downward-directed beam requires penetration of less metal than would be required by a view transverse to the direction of motion of the vehicle.

The use of an x-ray source and an x-ray detector, both located in a portal, for purposes of screening personnel, is the subject, for example, of US Patent No. ~~6,094,072,~~ to Smith, issued July 25, 2000, and incorporated herein by reference. A portal, however, is not typically amenable to rapid and flexible deployment, but, rather, requires a dedicated installation. An inspection system providing these features is desirable.

Summary of Embodiments of the Invention

In one embodiment of the present invention, there is provided a rapidly relocatable inspection system for inspecting an object. The inspection system has a conveyance capable of on-road travel, with a source of penetrating radiation mounted on the conveyance. The source is mounted on a deployable member, such as a boom, that deploys outward from the conveyance, and directs a first beam of penetrating radiation in a substantially vertical direction. A detector mechanically coupled to the conveyance detects penetrating radiation from the source after interaction of the object with the penetrating radiation, and generates a detector signal. Finally, the inspection system has a controller for creating an image of contents of the object based at least on the detector signal.

In alternate embodiments of the invention, the conveyance may be self-propelled, and it may be a trailer. The detector that is mechanically coupled to the conveyance may be deployed from the conveyance prior to inspection operation. It may be mechanically supported by an underlying surface during self-propelled passage thereover by an inspected vehicle, and at least one ramp may be coupled to the detector for facilitating passage thereover by an inspected vehicle. It may also be disposed on a deployable member, such as a boom, coupled to the conveyance.

In further embodiments, the source may include a collimator for shaping the beam of penetrating radiation, such as into a fan beam, and may also include a beam scanning mechanism, such as a rotating chopper wheel. The inspection system may also have at least

as one or more collimators. I n accordance with certain embodiments of the invention, x-rays having maximal energies in the range between 160 keV and 300 keV are employed. At this energy, x-rays penetrate into a vehicle, and organic objects inside the vehicle can be detected. Since lower doses of x-ray irradiation are thus possible, automobiles may be scanned using the present invention. For applications where the scanned vehicle may contain personnel, end point energies below 300 keV are preferred. The scope of the present invention, however, is not limited by the range of energies of the penetrating photons employed.

Spectral- and beam-shaping elements are described, for example, in US Patent No. 6,459,761, "Spectrally Shaped Inspection Beam," issued October 1, 2002, and incorporated herein by reference.

In certain embodiments of the invention, such as those that employ backscatter imaging, the emission of source **104** is shaped into a beam **108** that has the shape of a pencil beam. However, in other embodiments of the invention, beam **108** may be a fan beam, or may have another cross-sectional profile. Beam **108** may be swept, such as by means of a chopper wheel, as described, for example, in US Patent No. 6,459,764, "Drive-Through Vehicle Inspection System," issued October 1, 2002, and incorporated herein by reference.

Source **104** is disposed on a deployable member, which, in the embodiment depicted in Fig. 1, is a boom **112** that may be extended outward from conveyance **110** by rotation about a central axis designated by line **114** ~~substantially along the direction of road travel of~~ the conveyance. Typically, boom **112** rotates by approximately 90° between its stowed position, for on-road travel, and its deployed position, for inspection operation.

Conveyance **110** also carries a high-voltage power supply **120** to power source **104** as well as a cooling module **122** and an electronics module **124**, including controller **126**. Additionally, conveyance **110** typically includes an electrical generator **130**, such as a gasoline-powered genset, and a fuel tank **132**.

Concurrently with transmission imaging by means of transmission detector **106**, a scatter image may be obtained through use of a scatter detector, such as backscatter detector **116**. In the case where scatter information is to be obtained, beam **108** is a pencil beam, and

downward-directed beam requires penetration of less metal than would be required by a view transverse to the direction of motion of the vehicle.

The use of an x-ray source and an x-ray detector, both located in a portal, for purposes of screening personnel, is the subject, for example, of US Patent No. 6,094,472, to Smith, issued July 25, 2000, and incorporated herein by reference. A portal, however, is not typically amenable to rapid and flexible deployment, but, rather, requires a dedicated installation. An inspection system providing these features is desirable.

Summary of Embodiments of the Invention

In one embodiment of the present invention, there is provided a rapidly relocatable inspection system for inspecting an object. The inspection system has a conveyance capable of on-road travel, with a source of penetrating radiation mounted on the conveyance. The source is mounted on a deployable member, such as a boom, that deploys outward from the conveyance, and directs a first beam of penetrating radiation in a substantially vertical direction. A detector mechanically coupled to the conveyance detects penetrating radiation from the source after interaction of the object with the penetrating radiation, and generates a detector signal. Finally, the inspection system has a controller for creating an image of contents of the object based at least on the detector signal.

In alternate embodiments of the invention, the conveyance may be self-propelled, and it may be a trailer. The detector that is mechanically coupled to the conveyance may be deployed from the conveyance prior to inspection operation. It may be mechanically supported by an underlying surface during self-propelled passage thereover by an inspected vehicle, and at least one ramp may be coupled to the detector for facilitating passage thereover by an inspected vehicle. It may also be disposed on a deployable member, such as a boom, coupled to the conveyance.

In further embodiments, the source may include a collimator for shaping the beam of penetrating radiation, such as into a fan beam, and may also include a beam scanning mechanism, such as a rotating chopper wheel. The inspection system may also have at least

as one or more collimators. I n accordance with certain embodiments of the invention, x-rays having maximal energies in the range between 160 keV and 300 keV are employed. At this energy, x-rays penetrate into a vehicle, and organic objects inside the vehicle can be detected. Since lower doses of x-ray irradiation are thus possible, automobiles may be scanned using the present invention. For applications where the scanned vehicle may contain personnel, end point energies below 300 keV are preferred. The scope of the present invention, however, is not limited by the range of energies of the penetrating photons employed.

Spectral- and beam-shaping elements are described, for example, in US Patent No. 6,459,761, "Spectrally Shaped Inspection Beam," issued October 1, 2002, and incorporated herein by reference.

In certain embodiments of the invention, such as those that employ backscatter imaging, the emission of source **104** is shaped into a beam **108** that has the shape of a pencil beam. However, in other embodiments of the invention, beam **108** may be a fan beam, or may have another cross-sectional profile. Beam **108** may be swept, such as by means of a chopper wheel, as described, for example, in US Patent No. 6,459,764, "Drive-Through Vehicle Inspection System," issued October 1, 2002, and incorporated herein by reference.

Source **104** is disposed on a deployable member, which, in the embodiment depicted in Fig. 1, is a boom **112** that may be extended outward from conveyance **110** by rotation about a central axis designated by line **114** upright and perpendicular to the direction of road travel of the conveyance. Typically, boom **112** rotates by approximately 90° between its stowed position, for on-road travel, and its deployed position, for inspection operation.

Conveyance **110** also carries a high-voltage power supply **120** to power source **104** as well as a cooling module **122** and an electronics module **124**, including controller **126**. Additionally, conveyance **110** typically includes an electrical generator **130**, such as a gasoline-powered genset, and a fuel tank **132**.

Concurrently with transmission imaging by means of transmission detector **106**, a scatter image may be obtained through use of a scatter detector, such as backscatter detector **116**. In the case where scatter information is to be obtained, beam **108** is a pencil beam, and