second set of detectors disposed within the ramp of said portal for receiving X-rays that are backscattered from the vehicle.

In one embodiment, the system is collapsible. In one embodiment, the ramp comprises a base platform hinged to a first angled surface and a second angled surface and wherein, when said system is collapsed, the first angled surface and second angled surface are rotated upward.

In one embodiment, the top horizontal side is connected to said first vertical side at a first end and to said second vertical side at a second end and wherein the first X-ray source is disposed at a point mid way between said first end and said second end.

In one embodiment, the first X-ray source is a high energy source having an energy ranging from 100 kVp to 2 MV. In another embodiment, the second X-ray source is a low energy source having an energy ranging from 60 kVp to 250 kVp.

In one embodiment, the system further comprises a controller, wherein said controller is adapted to activate the first X-ray source only when the second X-ray source is inactive.

In one embodiment, the system further comprises a primary rotating collimator placed adjacent to said ~~first~~ second X-ray source, and a secondary static collimator placed adjacent to said rotating collimator and parallel to the inspection surface, wherein said secondary collimator is adapted to generate a first irradiation area in the center of the inspection area and a second irradiation area at a periphery of the inspection area and wherein said second irradiation area is larger than the first irradiation area.

In one embodiment, the system further comprises backscatter detectors in at least one of said first vertical side, said second vertical side, and said top horizontal side. In another embodiment, the backscatter X-ray source is not disposed with said backscatter detectors in at least one of said first vertical side, said second vertical side, and said top horizontal side.

In another embodiment, the present invention is a method for inspecting a vehicle, comprising: providing a portal defining an inspection area, said portal comprising a first vertical side, a second vertical side, a top horizontal side, and a horizontal base defined by a ramp adapted to be driven over by a vehicle; signalling a vehicle to drive over the ramp; irradiating a vehicle with X-rays from a first source disposed on one side of the portal; detecting the X-rays transmitted through the vehicle, using transmission detectors disposed within the portal, to produce a first output signal representative of the vehicle and contents thereof; irradiating the underside of the vehicle with X-rays from a second source disposed within the ramp; detecting

CLAIMS

1. A scanning system for the inspection of cargo, comprising:

a portal defining an inspection area, said portal comprising a first vertical side, a second vertical side, a top horizontal side, and a horizontal base defined by a ramp adapted to be driven over by a vehicle;

a first X-ray source disposed on at least one of the first vertical side, second vertical side or top horizontal side for generating an X-ray beam into the inspection area toward the vehicle;

a first set of transmission detectors disposed within the portal for receiving the X-rays transmitted through the vehicle;

a second X-ray source disposed within the ramp of said portal for generating an X-ray beam towards the underside of the vehicle; and

a second set of detectors disposed within the ramp of said portal for receiving X-rays that are backscattered from the vehicle.

2. The system of claim 1, wherein said first X-ray source is a high energy source having an energy ranging from 100 kVp to 2 MV.

3. The system of claim 1, wherein said second X-ray source is a low energy source having an energy ranging from 60 kVp to 250 kVp.

4. The system of claim 1, further comprising a controller, wherein said controller is adapted to activate the first X-ray source only when the second X-ray source is inactive.

5. The system of claim 1, wherein said system is collapsible.

6. The system of claim 5, wherein said ramp comprises a base platform hinged to a first angled surface and a second angled surface and wherein, when said system is collapsed, the first angled surface and second angled surface are rotated upward.

7. The system of claim 1, wherein said top horizontal side is connected to said first vertical side at a first end and to said second vertical side at a second end and wherein the first X-ray source is disposed at a point mid way between said first end and said second end.

8. The system of claim 1 further comprising a primary rotating collimator placed adjacent to said ~~first~~ second X-ray source, and a secondary static collimator placed adjacent to said rotating collimator and parallel to the inspection surface, wherein said secondary collimator is adapted to generate a first irradiation area in the center of the inspection area and a second irradiation area at a periphery of the inspection area and wherein said second irradiation area is larger than the first irradiation area.

9. The system of claim 1 further comprising backscatter detectors in at least one of said first vertical side, said second vertical side, and said top horizontal side.

10. The system of claim 9 wherein a backscatter X-ray source is not disposed with said backscatter detectors in at least one of said first vertical side, said second vertical side, and said top horizontal side.

11. A method for inspecting a vehicle, comprising:

providing a portal defining an inspection area, said portal comprising a first vertical side, a second vertical side, a top horizontal side, and a horizontal base defined by a ramp adapted to be driven over by a vehicle,

signalling a vehicle to drive over the ramp,

irradiating a vehicle with X-rays from a first source disposed on one side of the portal,

detecting the X-rays transmitted through the vehicle, using transmission detectors disposed within the portal, to produce a first output signal representative of the vehicle and contents thereof,

irradiating the underside of the vehicle with X-rays from a second source disposed within the ramp, detecting X-rays scattered back from the vehicle, using backscatter detectors disposed within the ramp, to produce a second output signal representative of the vehicle and contents thereof, and

correlating said first output signal and said second output signal to produce a visual image of the vehicle and contents thereof.

12. The method of claim 11, wherein said first X-ray source is a high energy source having an energy ranging from 100 kVp to 2 MV.

13. The method of claim 11, wherein said second X-ray source is a low energy source having an energy ranging from 60 kVp to 250 kVp.

14. The method of claim 11, wherein said first X-ray source is operated when said second X-ray source is inactive.

15. A scanning system for inspecting a vehicle, comprising:

a portal defining an inspection area, said portal comprising a first vertical side and a second vertical side spaced apart from each other and each having a top side;

a third side connecting said two top sides;

a ramp ~~over~~ adapted to be driven over by a vehicle;

an X-ray source disposed on one side of the portal for generating an X-ray beam into the inspection area;

a first set of detectors disposed within the portal for receiving X-rays transmitted through the vehicle;

a second set of detectors disposed within the ramp and the first, second and third sides of said portal for receiving X-rays backscattered from the vehicle; and

an image processor for receiving output signals from said first and second set of detectors and overlaying said output signals onto a visual image of the vehicle and contents thereof.

16. The system of claim 15, wherein said first set of detectors is disposed on at least two of the same sides of the portal as the second set of detectors.

17. The system of claim 1 or 15, wherein said first set of detectors comprises a first detector and a second detector adapted to measure an energy component of X-rays transmitted through the vehicle in a range of 0 keV to 50 keV and 20 keV to 200 keV, respectively, and a third detector to measure an energy component of X-rays transmitted through the vehicle in a range of 100 keV to 2 MeV.

18. The system of claim 17, wherein said three detectors are in a stacked configuration.

19. The system of claim 17, wherein a difference between an output of the third detector and a sum of outputs of the first and second detectors is used to achieve material discrimination.

20. The system of claim 15 further comprising a sensor to measure a speed of the vehicle as it passes through the portal.

21. The system of claim 20, further comprising a controller wherein said controller is in data communication with the sensor and receives the speed of vehicle and wherein said controller is adapted to modulate a pulse rate of the X-ray source to attain a substantially constant dose per unit length of the vehicle under inspection based on the speed.

22. The system of claim 1 or claim 2 wherein the first X-ray source is a pulsed X-ray source.

23. The system of any one of claims 1, 2 and 22 wherein the first X-ray source is a linear accelerator.

24. The system of claim 22 wherein the second X-ray source comprises a rotating collimator with two apertures, each located substantially opposite to the other, and the controller is adapted to activate the first X-ray source when the second X-ray source is not emitting a beam into the vehicle.

2~~3~~5. The system of claim 5 wherein the system is integrated with a trailer to permit towing of the system behind a vehicle.

26. The system of claim 1 further comprising an optical system arranged to acquire an optical image of the vehicle and an image processor for receiving output signals from the second set of detectors and overlaying said output signals onto the optical image.

27. The system of claim 26 further comprising a rotating collimator placed adjacent to the second X-ray source wherein the optical system comprises a mirror arranged to rotate with collimator and one or more photo detectors.