1/3

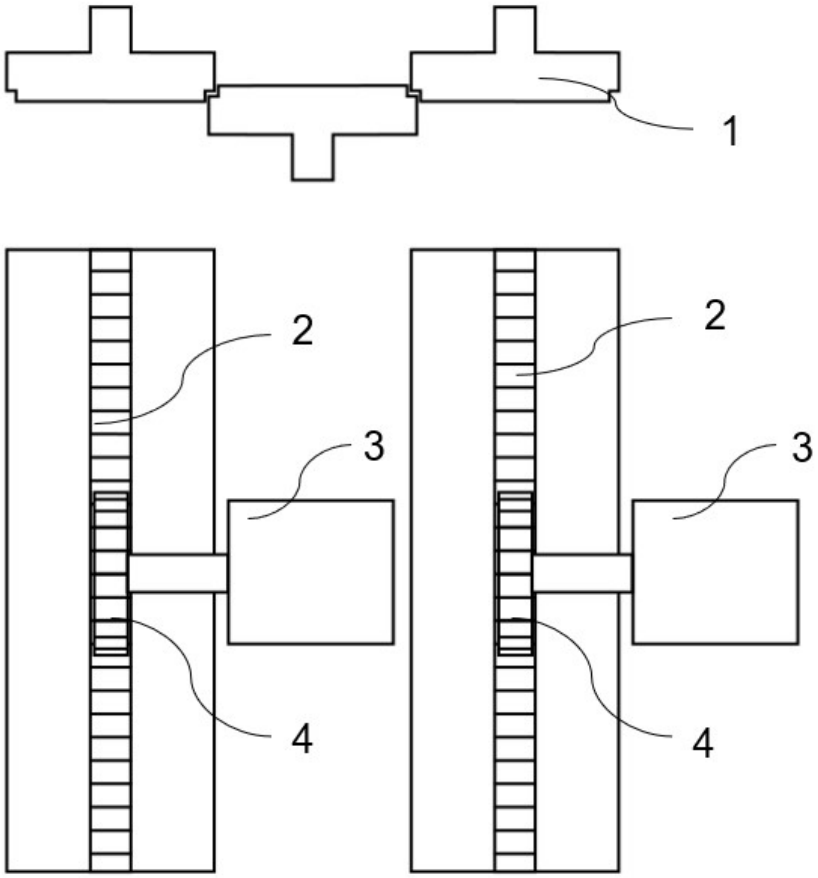


FIG. 1

(Chetan Chadha)
Patent Agent for the Applicant

2/3

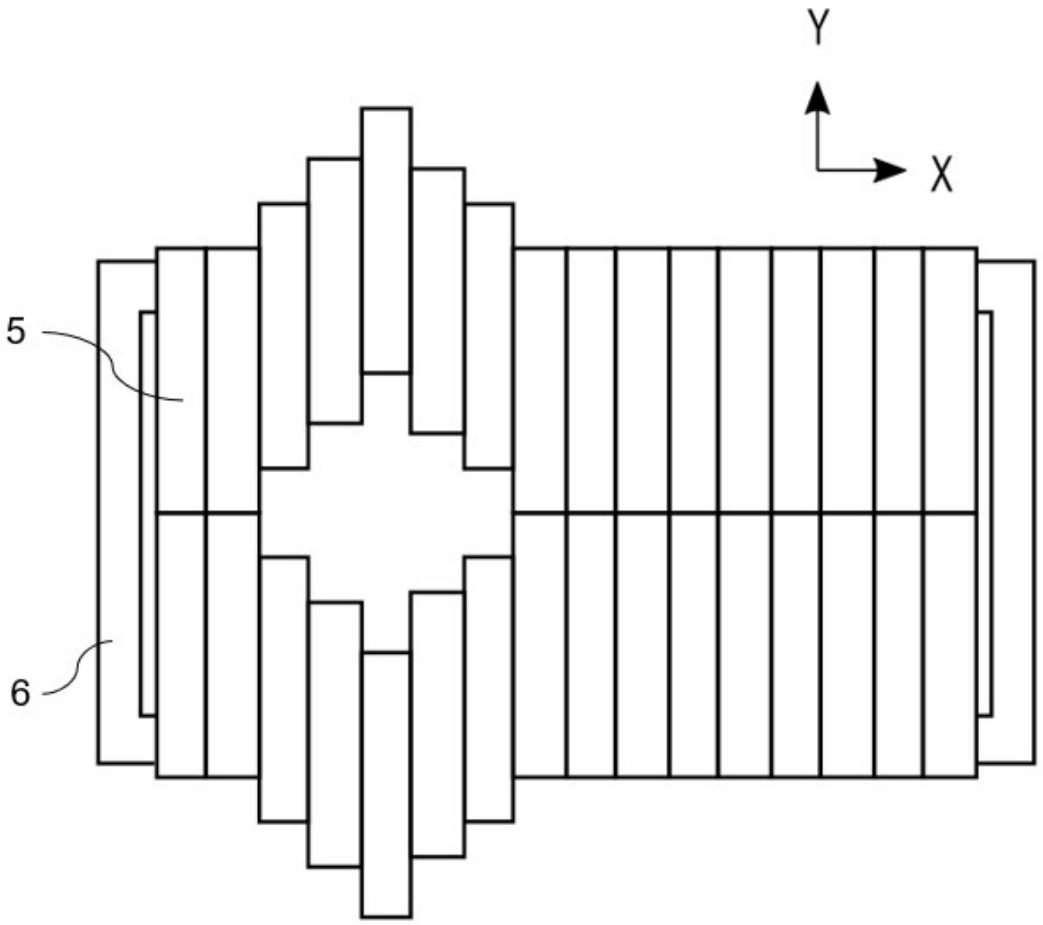


FIG. 2

(Chetan Chadha)
Patent Agent for the Applicant

3/3

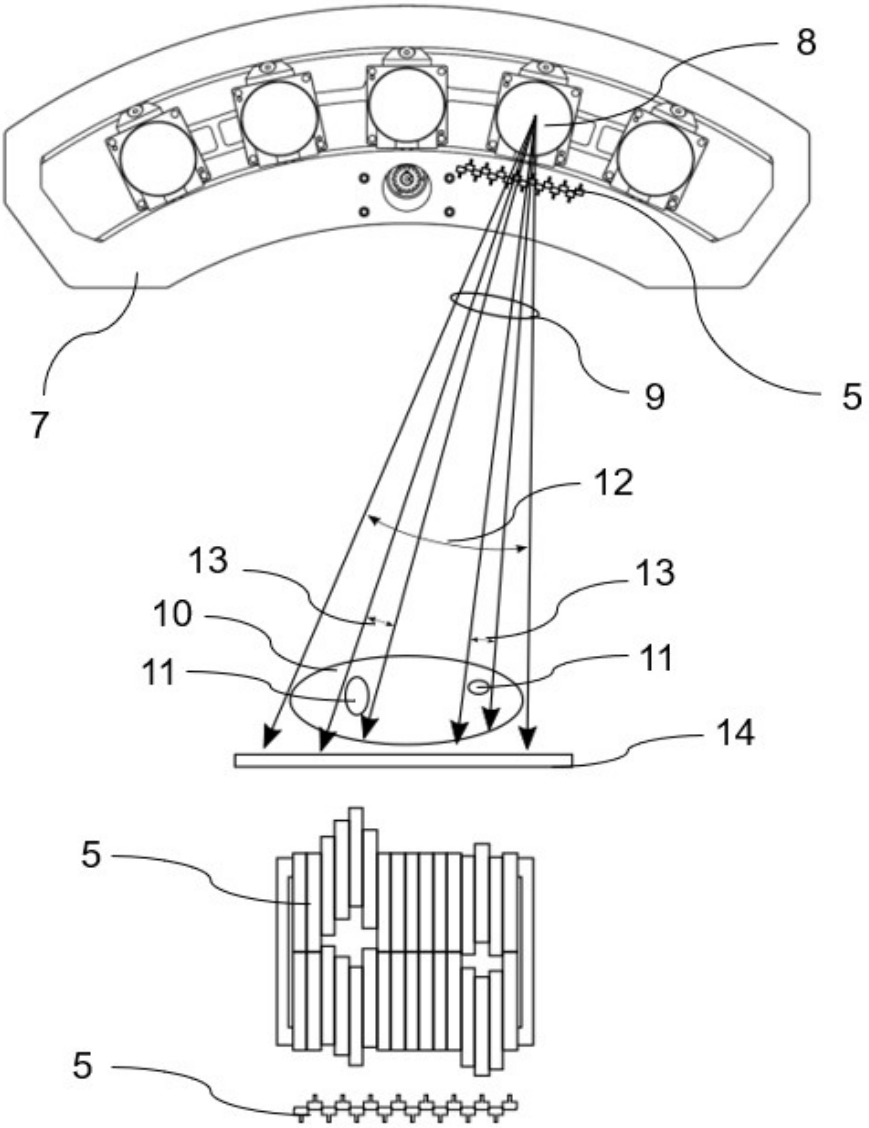


FIG. 3

(Chetan Chadha)
Patent Agent for the Applicant

FORM 2

THE PATENTS ACT, 1970

(39 of 1970)

& The Patent Rules, 2003

COMPLETE SPECIFICATION

1.TITLE OF THE INVENTION:

X-RAY MULTI-LEAF DYNAMIC COLLIMATION FOR MULTIPLE SOURCE-IN-MOTION TOMOSYNTHESIS IMAGING SYSTEM

2. APPLICANTS:

Name: AIXSCAN INC.

Nationality: USA

Address: 1209 Alderwood Avenue, Sunnyvale, California 94089, United States of America..

3. PREAMBLE TO THE DESCRIPTION:

The following specification particularly describes the invention and the manner in which it is to be performed:

We Claim:

1. A method of imaging an object radiographically with multiple X-ray source-in-motion tomosynthesis imaging system, comprising:

scanning an object with an X-ray full view using multiple X-ray source-in-motion tomosynthesis imaging system;

locating region of interest using artificial intelligence after an initial scan;

determining a dynamic collimation map for each of X-ray tubes;

applying a dynamic collimation map to motion control of the X-ray tubes; and

re-scanning the object using a multi-leaf dynamic collimator with X-ray beam only limited on the region of interest.

2. The method of claim 1, comprising mounting oppositely positioned heavy metal thin leaves with notches between the leaves to block radiation leakage.

3. The method of claim 1, comprising providing leaves-on-one-rack as one structure, wherein the rack is moved by a stepper motor.

4. The method of claim 1, comprising mounting one or a plurality of X-ray blocking leaves on a multi-leaf frame and moving the multi-leaf frame in a first direction

5. The method of claim 4, comprising moving one or more X-ray blocking leaves in a second direction.

6. The method of claim 1, comprising moving one or more x-ray blocking leaves to form an X-ray exposure window for a multiple X-ray source-in-motion tomosynthesis imaging system.

7. The method of claim 1, comprising moving multiple X-ray sources simultaneously around an object on a pre-defined track.

8. The method of claim 1, comprising mounting multiple pulsed X-ray sources on a mobile structure to form a source array and wherein each X-ray source is pulsed independently through an external exposure control unit.

9. The method of claim 8, wherein each individual X-ray source moves around a first position and when synchronized with the source array moving around a second position, controlling the X-ray sources to stay still during X-ray exposure.

10. The method of claim 1, comprising:

acquiring initial projection images from selected X-ray sources until a predetermined projection image threshold is met;

reconstructing a 3D tomosynthesis image volume from the projection images; and

searching for one or more lung nodules from the reconstructed 3D tomosynthesis image volume using machine learning.

11. An X-ray imaging apparatus, comprising:

a multiple pulsed X-ray source-in-motion tomosynthesis imaging system；

a or a plurality of dynamic collimators in front of each of X-ray tubes and including:

a plurality of heavy metal thin leaves each movable in a first direction; and

a frame that holds the heavy metal thin leaves moveable in a second direction.

a or a plurality of motor controllers to control multiple motors to move the frame and the leaves; and

a processor to control the multiple motors.

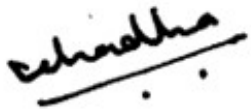
12. The system of claim 11, wherein oppositely positioned leaves with notches between the leaves are positioned to block radiation leakage from a multiple pulsed X-ray source-in-motion tomosynthesis imaging system.

13. The system of claim 11, wherein leaves are mounted on a rack as one structure, wherein the rack is moved by a stepper motor.

14. The system of claim 11, comprising one or a plurality of X-ray blocking leaves mounted on a multi-leaf frame and the multi-leaf frame moved in a first direction

15. The system of claim 14, wherein one or a plurality of X-ray blocking leaves are moved in a second direction.

Dated this 11th day of September, 2023.



(CHETAN CHADHA)

PATENT AGENT

Marked-up Claims:

1. A method of imaging an object radiographically with multiple X-ray source-in-motion tomosynthesis imaging system, comprising:

scanning an object with an X-ray full view using multiple X-ray source-in-motion tomosynthesis imaging system;

locating region of interest using artificial intelligence after an initial scan;

determining a dynamic collimation map for each of X-ray tubes;

applying a dynamic collimation map to motion control of the X-ray tubes; and

re-scanning the object using a multi-leaf dynamic collimator with X-ray beam only limited on the region of interest.

2. The method of claim 1, comprising mounting oppositely positioned heavy metal thin leaves with notches between the leaves to block radiation leakage.

3. The method of claim 1, comprising providing leaves-on-one-rack as one structure, wherein the rack is moved by a stepper motor.

4. The method of claim 1, comprising mounting one or a plurality of X-ray blocking leaves on a multi-leaf frame and moving the multi-leaf frame in a first direction

5. The method of claim 4, comprising moving one or more X-ray blocking leaves in a second direction.

6. The method of claim 1, comprising moving one or more x-ray blocking leaves to form an X-ray exposure window for a multiple X-ray source-in-motion tomosynthesis imaging system.

7. The method of claim 1, comprising moving multiple X-ray sources simultaneously around an object on a pre-defined track.

8. The method of claim 1, comprising mounting multiple pulsed X-ray sources on a mobile structure to form a source array and wherein each X-ray source is pulsed independently through an external exposure control unit.

9. The method of claim 8, wherein each individual X-ray source moves around a first position and when synchronized with the source array moving around a second position, controlling the X-ray sources to stay still during X-ray exposure.

10. The method of claim 1, comprising:

acquiring initial projection images from selected X-ray sources until a predetermined projection image threshold is met;

reconstructing a 3D tomosynthesis image volume from the projection images; and

searching for one or more lung nodules from the reconstructed 3D tomosynthesis image volume using machine learning.

11. An X-ray imaging apparatus, comprising:

a multiple pulsed X-ray source-in-motion tomosynthesis imaging system；

a or a plurality of dynamic collimators in front of each of X-ray tubes and including:

a plurality of heavy metal thin leaves each movable in a first direction; and

a frame that holds the heavy metal thin leaves moveable in a second direction.

a or a plurality of motor controllers to control multiple motors to move the frame and the leaves; and

a processor to control the multiple motors.

12. The system of claim 11, wherein oppositely positioned leaves with notches between the leaves are positioned to block radiation leakage from a multiple pulsed X-ray source-in-motion tomosynthesis imaging system.

13. The system of claim 11, wherein leaves are mounted on a rack as one structure, wherein the rack is moved by a stepper motor.

14. The system of claim 11, comprising one or a plurality of X-ray blocking leaves mounted on a multi-leaf frame and the multi-leaf frame moved in a first direction

15. The system of claim 14, wherein one or a plurality of X-ray blocking leaves are moved in a second direction.

~~16. The system of claim 11, wherein one or a plurality of x-ray blocking leaves are moved to form an X-ray exposure window.~~

~~17. The system of claim 11, comprising a motor to move multiple pulsed X-ray sources simultaneously around an object on a pre-defined track.~~

~~18. The system of claim 11, comprising multiple pulsed X-ray sources mounted on a mobile structure to form a source array.~~

~~19. The system of claim 18, wherein each X-ray source is pulsed independently through an external exposure control unit and wherein each individual X-ray source moves around a first position and when synchronized with the source array moving around a second position, controlling the X-ray sources to stay still during X-ray imaging.~~

~~20. The system of claim 11, wherein the processor executes computer readable code to:~~

~~acquire initial projection images from selected X-ray sources until a predetermined projection image threshold is met;~~

~~reconstruct a 3D tomosynthesis image volume from the projection images; and~~

~~identify one or more lung nodules from the reconstructed 3D tomosynthesis image volume using machine learning.~~