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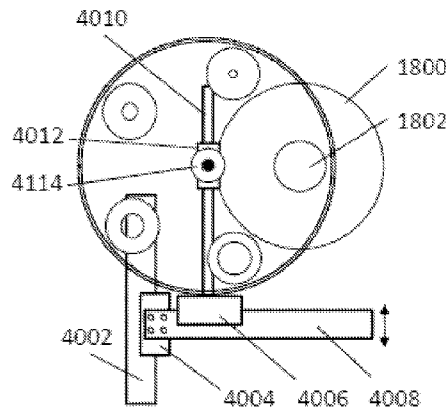
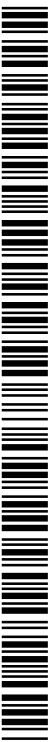


Figure 41B

(57) **Abstract:** A multiple frames imaging system is disclosed with capability of differential x-ray exposure of different input areas of an image intensifier or other x-ray detector. Collimators are provided to control the amount of radiation in various regions of the image and image processing is provided to provide the display of images of different qualities. Motion methods are provided to move the collimators to produce optimal image frames.



AMENDED CLAIMS
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1. A multiple frame imaging system comprising:
 - an x-ray source;
 - a detector having an input area;
 - a monitor configured to display detected images;
 - means for determining the location of at least one Region of Interest (ROI) of a patient on said displayed image; and
 - a collimator comprising:
 - means for projecting said at least one region of interest (ROI) on at least one selected fraction of said input area exposed by said x-ray source a first plate and a second plate mounted in planes generally parallel to the detector input surface plane and in at least partially overlapping positions, each plate has a single elongated aperture; wherein said first plate aperture long dimension is perpendicular to said second plate aperture long dimension; and
 - means for moving said first plate and said second plate independently in their planes in perpendicular directions to each other.
2. The system of claim 1, wherein each one of said plates is partially transparent to x-ray radiation and wherein the positioning of said plates is configured to create a fully transparent area in a gap formed by overlapping the elongated apertures of both plates, for projecting said at least one region of interest (ROI), first partially transparent areas covered by a single plate and a second partially transparent areas covered by two plates.
3. The system of claim 1, wherein said plates are movable in perpendicular directions.
4. The system of claim 3, wherein each one of said plates is connected to a carriage movable by a motor and a transmission system along a track.
5. The system of claim 4, wherein the x-ray is configured to operate in a pulsed mode and wherein said motors are configured to rotate continually in one direction and wherein the angular speed of the motors is designed

- so that the rotation frequency of the motors is the same as the frequency of the x-ray pulses.
6. The system of claim 1, wherein said plates are movable in a rotational motion around a center of rotation.
 7. The system of claim 6, wherein each one of said centers of rotation is connected to a motor through a driving belt.
 8. The system of claim 6, wherein each one of said centers of rotation is directly connected to a motor.
 9. The system of claim 6, wherein said plates are disc-shaped.
 10. The system of claim 9, wherein said aperture is along a radius of said disc-shaped plate.
 11. The system of claim 1, further comprising:
an image processing unit connected between said detector and said monitor, said image processing unit configured to optimize the detected image displayed on said monitor according to at least one image parts in said at least one ROI.
 12. The system of claim 11, wherein said image optimization comprises determining a tone reproduction function for the image.
 13. The system of claim 12, wherein said tone reproduction function is implemented as one of brightness function, a contrast function, a gamma function, an offset function, an n-degree linear function and a non-linear function.
 14. The system of claim 11, wherein said image optimization comprises controlling said x-ray source parameters.
 15. The system of claim 14, wherein said x-ray source parameters are selected from the group consisting of: current mode, Peak Kilo Voltage (PKV), pulse length and Automatic Gain Control (AGC).
 16. The system of claim 1, wherein said collimator is configured to move in accordance to the zoom setting of the detector and the determined ROI.
 17. A collimator comprising:
a first plate and a second plate mounted in planes generally parallel to each other and in an at least partially overlapping positions, each plate has a single elongated aperture;

wherein said first plate aperture long dimension is perpendicular to said second plate aperture long dimension; and
means for moving said first plate and said second plate independently in their planes in perpendicular directions to each other.

18. The collimator of claim 17, wherein each one of said plates is partially transparent to x-ray radiation and wherein the positioning of said plates is configured to create a fully transparent area in a gap formed by overlapping the elongated apertures of both plates.
19. The collimator of claim 17, wherein said plates are movable in perpendicular directions.
20. The collimator of claim 19, wherein each one of said plates is connected to a carriage movable by a motor and a transmission system along a track.
21. The collimator of claim 17, wherein said plates are movable in a rotational motion around a center of rotation.
22. The collimator of claim 21, wherein each one of said centers of rotation is connected to a motor through a driving belt.
23. The collimator of claim 21, wherein each one of said centers of rotation is directly connected to a motor.
24. The collimator of claim 18, wherein said plates are disc-shaped.
25. The collimator of claim 24, wherein said aperture is along a radius of said disc-shaped plate.
26. A collimator system comprising:
 - a round collimator comprising:
 - at least one aperture that allows radiation to pass through;
 - an outer annulus that reduces the radiation passing through at an amount depending on the material and the thickness of the said outer annulus;
 - and
 - an inner annulus between said aperture and said outer annulus, said inner annulus having changing thickness; and
 - two carriages associated with said collimator, said carriages movable by at least one motor thereby moving said collimator in a 2-dimensional plane .

27. The collimator system of claim 26, wherein said thickness changes as a function of the distance from said at least one aperture, starting at a low thickness on the side of each one of said at least one apertures and ending at the thickness of the outer annulus on the side of the outer annulus.
28. The collimator system of claim 26, wherein said carriages movable by at least one motor along a track.
29. The collimator system of claim 28, wherein said tracks are perpendicular to each other.
30. A method of controlling a display size of a ROI in an image of an x-ray irradiated area, comprising:
providing a multiple frame imaging system comprising:
an x-ray source;
a detector having an input area; and
a collimator comprising:
means for projecting a region of interest (ROI) on a selected fraction of said input area exposed by said x-ray source;
a first plate and a second plate mounted in planes generally parallel to the detector input surface plane and in at least partially overlapping positions, each plate has a single elongated aperture;
wherein said first plate aperture long dimension is perpendicular to said second plate aperture long dimension; and
motor means for moving said first plate and said second plate independently in their planes in perpendicular directions to each other;
and
determining location and size of an exposed area image on said detector input area by moving at least one of said first plate and said second plate to form a fully transparent gap between said plates.
31. The method of claim 30, wherein each one of said plates is partially transparent to x-ray radiation.
32. The method of claim 30, wherein the x-ray operates in a pulsed mode and wherein said motors rotate continually in one direction and wherein the angular speed of the motors is designed so that the rotation frequency of the motors is the same as the frequency of the x-ray pulses.

33. The system of claim 1, further comprising:
an image processing unit connected between said detector and said monitor, said image processing unit configured to optimize the detected image displayed on said monitor according to the image part in said ROI.
34. The system of claim 33, wherein said image optimization comprises determining a tone reproduction function for the image.
35. The system of claim 34, wherein said tone reproduction function is implemented as one of brightness function, a contrast function, a gamma function, an offset function, an n-degree linear function and a non-linear function.
36. The system of claim 35, wherein said image optimization comprises controlling said x-ray source parameters.
37. The system of claim 36, wherein said x-ray source parameters are selected from the group consisting of: current mode, Peak Kilo Voltage (PKV), pulse length and Automatic Gain Control (AGC).
38. A multiple frame imaging system comprising:
an x-ray source;
a detector having an input area;
a monitor configured to display detected images;
means for determining the location of at least one Region of Interest (ROI) of a patient on said displayed image according to the location of an operator's focus of attention;
and
a collimator comprising means for projecting said at least one region of interest (ROI) on at least one selected fraction of said input area exposed by said x-ray source;
said x-ray system comprising multiple filament elements configured to generate multiple and simultaneous X Ray beams;
means for selecting a subset of said x-ray beams; and
means for modifying the x-ray radiation in order to aim at said at least one determined ROI.
39. A multiple frame imaging system comprising:
an x-ray source;
a detector having an input area;

a monitor configured to display detected images;
means for determining the location of at least one Region of Interest (ROI) of a patient on said displayed image according to the location of an operator's focus of attention;
and
a collimator comprising means for projecting said at least one region of interest (ROI) on at least one selected fraction of said input area exposed by said x-ray source;
said x-ray system comprising a matrix/array of x ray tubes/sources configured to generate multiple and simultaneous X Ray beams;
means for selecting a subset of said x-ray beams; and
means for modifying the x-ray radiation in order to aim at said at least one determined ROI.

40. A multiple frame imaging system comprising:

an x-ray source;
a detector having an input area;
a monitor configured to display detected images;
means for determining the location of at least one Region of Interest (ROI) of a patient on said displayed image according to the location of an operator's focus of attention;
and
a collimator comprising means for projecting said at least one region of interest (ROI) on at least one selected fraction of said input area exposed by said x-ray source;
said x-ray system comprising rotatable and translatable cathodes and/or anodes configured to generate multiple and simultaneous X Ray beams;
means for selecting a subset of said x-ray beams; and
means for modifying the x-ray radiation in order to aim at said at least one determined ROI.

41. A variable aperture collimator system comprising:

a plurality of radiation attenuating plates, each one of said plates having an aperture;
means for selecting a radiation attenuating plate;

a collimator having an opening configured to receive any of said radiation attenuating plates;

and

a plate changing mechanism comprising:

a radiation transparent body comprising on one face thereof a plurality of said radiation attenuating plates;

said body is movable by a motor thereby to bring a selected plate to said opening of said collimator, wherein said plate is received by said collimator.

42. The variable aperture collimator system of claim 41, wherein said radiation transparent body has a circular shape.
43. The variable aperture collimator system of claim 41, wherein said radiation transparent body has an anchor like shape.
44. The variable aperture collimator system of claim 41, wherein said radiation attenuating disks are made of copper.