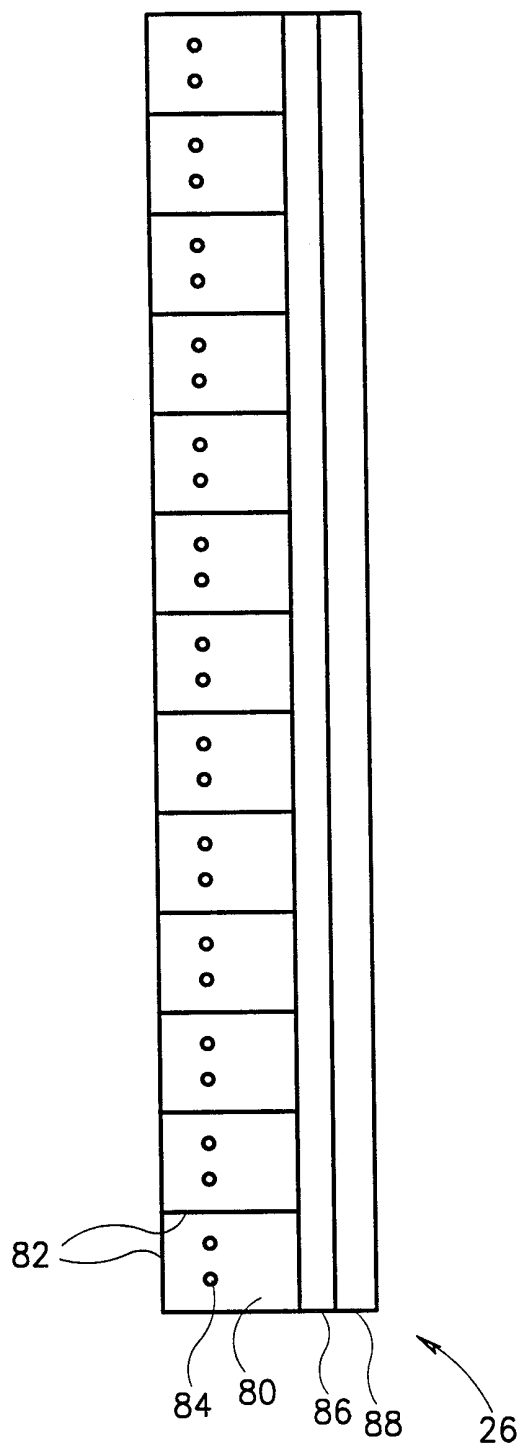


FIG. 6

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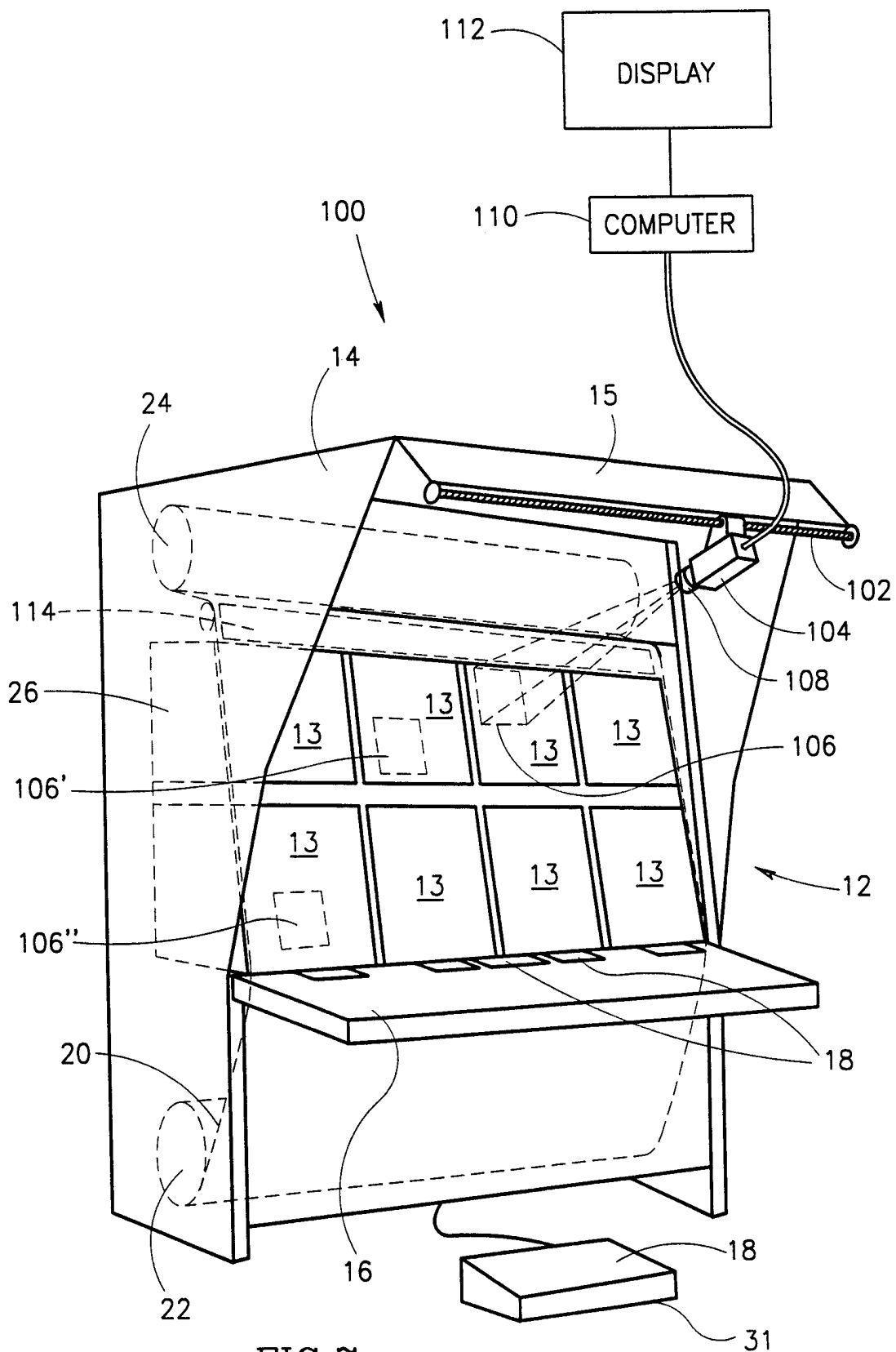


FIG. 7

INTERNATIONAL SEARCH REPORT

Int. Application No

PCT/IL 98/00397

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 G02B27/02 G09F11/29

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)

IPC 6 G02B G09F

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 practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 95 14950 A (ADAPTIVE VISUAL PERCEPTION ; INBAR DAN (IL); WOLF HANAN (IL)) 1 June 1995 cited in the application see page 18, line 8 - line 17 see page 23, line 2 - page 26, line 14; figures 1-3,6	88-94, 122-130, 168
Y		1,2,70, 84,117, 156
A		76,79, 131,134, 140,149, 152,155, 164,166, 173,174
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Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

° Special categories of cited documents :

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"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

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Date of the actual completion of the international search

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Manntz, W

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IL 98/00397

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 045 896 A (ADLON BRUCE E ET AL) 6 September 1977 see column 3, line 26 - column 4, line 9 see column 7, line 23 - column 8, line 44 see abstract; figures 1,2,9,16 ----	1,2,70, 84,117, 156
A	WO 93 01564 A (INBAR DAN ;TELTSCH GIORA JONATHAN (IL)) 21 January 1993 cited in the application see page 5, line 4 - page 7, line 38; figures 1-7 ----	1,2,17, 70,76, 84,88, 89,131, 152,164, 174
A	EP 0 048 353 A (IFFLAND AUGUST) 31 March 1982 see the whole document -----	1,2

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Information on patent family members

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