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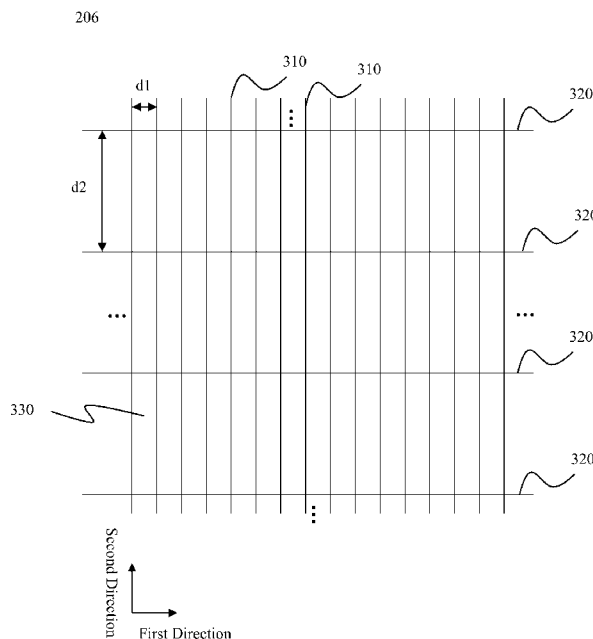
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(57) **Abstract:** Anti-scatter grids (206) are provided. An anti-scatter grid (206) may include a plurality of first grid walls (310) arranged in a first direction, and a plurality of second grid walls (320) arranged in a second direction. Each pair of adjacent first grid walls (310) of at least some of the plurality of first grid walls (310) may be spaced by a first distance (d1) in the first direction, each pair of adjacent second grid walls (320) of at least some of the plurality of second grid walls (320) may be spaced by a second distance (d2) in the second direction, a distance ratio of the first distance (d1) to the second distance (d2) may be set such that a maximum deflection of each first grid wall (310) in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid (206), and the first direction may be orthogonal to the second direction.

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ANTI-SCATTER GRID FOR IMAGING APPARATUS

TECHNICAL FIELD

[0001] The present disclosure generally relates to an imaging apparatus, and more particularly, to anti-scatter grids for an imaging apparatus.

BACKGROUND

[0002] Many imaging apparatuses, such as computed tomography (CT) scanners, positron emission tomography (PET) scanners, counting X-ray scanning apparatuses, or any scanning apparatuses use X-rays or other high-energy beams to inspect an object. These scanners may be used in various fields including, e.g., medicine (e.g., medical CT), industry (e.g., inspection of weld joints), research (e.g., archeology), or security (e.g., airport screening). High-energy beams emitted by such a scanner may traverse an object and be detected by a detector of the scanner for generating an image of the object. The quality of such an image may be affected by factors including, e.g., some of the high-energy beams being scattered by the scanned object.

SUMMARY

[0003] According to an aspect of the present disclosure, an anti-scatter grid is provided. The anti-scatter grid may include a plurality of first grid walls arranged in a first direction and a plurality of second grid walls arranged in a second direction. Each pair of adjacent first grid walls of at least some of the plurality of first grid walls are spaced by a first distance in the first direction, and each pair of adjacent second grid walls of at least some of the plurality of second grid walls are spaced by a second distance in the second direction. A distance ratio of the first distance to the second distance is set such that a maximum deflection of each first grid wall in the first direction within a predefined range determined based on a mechanical stability of the anti-scatter grid, and the first direction is orthogonal to the second direction.

[0004] In some embodiments, the predefined range is less than 20 μ m.

[0005] In some embodiments, the distance ratio of the first distance to the second distance is lower than 1.

[0006] In some embodiments, each pair of adjacent first grid walls of at least some of the plurality of first grid walls and each pair of adjacent second grid walls of at least some of the plurality of second grid walls define a region where a plurality of detector pixels are arranged, a count of pixel types of the plurality of detector pixels corresponding to each region is less than a type threshold, and each pixel type is associated with an effective area of a detector pixel.

[0007] In some embodiments, a second grid wall of at least some of the plurality of second grid walls is disposed between each pair of adjacent detector modules, and each detector module includes a plurality of detector pixels.

[0008] In some embodiments, a thickness of a second grid wall of at least some of the plurality of second grid walls is less than or equal to a module gap between two adjacent detector modules in the first direction where the second grid wall disposed.

[0009] In some embodiments, each of at least some of the plurality of first grid walls is disposed between two adjacent detector pixels, and a pixel gap between the two adjacent detector pixels in the first direction is less than the module gap between the two adjacent detector modules.

[0010] In some embodiments, the anti-scatter grid may further include a plurality of regions each of which is defined by a pair of adjacent first grid walls of at least some of the plurality of first grid walls and a pair of adjacent second grid walls of at least some of the plurality of second grid walls. For at least one of the

plurality of regions, a thickness of a first grid wall of the at least some of the plurality of first grid walls defining the region or a thickness of a second grid wall of the at least some of the plurality of second grid walls defining the region is associated with an effective area ratio of an effective area corresponding to the region to a total area corresponding to the region.

[0011] In some embodiments, the effective area ratio corresponding to the region is greater than an effective area ratio threshold.

[0012] In some embodiments, a height of a first grid wall of the plurality of first grid walls or a height of a second grid wall of the plurality of second grid walls is associated with a scatter primary ratio (SPR).

[0013] In some embodiments, the SPR is less than a SPR threshold.

[0014] In some embodiments, a thickness of a first grid wall of the plurality of first grid walls equals a thickness of a second grid wall of the plurality of second grid walls.

[0015] In some embodiments, a thickness of a first grid wall of the plurality of first grid walls is different from a thickness of a second grid wall of the plurality of second grid walls.

[0016] In some embodiments, a height of a first grid wall of the plurality of first grid walls equals a height of a second grid wall of the plurality of second grid walls.

[0017] In some embodiments, a height of a first grid wall of the plurality of first grid walls is different from a height of a second grid wall of the plurality of second grid walls.

[0018] In some embodiments, each of at least some of the plurality of first grid walls includes a first material; each of at least some of the plurality of second grid walls includes a second material; and the first material and the second material are the same.

[0019] In some embodiments, each of at least some of the plurality of first grid walls includes a first material; each of at least some of the plurality of second grid walls includes a second material; and the first material and the second material are different.

[0020] In some embodiments, the first material or the second material satisfies at least one of: a stiffness of the first material is within a range of 60-80HRC; a stiffness of the second material is within a range of 60-80HRC; the first material is tungsten; or the second material is tungsten.

[0021] Another aspect of the present disclosure relates to a scanning apparatus. The scanning apparatus may include a plurality of first grid walls arranged in a first direction and a plurality of second grid walls arranged in a second direction. Each pair of adjacent first grid walls of at least some of the plurality of first grid walls are spaced by a first distance in the first direction, each pair of adjacent second grid walls of at least some of the plurality of second grid walls are spaced by a second distance in the second direction, a distance ratio of the first distance to the second distance is set such that a maximum deflection of each first grid wall in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid, and the first direction is orthogonal to the second direction.

[0022] Additional features will be set forth in part in the description which follows, and in part will become apparent to those skilled in the art upon examination of the following and the accompanying drawings or may be learned by production or operation of the examples. The features of the present disclosure may be realized and attained by practice or use of various aspects of the methodologies, instrumentalities and combinations set forth in the detailed examples discussed below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The present disclosure is further described in terms of exemplary embodiments. These exemplary embodiments are described in detail with reference to the drawings. These embodiments are non-limiting examples, in which like reference numerals represent similar structures throughout the several views of the drawings, and wherein:

[0024] FIG. 1 is a schematic block diagram of an exemplary imaging system according to some embodiments of the present disclosure;

[0025] FIG. 2 is a schematic structure of an exemplary scanning apparatus according to some embodiments of the present disclosure;

[0026] FIG. 3 illustrates an exemplary anti-scatter grid according to some embodiments of the present disclosure;

[0027] FIG. 4 illustrates exemplary first grid walls according to some embodiments of the present disclosure;

[0028] FIG. 5 illustrates an exemplary detector according to some embodiments of the present disclosure;

[0029] FIG. 6 illustrates an exemplary region according to some embodiments of the present disclosure;

[0030] FIG. 7 illustrates an exemplary anti-scatter grid according to some embodiments of the present disclosure; and

[0031] FIG. 8 illustrates an exemplary a detector unit of a detector according to some embodiments of the present disclosure.

DETAILED DESCRIPTION

[0032] In the following detailed description, numerous specific details are set forth by way of examples in order to provide a thorough understanding of the relevant disclosure. However, it should be apparent to those skilled in the art that the present disclosure may be practiced without such details. In other instances, well-known methods, procedures, systems, components, and/or circuitry have been described at a relatively high-level, without detail, in order to avoid unnecessarily obscuring aspects of the present disclosure. Various modifications to the disclosed embodiments will be readily apparent to those skilled in the art, and the general principles defined herein may be applied to other embodiments and applications without departing from the spirits and scope of the present disclosure. Thus, the present disclosure is not limited to the embodiments shown, but to be accorded the widest scope consistent with the claims.

[0033] It will be understood that the term “system,” “unit,” “module,” and/or “block” used herein are one method to distinguish different components, elements, parts, section or assembly of different level in ascending order. However, the terms may be displaced by other expression if they may achieve the same purpose.

[0034] It will be understood that when a unit, module or block is referred to as being “on,” “connected to” or “coupled to” another unit, module, or block, it may be directly on, connected or coupled to the other unit, module, or block, or intervening unit, module, or block may be present, unless the context clearly indicates otherwise. As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

[0035] It will be understood that, although the terms “first,” “second,” “third,” etc., may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to

distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element, without departing from the scope of exemplary embodiments of the present disclosure.

[0036] Spatial and functional relationships between elements are described using various terms, including "connected," "attached," and "mounted." Unless explicitly described as being "direct," when a relationship between first and second elements is described in the present disclosure, that relationship includes a direct relationship where no other intervening elements are present between the first and second elements, and also an indirect relationship where one or more intervening elements are present (either spatially or functionally) between the first and second elements. In contrast, when an element is referred to as being "directly" connected, attached, or positioned to another element, there are no intervening elements present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., "between," versus "directly between," "adjacent," versus "directly adjacent," etc.).

[0037] These and other features, and characteristics of the present disclosure, as well as the methods of operation and functions of the related elements of structure and the combination of parts and economies of manufacture, may become more apparent upon consideration of the following description with reference to the accompanying drawings, all of which form a part of this disclosure. It is to be expressly understood, however, that the drawings are for the purpose of illustration and description only and are not intended to limit the scope of the present disclosure. It is understood that the drawings are not to scale.

[0038] The term "image" in the present disclosure is used to collectively refer to image data (e.g., scan data, projection data) and/or images of various forms, including a two-dimensional (2D) image, a three-dimensional (3D) image, a four-dimensional (4D), etc. The term "pixel" and "voxel" in the present disclosure are used interchangeably to refer to an element of an image. The term "anatomical structure" in the present disclosure may refer to gas (e.g., air), liquid (e.g., water), solid (e.g., stone) cell, tissue, organ of a subject, or any combination thereof, which may be displayed in an image and really exist in or on the subject's body. The term "region," "location," and "area" in the present disclosure may refer to a location of an anatomical structure shown in the image or an actual location of the anatomical structure existing in or on the subject's body, since the image may indicate the actual location of a certain anatomical structure existing in or on the subject's body. The term "an image of a subject" may be referred to as the subject for brevity.

[0039] For illustration purposes, the following description is provided to help better understanding an image registration process. It is understood that this is not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, a certain amount of variations, changes and/or modifications may be deducted under the guidance of the present disclosure. Those variations, changes and/or modifications do not depart from the scope of the present disclosure.

[0040] Anti-scatter grids (ASGs) may be used to limit the amount of radiation scatter occurring in such radiography processes. For example, an anti-scatter grid may be placed in front of a detector to selectively block beams that are scattered and allow beams that are not scattered to traverse and then be detected by the detector. Some existing anti-scatter grids have grid walls that may lack sufficient mechanical stability. Some existing anti-scatter grids may be associated with complicated processes for focus correction and/or scattering correction of the image data acquired due to different effective areas of detector pixels corresponding to regions that are defined by pairs of adjacent grid walls in different directions. Accordingly,

it is desirable to provide ASGs having sufficient mechanical stability and associated with simplified correction processes of image data acquired involving the ASGs.

[0041] An aspect of the present disclosure relates to an anti-scatter grid for an imaging apparatus. In some embodiments, an anti-scatter grid may include a plurality of first grid walls arranged in a first direction and a plurality of second grid walls arranged in a second direction. The first direction may be orthogonal to the second direction. In some embodiments, each pair of adjacent first grid walls of at least some of the plurality of first grid walls may be spaced by a first distance in the first direction. Each pair of adjacent second grid walls of at least some of the plurality of second grid walls may be spaced by a second distance in the second direction. The first distance may be smaller than the second distance such that a distance ratio of the first distance to the second distance may be lower than 1. The maximum deflection of the first grid walls in the first direction may be larger than the maximum deflection of the first grid walls in the second direction and also larger than the maximum deflections of the second grid walls in the first direction and in the second direction. Accordingly, the maximum deflection of the first grid walls in the first direction may be used to assess the mechanical stability of the ASG. In some embodiments, a distance ratio of the first distance to the second distance may be set such that a maximum deflection of each first grid wall in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid. The maximum deflection of each first grid wall in the first direction being within the predefined range may ensure that the anti-scatter grid has sufficient mechanical stability to limit the amount of radiation scatter occurring in radiography processes. In some embodiments, the predefined range is less than 20um. A stable structure of the anti-scatter grid may be achieved in which the maximum deflection of each first grid wall in the first direction is less than 20um.

[0042] In some embodiments, the ASG may be configured to simplify the impact of the first and second grid walls on the effective areas of detector pixels of the detector so as to simplify the processing of image data acquired using the detector in combination with the ASG. In some embodiments, each pair of adjacent first grid walls of at least some of the plurality of first grid walls and each pair of adjacent second grid walls of at least some of the plurality of second grid walls may define a region where a plurality of detector pixels are arranged. In some embodiments, the plurality of detector pixels may be divided into different pixel types according to an effective area of each detector pixel. As used herein, an effective area of a detector pixel may be an area of an effective part of the detector pixel that detects radiation. Compared with the effective part, the detector pixel may include (or may not include) a shielded part where at least one of the grid walls (that define the region to which the detector pixel corresponds) shields or covers such that radiation does not impinge on the shielded part of the detector pixel. A sum of the effective area and an area of the shielded part may be a total area of the detector pixel. In some embodiments, a count of pixel types of the plurality of detector pixels corresponding to each region of the ASG may be less than a type threshold. Limited pixel types which are less than the type threshold may simplify processes for processing image data acquired using the detector in combination with the ASG including, e.g., focus correction and/or scattering correction of the image data.

[0043] In some embodiments, the anti-scatter grids according to some embodiments of the present disclosure may be used in any imaging apparatuses, such as a computed tomography (CT) scanner, a positron

emission tomography (PET) scanner, a counting X-ray scanning apparatus, or any scanning apparatus using X-rays or other high-energy beams to inspect an object.

[0044] FIG. 1 is a schematic block diagram of an exemplary imaging system 100 according to some embodiments of the present disclosure. As shown in FIG. 1, the imaging system 100 may include an imaging apparatus (or referred to as a scanning apparatus) 102, a data acquisition module 104, an image reconstruction module 106, a console 108, a controller 110, and a storage device 112. It should be noted that the imaging system described below is merely provided for illustration purposes, and not intended to limit the scope of the present disclosure. The imaging system may find its applications in various fields, such as the healthcare industry (e.g., medical applications), security applications, industrial applications, etc. For example, the imaging system may be a computed tomography (CT) system, a digital radiography (DR) system, a positron emission tomography (PET) system, a single positron emission tomography (SPET) system, a multi-modality system, or the like, or a combination thereof. In some embodiments, the system 100 may be used for internal inspections of components including, e.g., flaw detection, security scanning, failure analysis, metrology, assembly analysis, void analysis, wall thickness analysis, or the like, or a combination thereof.

[0045] The scanning apparatus 102 may generate a signal by emitting radiation beams to an object. The scanning apparatus 102 may be a computed tomography (CT) scanner, a digital radiography (DR) scanner, a computed radiography (CR) scanner, a positron emission tomography (PET) scanner, a single positron emission tomography (SPET) scanner, a multi-modality scanner, or the like, or a combination thereof. Exemplary multi-modality scanners may include a computed tomography-positron emission tomography (CT-PET) scanner, a computed tomography-magnetic resonance imaging (CT-MRI) scanner, etc. The radiation may include a particle ray, a photon ray, or the like, or a combination thereof. The particle ray may include a beam of neutrons, a beam of protons (e.g., a α -ray), electron (e.g., a β -ray), a beam of μ -mesons, a beam of heavy ions, or the like, or a combination thereof. The photon ray may include an X-ray, a γ -ray, ultraviolet, laser, or the like, or a combination thereof. The object may include a substance, a tissue, an organ, a specimen, a body, a human being, or the like, or a combination thereof. The signal may be an optical signal such as a visible light signal containing characteristic information of the object, such as density, thickness, composition, etc. For example, a detector in the scanning apparatus 102 may detect radiation traversing an object and the detected radiation may excite a scintillating material on the detector to generate a visible light signal. More descriptions regarding the scanning apparatus 102 may be found elsewhere in the present disclosure. See, e.g., FIG. 2 and the descriptions thereof.

[0046] The data acquisition module 104 may obtain a signal generated by the scanning apparatus 102. In some embodiments, the signal may be a visible light signal converted from radiation beams traversing an object. In some embodiments, the data acquisition module 104 may include an optoelectronic conversion unit, an analog-digital converter (ADC), or the like, or a combination thereof. The optoelectronic conversion unit may convert the visible light signal into an electronic signal. It should be noted that, in some embodiments, the optoelectronic conversion unit may be integrated into the scanning apparatus 102. The analog-digital converter may convert the electronic signal into a digital signal, such as projected data indicative of the signal generated by the scanning apparatus 102. The projected data may be transmitted to the image reconstruction module 106.

[0047] The image reconstruction module 106 may generate an image based on data relating to an object obtained from the data acquisition module 104, or the storage device 112. In some embodiments, the data relating to the object may include projected data corresponding to radiation beams traversing the object. In some embodiments, the image may be generated by using a suitable analytical, an iterative, and/or other reconstruction techniques. In some embodiments, the image reconstruction module 106 may be connected to or communicate with the data acquisition module 104, the console 108, the controller 110, and the storage device 112 via a wireless connection, a wired connection, or a combination thereof. In some embodiments, the image reconstruction module 106 may include a digital-analog converter (DAC) which may convert the image data into an analog signal. The analog signal may be processed and transmitted to the console 108 for display.

[0048] The console 108 may include a user interface through which a user or an operator may communicate with different components in the imaging system 100. In some embodiments, the console 108 may include an input device, a control panel, etc. The input device may include alphanumeric and other keys that may be input via a keyboard, a touch screen (for example, with a haptics or tactile feedback), a speech input, an eye tracking input, a brain monitoring system, or any other comparable input mechanism. The input device may also include, for example, a cursor control device, such as a mouse, a trackball, or cursor direction keys, etc. In some embodiments, the console 108 may display images generated by the image reconstruction module 106. In some embodiments, the console 108 may send a command or an instruction from a user or an operator to the image reconstruction module 106, and/or the controller 110. The console 108 may set one or more parameters for the imaging system 100, including acquisition parameters and/or reconstruction parameters. The acquisition parameters may relate to one or more conditions in obtaining scan data by, for example, scanning an object. The reconstruction parameters may relate to one or more conditions in reconstructing an image of the object. For example, the acquisition parameters may include a tube voltage, a tube current, recon parameters (e.g., a slice thickness), a scan time, a collimation/slice width, a beam filtration, a helical pitch, etc. The reconstruction parameters may include a reconstruction field of view (FOV), a reconstruction matrix, a convolution kernel/reconstruction filter, etc.

[0049] The controller 110 may control the scanning apparatus 102, the data acquisition module 104, the image reconstruction module 106, the console 108, and/or the storage device 112. For example, the scanning apparatus 102 may be controlled by the controller 110 to rotate to a desired position that may be prescribed by a user via the console 108. The controller 110 may control the parameters of radiation beams, including the magnitude of radiation beams. As another example, the controller 110 may control the display of images on the console 108. In some embodiments, the controller 110 may control the data acquisition module 104 to acquire a signal generated from the scanning apparatus 102. Furthermore, the controller 110 may control the image reconstruction module 106 to generate an image based on data received from the data acquisition module 104.

[0050] In some embodiments, the controller 110 may include a processor, a processing core, a memory, or the like, or a combination thereof. Specifically, the controller 110 may include a central processing unit (CPU), an application-specific integrated circuit (ASIC), an application-specific instruction-set processor (ASIP), a graphics processing unit (GPU), a physics processing unit (PPU), a digital signal processor (DSP), a

field-programmable gate array (FPGA), a programmable logic device (PLD), a microcontroller unit, a microprocessor, an advanced RISC machines processor (ARM), or the like, or a combinations thereof.

[0051] The storage device 112 may store data relating to the imaging system 100. The data may be a numerical value, an image, information of a subject, an instruction and/or a signal to operate the scanning apparatus 102, voice, a model relating to a patient, an algorithm relating to an image processing method, or the like, or a combination thereof. In some embodiments, the numerical value may include a threshold, a CT value, a value relating to an anti-scatter grid, or the like, or a combination thereof. The algorithm may include a series of image processing methods. The image may include a raw image or a processed image (e.g., an image after pretreatment). The model relating to a patient may include the background information of the patient, such as, ethnicity, citizenship, religion, gender, age, matrimony state, height, weight, medical history (e.g., history relating to different organs, or tissues), job, personal habits, or the like, or a combination thereof.

[0052] The storage device 112 may include a random access memory (RAM), a read-only memory (ROM), or the like, or a combination thereof. The random access memory (RAM) may include a dekatron, a dynamic random access memory (DRAM), a static random access memory (SRAM), a thyristor random access memory (T-RAM), a zero capacitor random access memory (Z-RAM), or the like, or a combination thereof. The read only memory (ROM) may include a bubble memory, a magnetic button line memory, a memory thin film, a magnetic plate line memory, a core memory, a magnetic drum memory, a CD-ROM drive, a hard disk, a flash memory, or the like, or a combination thereof. In some embodiments, the storage device 112 may be a removable storage such as a U flash disk that may read data from and/or write data to the image reconstruction module 106 in a certain manner. The storage device 112 may also include other similar means for providing computer programs or other instructions to operate the modules/units in the imaging system 100. In some embodiments, the storage device 112 may be operationally connected with one or more virtual storage resources (e.g., a cloud storage, a virtual private network, other virtual storage resources, etc.) for transmitting or storing the data into the virtual storage resources.

[0053] In some embodiments, the imaging system 100 may be connected to a network (not shown in the figure). The network may be a local area network (LAN), a wide area network (WAN), a public network, a private network, a proprietary network, a public switched telephone network (PSTN), the Internet, a virtual network, a metropolitan area network, a telephone network, or the like, or a combination thereof. The connection between different components in the imaging system 100 may be wired or wireless. The wired connection may include using a metal cable, an optical cable, a hybrid cable, an interface, or the like, or a combination thereof. The wireless connection may include using a Wireless Local Area Network (WLAN), a Wireless Wide Area Network (WWAN), a Bluetooth, a ZigBee, a Near Field Communication (NFC), or the like, or a combination thereof.

[0054] It should be noted that the above description of the imaging system 100 is merely provided for the purposes of illustration, and not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, multiple variations and modifications may be made under the teachings of the present disclosure. However, those variations and modifications do not depart from the scope of the present disclosure. For example, the storage device 112 may be a database including cloud computing platforms, such as a public cloud, a private cloud, a community and hybrid clouds, etc. As another example, the data

acquisition module 104 and the image reconstruction module 106 may be integrated into one single module. As a further example, the controller 110 and the storage device 112 may be integrated into one module. However, those variations and modifications do not depart the scope of the present disclosure.

[0055] FIG. 2 is a schematic structure of an exemplary scanning apparatus 200 according to some embodiments of the present disclosure. In some embodiments, the scanning apparatus 102 may be implemented on the scanning apparatus 200. As shown in FIG. 2, the scanning apparatus 200 may include a radiation source 202, an anti-scatter grid 206, and a detector 208.

[0056] The radiation source 202 may generate and emit one or more radiation beams traveling toward an object 204. The radiation beams may include, for example, one or more primary radiation beams 210 and secondary radiation beams 212 as shown in FIG. 2. The primary radiation beams 210 may include one or more radiation beams that travel along a substantially straight axis or direct trajectory path from the radiation source 202 to the detector 208. The secondary radiation beams 212 may include one or more radiation beams that are scattered while traversing the object 204. The secondary radiation beams 212 may arrive at the detector 208 at an angle relative to their original path(s) from the radiation source 202. In some embodiments, the secondary radiation beams 212 may also be referred to as scattered radiation beams. While the primary radiation beams 210 are useful for generating an image of the object 204 under examination, the secondary radiation beams 212 may cause artifacts in the image.

[0057] In some embodiments, the radiation source 202 may include a tube, such as a cold cathode ion tube, a high vacuum hot cathode tube, a rotating anode tube, etc. The tube may be powered by a high voltage generator, emitting the radiation beams that may be received by the detector 208. The detector 208 may receive the radiation beams passing through apertures in the scanning apparatus 200 defined by, for example, the anti-scatter grid 206. Merely by way of example, the radiation beams may include a particle ray, a photon ray, or the like, or a combination thereof as described elsewhere in the disclosure. The object 204 may include a substance, a tissue, an organ, an object, a specimen, a body, a human being, or the like, or a combination thereof as described elsewhere in the disclosure. The shape of the radiation beams emitted by the radiation source 202 may be a line, a narrow pencil, a narrow fan, a fan, a cone, a wedge, an irregular shape, or the like, or a combination thereof.

[0058] The anti-scatter grid 206 may absorb scattered radiation. For example, the anti-scatter grid 206 may absorb one or more of the secondary radiation beams 212 and/or may alter directions of one or more of the secondary radiation beams 212, while allowing one or more of the primary radiation beams 210 to pass through the anti-scatter grid 206. The types of radiation may include, for example, electromagnetic radiation, particle radiation, x-rays, gamma radiation, etc.

[0059] In some embodiments, the anti-scatter grid 206 may be placed between the radiation source 202 and the detector 208. In some embodiments, the anti-scatter grid 206 may be coupled to the detector 208. For example, the anti-scatter grid 206 may be coupled to the detector 208 by bonding, welding, etc. In some embodiments, one or more coupling structures may be used to connect the anti-scatter grid 206 to the detector 208 via one or more rivets, screws, bolts, pins joints, key joints, and/or any other coupling structure.

[0060] The shape of the anti-scatter grid 206 may be flat, arc-shaped, circular, linear, or the like, or a combination thereof. Exemplary anti-scatter grid 206 may include a focused grid (e.g., an arc-focused grid), a linear grid, a crossed grid, a parallel grid, or the like, or a combination thereof. In some embodiments, the

anti-scatter grid 206 may include a specific configuration defined by one or more parameters, such as a focal length, a grid ratio, a grid density, etc. For example, the plurality of highly absorbing materials may be in shape of grid walls. The focal length may refer to a perpendicular distance from the focal point to the upper surface of the anti-scatter grid 206. The focal point of the anti-scatter grid 206 may be a point that the plurality of grid walls may be focused toward the radiation source 202. The highly absorbing materials in shape of grid walls may be placed at various positions based on the focal length of anti-scatter grid 206. In some embodiments, an offset angle corresponding to a grid wall may be determined. The offset angle may be set in a manner that one or more primary radiation beams 210 is not blocked by the grid walls, while one or more secondary radiation beams 212 may be blocked by the grid walls. The offset angle may be defined as an angle between a path of a primary radiation beam 210 emitted from the radiation source 202 and the normal line that is perpendicular to the upper surface of the anti-scatter grid 206. The grid ratio may be a ratio of the height of the grid wall to an interspace between adjacent grid walls. More descriptions regarding the anti-scatter grid 206 may be found elsewhere in the present disclosure. See, e.g., FIGs. 3-9 and the descriptions thereof.

[0061] The detector 208 may detect radiation beams traversing the object 204. In some embodiments, the detector 208 may convert the radiation beams into a visible light signal. The detector 208 may include one or more detector modules positioned to form an arcuate structure including a plurality of detector pixels. The detector pixels may detect radiation beams to generate signals. The signals may be generated by respective detector pixels when the radiation beams are detected. The signals may include different attributes (e.g., a radiation amplitude). For example, a signal may include a lower radiation amplitude when a radiation beam is detected traversing a higher density tissue (e.g., a bone tissue).

[0062] The detector 208 may have any suitable shape. For example, the shape of the detector 208 may be flat, arc-shaped, circular, or the like, or a combination thereof. The fan angle of an arc-shaped detector may have any suitable value. For example, the fan angle may be in the range from 0° to 360°, from 30° to 270°, from 45° to 300°, etc. In some embodiments, the fan angle of the arc-shaped detector may be above 30°. In some embodiments, the fan angle of the arc-shaped detector may be above 45°. In a specific example, the fan angle of the arc-shaped detector may be one of 45°, 60°, 75°, 90°, or 105°. The fan angle may be fixed or adjustable according to different conditions including, for example, a desired resolution of an image, the size of an image, the sensitivity of the detector, the stability of the detector, or the like, or a combination thereof. In some embodiments, the detector pixels may be arranged in a single row, two rows, or any other number of rows.

[0063] In some embodiments, the detector 208 may include a scintillator layer that may absorb radiation beams, and emit a visible light that may be detected by an array of photodiodes. The array of photodiodes may convert the visible light into an electrical signal. In some embodiments, the radiation beams may be converted directly into an electrical signal by a suitable direct conversion material, such as amorphous selenium. In some embodiments, the detector 208 may be and/or include a film-based detector.

[0064] In some embodiments, the primary radiation beams 210 that traverse the object 204 may be detected by the detector 208. Targets within the object 204 may cause various numbers of radiation beams to traverse the object 204 (e.g., creating areas of high traversal and areas of low traversal within the object 204). For example, fewer radiation beams may traverse targets with a higher density and/or a higher atomic number

(relative to densities and atomic numbers of other targets in the object 204). In this way, a bone may appear more prominent in an image than surrounding tissue (which may be virtually invisible), since tissue may be less dense than bone (e.g., more radiation traverses the tissue than the bone). The secondary radiation beams 212 (also referred to as the scattered radiation beams) may be absorbed by the anti-scatter grid 206. In some embodiments, the secondary radiation beams 212 absorbed by the anti-scatter grid 206 may not contribute to an image of the object 204. More descriptions regarding the detector 208 may be found elsewhere in the present disclosure. See, e.g., FIGs. 5 and 8 and the descriptions thereof.

[0065] In some embodiments, the scanning apparatus 200 may include a gantry (not shown) in which the radiation source 202, the anti-scatter grid 206, and the detector 208 are installed. In some embodiments, the scanning apparatus 200 may further include a bed (not shown) that carries the object 204 and moves into or out of the gantry of the scanning apparatus 200 along a direction (e.g., Z direction shown in FIG. 2). As shown in FIG. 2, X direction may be a direction along a short axis of the bed, and Y direction may be a direction perpendicular to the bed of the scanning apparatus 200.

[0066] It should be noted that the above description of the scanning apparatus 200 is merely provided for the purposes of illustration, and not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, multiple variations and modifications may be made under the teachings of the present disclosure. However, those variations and modifications do not depart from the scope of the present disclosure. For example, the anti-scatter grid 206 may be an integrated part of the detector 208. However, those variations and modifications do not depart the scope of the present disclosure.

[0067] FIG. 3 illustrates an exemplary anti-scatter grid 206 according to some embodiments of the present disclosure. As shown in FIG. 3, the anti-scatter grid 206 may include a plurality of first grid walls 310 arranged in a first direction and a plurality of second grid walls 320 arranged in a second direction. In some embodiments, the first direction may be orthogonal to the second direction. For example, the first direction may be X direction, and the second direction may be Z direction as shown in FIG. 2. In some embodiments, the plurality of first grid walls 310 may be configured to mainly absorb scattered radiation. In some embodiments, the plurality of second grid walls 320 may be configured to support the plurality of first grid walls 310 to prevent excessive deflection of the first grid walls 310 in the first direction. For example, the plurality of first grid walls 310 may absorb more scattered radiation than the plurality of second grid walls 320. It should be noted that FIG. 2 is just a non-limiting example. The first direction may be any one of X, Y and Z directions, and the second direction may be another one of X, Y and Z directions which is different from the first direction.

[0068] In some embodiments, each grid wall (e.g., a first grid wall 310, a second grid wall 320) may have any suitable shape and/or dimension. For example, the shape of the first grid wall 310 or the second grid wall 320 may be of the size of a rectangle, a trapezoid, or an irregular shape. The grid wall may be arranged in a manner that each grid wall may correspond to an offset angle with respect to, for example, the detector 208. An offset angle of a grid wall with respect to the detector 208 may be defined as an angle between the incident surface of the detector 208 and a surface that absorbs the scattered radiation. In some embodiments, the first grid walls 310 (or the second grid walls 320) may be parallel to and/or substantially parallel to each other. As used herein, substantially, when used to describe a feature (e.g., parallel), indicates that a deviation from the feature is less than a threshold. For instance, A and B being substantially parallel indicates that a deviation of

an angle between A and B from 0 or 180 degrees is less than 40 degrees, or 30 degrees, or 20 degrees, or 10 degrees. For brevity, “substantially” may be omitted. However, it is understood that the omission is intended to indicate not that a feature (e.g., being parallel) is absolutely accurate but that there may be a deviation from the feature not exceeding a threshold. In some embodiments, each grid wall (e.g., a first grid wall 310, a second grid wall 320) may be positioned according to an offset angle relative to a path of radiation beams emitted from a radiation source (e.g., the radiation source 202). An offset angle of a grid wall relative to a path of a radiation beam may be defined as an angle between the path of radiation beam and a surface that absorbs the scattered radiation. For example, each grid wall (e.g., a first grid wall 310, a second grid wall 320) may be adjusted according to the offset angle to be (substantially) parallel to the primary radiation beams emitted from the radiation source 202.

[0069] In some embodiments, each pair of adjacent first grid walls 310 of at least some of the plurality of first grid walls 310 may be spaced by a first distance $d1$ in the first direction. Each pair of adjacent second grid walls 320 of at least some of the plurality of second grid walls 320 may be spaced by a second distance $d2$ in the second direction. In some embodiments, the plurality of first grid walls 310 (or the plurality of second grid walls 320) may be (substantially) parallel to each other. As used herein, a pair of adjacent grid walls refers to two grid walls that are next to each other. As used herein, a distance between two adjacent parallel grid walls refers to a distance between the two adjacent parallel grid walls at the roots or endpoints of the grid walls where the grid walls are attached to a substrate or support 410.

[0070] In some embodiments, the plurality of first grid walls 310 (or the plurality of second grid walls 320) may lean toward an axis 420 of the radiation source 202. FIG. 4 illustrates exemplary first grid walls 310 according to some embodiments of the present disclosure. As shown in FIG. 4, the plurality of first grid walls 310 may lean toward the axis 420 of the radiation source 202. A distance between two adjacent grid walls may be a distance between the two endpoints of the two adjacent grid walls that are away from the radiation source 202.

[0071] In some embodiments, the plurality of first grid walls 310 (or the plurality of second grid walls 320) may be equally spaced. For example, the first distance $d1$ (or the second distance $d2$ as illustrated in, e.g., FIG. 3) between any pair of adjacent first grid walls 310 (or any pair of adjacent second grid walls 320 as illustrated in, e.g., FIG. 3) may be the same. In some embodiments, at least some of the plurality of first grid walls 310 (or at least some of the plurality of second grid walls 320) may be unequally spaced. For example, the first distance $d1$ (or the second distance $d2$) between a first pair of adjacent first grid walls 310 (or a first pair of adjacent second grid walls 320) may be different from a second pair of adjacent first grid walls 310 (or a second pair of adjacent second grid walls 320).

[0072] In some embodiments, a distance ratio $d1/d2$ of the first distance $d1$ to the second distance $d2$ of the ASG may be set such that a maximum deflection of each first grid wall in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid. The predefined range may ensure that the anti-scatter grid 206 has sufficient mechanical stability. In some embodiments, the predefined range may be less than 20 μ m. As used herein, a maximum deflection of a first grid wall 310 refers to a maximum displacement value along the first direction of the first grid wall 310. In some embodiments, the maximum deflection may occur at the farthest end (e.g., a free end) opposite to a fixed end (e.g., a root of the first grid wall 310 where the first grid wall 310 is attached to a support or substrate) of the

first grid wall 310. For example, as shown in FIG. 4, the maximum deflection Def_{max} along the first direction may occur at the farthest end 311 from a fixed end 312 of the first grid wall 310. In some embodiments, the maximum deflection may be an absolute value. For example, the maximum deflection may be 10 μ m, 13 μ m, 15 μ m, 18 μ m, 19 μ m, etc. In some embodiments, the maximum deflection may be a relative value in terms of one or more factors that affect the deflection of the first grid wall 310. Exemplary factors that affect the deflection of the first grid wall 310 may include a stiffness, a Young's modulus, a height, a rotation speed of the first grid wall 310 of the ASG that is configured to rotate with the gantry of the scanning apparatus 200, or the like, or any combination thereof. For example, the maximum deflection may be a ratio of the maximum displacement value to the Young's modulus of the first grid wall 310, a ratio of the maximum displacement value to the height of the first grid wall 310, etc.

[0073] In some embodiments, the distance ratio $d1/d2$ of the first distance $d1$ to the second distance $d2$ of the ASG may be set such that a scatter primary ratio (SPR) of a region 330 defined by the two adjacent first grid walls 310 and the two adjacent second grid walls 320 is less than a SPR threshold. The SPR may be a ratio of an energy of scattered radiation beams to an energy of primary radiation beams detected by the detector pixels corresponding to the region 330. As used herein, a detector pixel of a detector corresponding to a region of an ASG may indicate that the detector pixel is located within a portion of the detector that (substantially) overlaps a projection of the region of the ASG onto an incident surface of the detector along the direction perpendicular to the incident surface of the detector. As used herein, an incident surface of a detector refers to a surface where an incoming radiation beam impinges on the detector. In some embodiments, the less SPR, the less scattered radiation beams, and the higher contrast of an image (or an image part) obtained based on image data acquired by the detector pixels corresponding to the region 330. A higher contrast of an image may correspond to a lower SPR threshold. For example, the SPR threshold may be 5%, 10%, 15%, etc.

[0074] In some embodiments, to ensure that the maximum deflection of each first grid wall in the first direction is less than 20 μ m and/or the SPR is less than the SPR threshold, the distance ratio $d1/d2$ of the first distance $d1$ to the second distance $d2$ may be lower than 1. For example, the distance ratio $d1/d2$ may be 0.8. As another example, the first distance $d1$ may be 1 mm and the second distance $d2$ may be 1.25 mm.

[0075] FIG. 5 illustrates an exemplary detector 208 according to some embodiments of the present disclosure. As shown in FIG. 5, the detector 208 may include a plurality of detector modules 340. Each of the plurality of detector modules 340 may include a plurality of detector pixels 341. In some embodiments, a count of detector modules 340, a size of each detector module 340, a count of detector pixels 341 in a detector module 340, and/or a size of each detector pixel 341 may be determined based on a size of the detector 208. In some embodiments, the count of detector modules 340 may be with a range 10-40. For example, the count of detector modules 340 may be 10, 12, 15, 16, 20, 25, 30, 32, 40, etc. A size of each detector module 340 may be 24mm $\times$ 24mm, 24mm $\times$ 80mm, 24mm $\times$ 160mm, 24mm $\times$ 320mm, etc. The count of detector pixels 341 in a detector module 340 may be 24 $\times$ 40, 24 $\times$ 80, 24 $\times$ 192, etc. A size of a detector pixel 341 may be 350 micrometers $\times$ 350 micrometers, 300 micrometers $\times$ 350 micrometers, 300 micrometers $\times$ 300 micrometers, 1 millimeter $\times$ 1 millimeter, etc.

[0076] In some embodiments, the anti-scatter grid 206 may be disposed on the detector 208. For example, as shown in FIG. 5, a second grid wall 320 of at least some of the plurality of second grid walls 320 may be disposed, along the second direction, between each pair of adjacent detector modules 340. Each of at least some of the plurality of first grid walls 310 may be disposed, along the first direction, between two adjacent detector pixels 341. In some embodiments, a pixel gap pg between the two adjacent detector pixels 341 in the first direction may be less than the module gap mg between the two adjacent detector modules 340. In some embodiments, the module gap mg may be within a range of 50 micrometers-150 micrometers. For example, the module gap mg may be 50 micrometers, 80 micrometers, 100 micrometers, 120 micrometers, 150 micrometers, etc. In some embodiments, the pixel gap pg may be within a range of 30 micrometers-100 micrometers. For example, the pixel gap pg may be 30 micrometers, 40 micrometers, 50 micrometers, 60 micrometers, 80 micrometers, 100 micrometers, etc.

[0077] In some embodiments, as shown in FIG. 5, a thickness $t2$ of each second grid wall 320 of at least some of the plurality of second grid walls 320 may be less than a module gap mg between two adjacent detector modules 340 in the first direction where the second grid wall 320 is disposed. For example, the thickness $t2$ of a second grid wall 320 may be 100 micrometers, and the module gap mg between two adjacent detector modules 340 in the first direction where the second grid wall 320 is disposed may be 120 micrometers. Alternatively, the thickness $t2$ of the second grid wall 320 of at least some of the plurality of second grid walls 320 may be equal to the module gap mg between two adjacent detector modules 340 in the first direction where the second grid wall 320 is disposed. For example, the thickness $t2$ of a second grid wall 320 may be 120 micrometers, and the module gap mg between two adjacent detector modules 340 in the first direction where the second grid wall 320 is disposed may be 120 micrometers.

[0078] In some embodiments, a thickness $t1$ of each first grid wall 310 of at least some of the plurality of first grid walls 310 may be less than a pixel gap pg between two adjacent detector pixels 341 in the second direction where the first grid wall 310 is disposed. For example, the thickness $t1$ of a first grid wall 310 may be 50 micrometers, and the pixel gap pg between two adjacent detector pixels 341 in the second direction where the first grid wall 310 is disposed may be 80 micrometers. Alternatively, the thickness $t1$ of the first grid wall 310 of at least some of the plurality of first grid walls 310 may be equal to the pixel gap pg between two adjacent detector pixels 341 in the second direction where the first grid wall 310 is disposed. For example, the thickness $t1$ of a first grid wall 310 may be 50 micrometers, and the pixel gap pg between two adjacent detector pixels 341 in the second direction where the first grid wall 310 is disposed may be 50 micrometers.

[0079] In some embodiments, the anti-scatter grid (ASG) 206 may include a plurality of regions. Each pair of adjacent first grid walls 310 of at least some of the plurality of first grid walls 310 and each pair of adjacent second grid walls 320 of at least some of the plurality of second grid walls 320 may define a region (e.g., a region 330 shown in FIGs. 3 and 5) of the plurality of regions. As shown in FIG. 5, a plurality of detector pixels 341 may be arranged corresponding to each region 330 of the plurality of regions 330 of the ASG 206. In some embodiments, for at least one of the plurality of regions 330 of the ASG 206, a thickness $t1$ of a first grid wall 310 of the at least some of the plurality of first grid walls 310 defining the region 330 or a thickness $t2$ of a second grid wall 320 of the at least some of the plurality of second grid walls 320 defining

the region 330 may relate to an effective area ratio corresponding to the region 330 of the ASG 206. As used herein, an effective area ratio corresponding to a region (e.g., a region 330) of the ASG (e.g., the ASG 206) refers to a sum of effective areas of detector pixels corresponding to the region 330 to a total area (or referred to as a sum of areas) of the detector pixels corresponding to the region 330. Compared with an effective part (or referred to as an aggregated effective part) of the detector pixels corresponding to a region 330 of the ASG 206, the detector pixels corresponding to the region 330 may include (or may not include) a shielded part (or referred to as an aggregated shielded part) on which the grid walls that define the region 330 shield or block a radiation beam from impinging. A sum of the effective area corresponding to the region 330 and an area of the shielded part of the detector pixels corresponding to the region 330 (or referred to as the shielded part corresponding to the region 330 for brevity) may be a total area of the detector pixels corresponding to the region 330 (or referred to as the total area corresponding to the region 330 for brevity). In some embodiments, the thickness t_1 of the first grid wall 310 defining the region 330 and/or the thickness t_2 of the second grid wall 320 defining the region may be set such that the effective area ratio corresponding to the region 330 is greater than the effective area ratio threshold. In some embodiments, the less thickness t_1 (and/or the less thickness t_2), the less shielded area, and the greater the effective area corresponding to the region 330. For example, disposed on a same pixel gap $pg = 50$ micrometers, two adjacent first grid walls 310 whose thicknesses $t_1 = 30$ micrometers may shield less areas of detector pixels corresponding to a region 330 defined by the two adjacent first grid walls 310 and two adjacent second grid walls 320 of same thicknesses than two adjacent first grid walls 310 whose thicknesses $t_1 = 40$ micrometers. As another example, disposed on a same module gap $mg = 120$ micrometers, two adjacent second grid walls 320 whose thicknesses $t_2 = 100$ micrometers may shield less areas of detector pixels corresponding to a region 330 defined by the two adjacent second grid walls 320 and two adjacent first grid walls 310 of same thicknesses than two adjacent second grid walls 320 whose thicknesses $t_2 = 120$ micrometers.

[0080] In some embodiments, the effective area ratio threshold may be determined according to a desired image quality (e.g., an image resolution) of an image obtained based on image data acquired by the scanning apparatus 200. A better image quality (e.g., a greater low contrast resolution, a better noise performance, a greater efficiency of the detector) may correspond to a greater effective area ratio threshold. For example, the effective area ratio threshold may be 70%, 75%, 80%, 85%, 90%, 95%, etc.

[0081] In some embodiments, a thickness t_1 of a first grid wall 310 of the plurality of first grid walls 310 may equal a thickness t_2 of a second grid wall 320 of the plurality of second grid walls 320. For example, the thickness t_1 of each first grid wall 310 of the plurality of first grid walls 310 and the thickness t_2 of each second grid wall 320 of the plurality of second grid walls 320 may both be 30 micrometers, 50 micrometers, 80 micrometers, 100 micrometers, or 120 micrometers. In some embodiments, a thickness t_1 of a first grid wall 310 of the plurality of first grid walls 310 may be different from a thickness t_2 of a second grid wall 320 of the plurality of second grid walls 320. For example, the thickness t_1 of each first grid wall 310 of the plurality of first grid walls 310 may be 30 micrometers, and the thickness t_2 of each second grid wall 320 of the plurality of second grid walls 320 may be 80 micrometers. As another example, the thickness t_1 of each first grid wall 310 of the plurality of first grid walls 310 may be 100 micrometers, and the thickness t_2 of each second grid wall 320 of the plurality of second grid walls 320 may be 120 micrometers. As still

another example, the thickness t_1 of each first grid wall 310 of the plurality of first grid walls 310 may be 120 micrometers, and the thickness t_2 of each second grid wall 320 of the plurality of second grid walls 320 may be 150 micrometers. As still another example, the thickness t_1 of each first grid wall 310 of the plurality of first grid walls 310 may be 150 micrometers, and the thickness t_2 of each second grid wall 320 of the plurality of second grid walls 320 may be 120 micrometers.

[0082] In some embodiments, each of the plurality of first grid walls 310 may have a same thickness t_1 . For example, the thickness t_1 of each of the plurality of first grid walls 310 may be 100 micrometers. In some embodiments, one or more of the plurality of first grid walls 310 may have a different thickness t_1 from the remaining first grid walls 310 of the plurality of first grid walls 310. For example, each of some of the plurality of first grid walls 310 may have a first thickness t_1 , and each of the remaining first grid walls 310 of the plurality of first grid walls 310 may have a second thickness t_1 . The first thickness t_1 may be different from the second thickness t_1 . For example, the thickness t_1 of each of some of the plurality of first grid walls 310 (e.g., first grid walls 310 at the boundaries of the anti-scatter grid 206) may be 120 micrometers, and the thickness t_1 of each of the remaining first grid walls 310 of the plurality of first grid walls 310 (e.g., first grid walls 310 at the interior of the anti-scatter grid 206 other than the boundaries of the anti-scatter grid 206) may be 110 micrometers. As another example, to ensure that first grid walls 310 at gaps between two adjacent detector modules 340 can overlap the gaps, a thickness of a first grid wall of the plurality of first grid walls 310 at a center of a detector module 340 may be less than a thickness of a first grid wall of the plurality of first grid walls 310 at an edge of the detector module 340.

[0083] In some embodiments, each of the plurality of second grid walls 320 may have a same thickness t_2 . For example, the thickness t_2 of each of the plurality of second grid walls 320 may be 100 micrometers. In some embodiments, one or more of the plurality of second grid walls 320 may have a different thickness t_2 from the remaining second grid walls 320 of the plurality of second grid walls 320. For example, each of some of the plurality of second grid walls 320 may have a first thickness t_2 , and each of the remaining second grid walls 320 of the plurality of second grid walls 320 may have a second thickness t_2 . The first thickness t_2 may be different from the second thickness t_2 . For example, the thickness t_2 of each of some of the plurality of second grid walls 320 (e.g., second grid walls 320 at the boundaries of the anti-scatter grid 206) may be 120 micrometers, and the thickness t_2 of each of the remaining second grid walls 320 of the plurality of second grid walls 320 (e.g., second grid walls 320 at the interior of the anti-scatter grid 206 other than the boundaries of the anti-scatter grid 206) may be 110 micrometers. As another example, to ensure that second grid walls 320 at gaps between two adjacent detector modules 340 can overlap the gaps, a thickness of a second grid wall of the plurality of second grid walls 320 at a center of a detector module 340 may be less than a thickness of a second grid wall of the plurality of second grid walls 320 at an edge of the detector module 340.

[0084] In some embodiments, each of the plurality of detector pixels 341 may be designated as one of one or more pixel types. In some embodiments, each pixel type may be associated with an effective area (or an effective area ratio) of a detector pixel 341. As used herein, an effective area of a detector pixel 341 may be an area of an effective part of the detector pixel 341 that detects radiation. Compared with the effective part, the detector pixel 341 may include (or may not include) a shielded part where at least one of the grid walls

(that define the region to which the detector pixel corresponds) shields or covers such that radiation does not impinge on the shielded part of the detector pixel. A sum of the effective area of the detector pixel 341 and an area of the shielded part of the detector pixel 341 may be a total area of the detector pixel 341. As used herein, an effective area ratio corresponding to a detector pixel 341 refers to an effective area of the detector pixel 341 to a total area of the detector pixel 341. In some embodiments, if two detector pixels 341 corresponding to a same region of an ASG have a (substantially) same effective area (or same effective area ratio), the two detector pixels 341 may be regarded as belonging to a same pixel type. As used herein, two detector pixels 341 corresponding to a same region of an ASG having a (substantially) same effective area (or same effective area ratio) indicates that a difference between the effective areas (or the effective area ratios) of the two detector pixels 341 is less than an area difference threshold (or an area ratio difference threshold). In some embodiments, the area difference threshold (or the area ratio difference threshold) may be a predetermined value or determined according to different application scenarios. For example, the area ratio difference threshold may be 2. As another example, the area difference threshold may be double a value of a smaller effective area between two detector pixels 341.

[0085] In some embodiments, different correction processes for focus correction and/or scattering correction may be applied for image data acquired by a detector including detector pixels of different pixel types. Fewer pixel types of detector pixels 341 corresponding to a region 330 may be associated with a simpler correction process for processing image data acquired using the detector. In some embodiments, a count of pixel types of the plurality of detector pixels 341 corresponding to each region 330 may be lower than a type threshold. In some embodiments, the type threshold may be a predetermined value. For example, the type threshold may be 5, 4, 3, etc. As another example, the type threshold may be determined according to different application scenarios.

[0086] FIG. 6 illustrates an arrangement of detector pixels corresponding to an exemplary region 330 of an ASG according to some embodiments of the present disclosure. As shown in FIG. 6, the region 330 may correspond to an array of $3 \times N$ detector pixels 341, where 3 denotes the number (or count) of detector pixels 341 corresponding to the region 330 of the ASG defined by two adjacent first grid walls 310 in each row in the first direction of the array, and N denotes the number (or count) of detector pixels 341 corresponding to the region 330 of the ASG defined by two adjacent second grid walls 320 in the second direction in each column of the array, and N is a positive integer. In the exemplary arrangement illustrated in FIG. 6, $N=6$. Not limited to this, the region 320 can also be configured to correspond to other detector pixel array arranged, for example, in 2×5 , 4×6 , 3×10 , etc.

[0087] In some embodiments, due to a combination of factors including that a second grid wall 320 defining a region 330 is disposed between a pair of adjacent detector modules 340 and spaced from an adjacent second grid wall 320 by a large distance d_2 and that a thickness t_2 of the second grid wall 320 is less than or equal to a module gap mg between the pair of adjacent detector modules 340 where the second grid wall 320 is disposed, the second grid walls 320 may shield or cover substantially no area of a detector pixels 341 located in a vicinity of the second grid wall 320 including, such as, as exemplified in FIG. 6, a detector pixel 3411, a detector pixel 3416, a detector pixel 3412, etc. In some embodiments, due to a combination of factors including that a first grid wall 310 defining a region 330 is disposed between two adjacent detector pixels 341 and spaced from an adjacent first grid wall 310 by a distance d_1 (smaller than d_2) and that a pixel gap pg

between the two adjacent detector pixels 341 is less than the module gap mg between the two adjacent detector modules 340, compared to a second grid wall 320, the first grid wall 310 may shield or cover a larger area of the detector pixels 341 located in a vicinity of a first grid wall 310, such as, as shown in FIG. 6, a corner detector pixel 3411, a detector pixel 3412, a detector pixel 3415, etc.

[0088] In some embodiments, as shown in FIG. 6, each of the detector pixels labeled with “T1” (e.g., the detector pixels 3411, 3412, 3415, 3416, etc.) may have a (substantially) same effective area (e.g., a difference between any two of the detector pixels being less than the area difference threshold), and be regarded as belonging to a same pixel type (e.g., a first pixel type). Each of the detector pixels labeled with “T2” (e.g., the detector pixels 3413, 3414, etc.) may have a (substantially) same effective area (e.g., a difference between any two of the detector pixels being less than the area difference threshold). Each of the detector pixels labeled with “T1” (e.g., the detector pixels 3411, 3412, 3415, 3416, etc.) may have a different effective area than each of the detector pixels labeled with “T2” (e.g., the detector pixels 3413, 3414, etc.). In some embodiments, the difference between the effective area of a detector pixel labeled with “T1” and the effective area of a detector pixel labeled with “T2” may be greater than the area difference threshold, and thus, the detector pixels labeled with “T2” may be regarded as belonging to another pixel type (e.g., a second pixel type different from the first pixel type) different from the detector pixels labeled with “T1.” In some embodiments, as shown in FIG. 6, a count of pixel types of the plurality of detector pixels 341 in the region 330 may be 2, which is less than or equal to the type threshold (e.g., 2).

[0089] In some embodiments, fewer pixel types of detector pixels of a detector 208 may lead to a simplified correction process for correcting image data acquired using the detector 208. Compared to an existing ASG, the anti-scatter grid 206 according to some embodiments of the present disclosure may reduce the pixel types of detector pixels of a detector 208, thereby simplifying the correction processes for focus correction and/or scattering correction of image data acquired using the detector 208 in combination with the ASG 206.

[0090] It should be noted that the above description of the region 330 described in FIG. 6 is merely provided for the purposes of illustration, and not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, multiple variations and modifications may be made under the teachings of the present disclosure. For example, the region 330 may correspond to $1 \times N$, $2 \times N$, $4 \times N$, $5 \times N$, etc., detector pixels 341. However, those variations and modifications do not depart from the scope of the present disclosure.

[0091] In some embodiments, each grid wall of the anti-scatter grid 206 may have a height. FIG. 7 illustrates an exemplary anti-scatter grid 206 according to some embodiments of the present disclosure. As shown in FIG. 7, a height of a first grid wall 310 of the plurality of first grid walls 310 may be $h1$, and a height of a second grid wall 320 of the plurality of second grid walls 320 may be $h2$. In some embodiments, a height $h1$ of each first grid wall 310 of two adjacent first grid walls 310 and/or a height $h2$ of each second grid wall 320 of two adjacent second grid walls 320 may be associated with an SPR of the detector pixels corresponding to a region 330 (or referred to as an SPR corresponding to the region 330) defined by the two adjacent first grid walls 310 and the two adjacent second grid walls 320. In some embodiments, the greater the height $h1$ (and/or the height $h2$), the less the SPR corresponding to the region 330. In some embodiments, the SPR may be less than an SPR threshold. The SPR threshold may be 5%, 10%, 15%, etc.

[0092] In some embodiments, a height $h1$ of a first grid wall 310 of the plurality of first grid walls 310 may equal a height $h2$ of a second grid wall 320 of the plurality of second grid walls 320. For example, the height $h1$ of each first grid wall 310 of the plurality of first grid walls 310 and the height $h2$ of each second grid wall 320 of the plurality of second grid walls 320 may both be 10 mm, 15 mm, 20 mm. In some embodiments, a height $h1$ of a first grid wall 310 of the plurality of first grid walls 310 may be different from a height $h2$ of a second grid wall 320 of the plurality of second grid walls 320. In some embodiments, the height $h1$ of the first grid wall 310 of the plurality of first grid walls 310 may be greater than the height $h2$ of the second grid wall 320 of the plurality of second grid walls 320. For example, the height $h1$ of each first grid wall 310 of the plurality of first grid walls 310 may be 20 mm, and the height $h2$ of each second grid wall 320 of the plurality of second grid walls 320 may be 10 mm. In some embodiments, the height $h1$ of the first grid wall 310 of the plurality of first grid walls 310 may be less than the height $h2$ of the second grid wall 320 of the plurality of second grid walls 320. For example, the height $h1$ of each first grid wall 310 of the plurality of first grid walls 310 may be 10 mm, and the height $h2$ of each second grid wall 320 of the plurality of second grid walls 320 may be 15 mm.

[0093] In some embodiments, each of the plurality of first grid walls 310 may have a same height $h1$. For example, the height $h1$ of each of the plurality of first grid walls 310 may be 10 mm. In some embodiments, one or more of the plurality of first grid walls 310 may have a different height $h1$ from the remaining first grid walls 310 of the plurality of first grid walls 310. For example, each of some of the plurality of first grid walls 310 may have a first height $h1$, and each of the remaining first grid walls 310 of the plurality of first grid walls 310 may have a second height $h1$. The first height $h1$ may be different from the second height $h1$. For example, the height $h1$ of each of some of the plurality of first grid walls 310 (e.g., first grid walls 310 at the boundaries of the anti-scatter grid 206) may be 10 mm, and the height $h1$ of each of the remaining first grid walls 310 of the plurality of first grid walls 310 (e.g., first grid walls 310 at the interior of the anti-scatter grid 206 other than the boundaries of the anti-scatter grid 206) may be 15 mm. As another example, a height of a first grid wall of the plurality of first grid walls 310 along a direction that the bed moves into the gantry of the scanning apparatus 200 (e.g., the Z direction shown in FIG. 2) may be greater than a height of a first grid wall of the plurality of first grid walls 310 along a direction perpendicular to the Z direction.

[0094] In some embodiments, each of the plurality of second grid walls 320 may have a same height $h2$. For example, the height $h2$ of each of the plurality of second grid walls 320 may be 10 mm. In some embodiments, one or more of the plurality of second grid walls 320 may have a different height $h2$ from the remaining second grid walls 320 of the plurality of second grid walls 320. For example, each of some of the plurality of second grid walls 320 may have a first height $h2$, and each of the remaining second grid walls 320 of the plurality of second grid walls 320 may have a second height $h2$. The first height $h2$ may be different from the second height $h2$. For example, the height $h2$ of each of some of the plurality of second grid walls 320 (e.g., second grid walls 320 at the boundaries of the anti-scatter grid 206) may be 10 mm, and the height $h2$ of each of the remaining second grid walls 320 of the plurality of second grid walls 320 (e.g., second grid walls 320 at the interior of the anti-scatter grid 206 other than the boundaries of the anti-scatter grid 206) may be 15 mm. As another example, a height of a second grid wall of the plurality of second grid walls 320 along a direction that the bed moves into the gantry of the scanning apparatus 200 (e.g., the Z direction shown in

FIG. 2) may be greater than a height of a second grid wall of the plurality of second grid walls 320 along a direction perpendicular to the Z direction.

[0095] In some embodiments, each of at least some of the plurality of first grid walls may include a first material. Each of at least some of the plurality of second grid walls may include a second material. In some embodiments, the first material and the second material may be the same. For example, the first material and the second material may be a highly absorbing material that absorbs one or more types of radiation.

Exemplary highly absorbing materials may include tungsten, lead, uranium, gold, silver, copper, molybdenum, or the like, or any combination thereof.

[0096] In some embodiments, the first material and the second material may be different. For example, the first material may be a first material of a first radiation absorption rate (e.g., tungsten), and the second material may be a second material of a second radiation absorption rate (e.g., lead). As another example, the first material may be a first material of a first radiation absorption rate (e.g., a highly absorbing material), and the second material may be a second material of a second radiation absorption rate (e.g., a poorly absorbing material) that is lower than the first radiation absorption rate so as to allow more radiation to pass than the first material. A highly absorbing material and a poorly absorbing material may absorb different amounts of radiation of a certain type. For example, the highly absorbing material may absorb a greater amount of radiation of a certain type than the poorly absorbing material. In some embodiments, the second material may be at least partially permeable with respect to radiation of a certain type (e.g., x-ray radiation) and/or allow at least a portion of the radiation to pass through. For example, all or a certain amount of the radiation may pass through the second material. Exemplary poorly absorbing materials may include resin, fiber, rubber, inorganic non-metallic material (e.g., ceramics), resin-based composite material, rubber-based composite material, aluminium alloy, or the like, or any combination thereof. The resin may include thermoplastic resin or thermosetting resin. The thermosetting resin may include phenolic resin, urea-formaldehyde resin, melamine-formaldehyde resin, epoxy resin, unsaturated resin, polyurethane, polyimide, etc. The thermoplastic resin may include polymethyl methacrylate (PMMA), acrylonitrile butadiene styrene (ABS), polyamide, polylactic acid (PLA), polybenzimidazole (PBI), polycarbonate (PC), polyethersulfone (PES), polyetheretherketone (PEEK), polyethylene (PE), polyphenylene oxide (PPO), polyphenylene sulfide (PPS), polypropylene (PP), polystyrene (PS), polyvinyl chloride (PVC), etc. The fiber may include inorganic fiber and organic fiber. Inorganic fiber may include glass fiber, carbon fiber, boron fiber, whisker, asbestos fiber, silicon carbide fiber, etc. Organic fiber may include synthetic fiber such as aramid fiber, aramid fiber, polyester fiber, nylon fiber, vinylon fiber, polypropylene fiber, polyimide fibers, etc., and natural fiber such as cotton, sisal, paper, etc. The rubber may include butyl rubber, chlorinated rubber, nitrile rubber, etc.

Merely by way of example, the first material may be tungsten, and the second material may be ceramics.

[0097] In some embodiments, to achieve a desired mechanical stability such that a maximum deflection of each first grid wall in the first direction is less than 20 μ m, the first material of the first grid walls 310 and/or the second material of the second grid walls 320 may satisfy one or more certain conditions. For example, a stiffness of the first material may be within a range of 60-80HRC. As another example, a stiffness of the second material may be within a range of 60-80HRC. As another example, a stiffness of the first material or the second material may be 60-80HRC. As still another example, a Young's modulus of the first material

may be greater than 411Gpa. As still another example, a Young's modulus of the second material may be greater than 411Gpa.

[0098] FIG. 8 illustrates an exemplary a detector unit 2081 of a detector 208 according to some embodiments of the present disclosure. The detector 208 may include a plurality of detector units 2081 arranged along the first direction. As shown in FIG. 8, the detector unit 2081 may include a plurality of detector modules 340 arranged along the second direction. The plurality of detector modules 340 may be mounted on a bracket 802 and operably connected to a data readout board 804 for outputting data from the detector 208. A detector module 340 may include a scintillator layer 806 configured to absorb radiation beams, and emit a visible light that may be detected by photodiodes 808. The photodiodes 808 may convert the visible light into an electrical signal. In some embodiments, the scintillator layer 806 may include a photosensitive material. Exemplary photosensitive materials may include CdTe, CdZnTe, GaAs, CZT, CdZnTeSe, CdTeSe, CdMnTe, InP, TlBr₂, HgI₂, Si, or the like, or any combination thereof.

[0099] As shown in FIG. 8, the anti-scatter grid 206 may be supported on or attached to the detector unit 2081. For example, the anti-scatter grid 206 may be supported on or attached to the detector unit 2081 by bonding, welding, etc. In some embodiments, one or more coupling structures may be used to mechanically connect the anti-scatter grid 206 to the detector unit 2081 via one or more rivets, screws, bolts, pins joints, key joints, and/or any other coupling structure.

[0100] It should be noted that FIG. 8 is merely provided for the purposes of illustration, and not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, multiple variations and modifications may be made under the teachings of the present disclosure. However, those variations and modifications do not depart from the scope of the present disclosure. For example, the detector 208 may include a plurality of detector units 2081 of other shapes, such as arc-shaped, circular, linear, or the like, or a combination thereof. However, those variations and modifications do not depart the scope of the present disclosure.

[0101] It should be noted that the above description of the detector unit 2081 of the detector 208 is merely provided for the purposes of illustration, and not intended to limit the scope of the present disclosure. For persons having ordinary skills in the art, multiple variations and modifications may be made under the teachings of the present disclosure. For example, the anti-scatter grid 206 may be an integrated part of the detector unit 2081. However, those variations and modifications do not depart from the scope of the present disclosure.

[0102] Having thus described the basic concepts, it may be rather apparent to those skilled in the art after reading this detailed disclosure that the foregoing detailed disclosure is intended to be presented by way of example only and is not limiting. Various alterations, improvements, and modifications may occur and are intended to those skilled in the art, though not expressly stated herein. These alterations, improvements, and modifications are intended to be suggested by this disclosure, and are within the spirit and scope of the exemplary embodiments of this disclosure.

[0103] Moreover, certain terminology has been used to describe embodiments of the present disclosure. For example, the terms "one embodiment," "an embodiment," and/or "some embodiments" mean that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present disclosure. Therefore, it is emphasized and should be appreciated that

two or more references to “an embodiment” or “one embodiment” or “an alternative embodiment” in various portions of this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures or characteristics may be combined as suitable in one or more embodiments of the present disclosure.

[0104] Further, it will be appreciated by one skilled in the art, aspects of the present disclosure may be illustrated and described herein in any of a number of patentable classes or context including any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof. Accordingly, aspects of the present disclosure may be implemented entirely hardware, entirely software (including firmware, resident software, micro-code, etc.) or combining software and hardware implementation that may all generally be referred to herein as a “block,” “module,” “engine,” “unit,” “component,” or “system.” Furthermore, aspects of the present disclosure may take the form of a computer program product embodied in one or more computer readable media having computer readable program code embodied thereon.

[0105] A computer readable signal medium may include a propagated data signal with computer readable program code embodied therein, for example, in baseband or as part of a carrier wave. Such a propagated signal may take any of a variety of forms, including electro-magnetic, optical, or the like, or any suitable combination thereof. A computer readable signal medium may be any computer readable medium that is not a computer readable storage medium and that may communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device. Program code embodied on a computer readable signal medium may be transmitted using any appropriate medium, including wireless, wireline, optical fiber cable, RF, or the like, or any suitable combination of the foregoing.

[0106] Computer program code for carrying out operations for aspects of the present disclosure may be written in any combination of one or more programming languages, including an object-oriented programming language such as Java, Scala, Smalltalk, Eiffel, JADE, Emerald, C++, C#, VB. NET, Python or the like, conventional procedural programming languages, such as the “C” programming language, Visual Basic, Fortran 2003, Perl, COBOL 2002, PHP, ABAP, dynamic programming languages such as Python, Ruby and Groovy, or other programming languages. The program code may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider) or in a cloud computing environment or offered as a service such as a Software as a Service (SaaS).

[0107] Furthermore, the recited order of processing elements or sequences, or the use of numbers, letters, or other designations therefore, is not intended to limit the claimed processes and methods to any order except as may be specified in the claims. Although the above disclosure discusses through various examples what is currently considered to be a variety of useful embodiments of the disclosure, it is to be understood that such detail is solely for that purpose, and that the appended claims are not limited to the disclosed embodiments, but, on the contrary, are intended to cover modifications and equivalent arrangements that are within the spirit and scope of the disclosed embodiments. For example, although the implementation of various components

described above may be embodied in a hardware device, it may also be implemented as a software only solution—e.g., an installation on an existing server or mobile device.

[0108] Similarly, it should be appreciated that in the foregoing description of embodiments of the present disclosure, various features are sometimes grouped together in a single embodiment, figure, or description thereof for the purpose of streamlining the disclosure aiding in the understanding of one or more of the various inventive embodiments. This method of disclosure, however, is not to be interpreted as reflecting an intention that the claimed subject matter requires more features than are expressly recited in each claim. Rather, inventive embodiments lie in less than all features of a single foregoing disclosed embodiment.

[0109] In some embodiments, the numbers expressing quantities of ingredients, properties, and so forth, used to describe and claim certain embodiments of the application are to be understood as being modified in some instances by the term “about,” “approximate,” or “substantially.” For example, “about,” “approximate,” or “substantially” may indicate $\pm 20\%$ variation of the value it describes, unless otherwise stated. Accordingly, in some embodiments, the numerical parameters set forth in the written description and attached claims are approximations that may vary depending upon the desired properties sought to be obtained by a particular embodiment. In some embodiments, the numerical parameters should be construed in light of the number of reported significant digits and by applying ordinary rounding techniques. Notwithstanding that the numerical ranges and parameters setting forth the broad scope of some embodiments of the application are approximations, the numerical values set forth in the specific examples are reported as precisely as practicable.

[0110] Each of the patents, patent applications, publications of patent applications, and other material, such as articles, books, specifications, publications, documents, things, and/or the like, referenced herein is hereby incorporated herein by this reference in its entirety for all purposes, excepting any prosecution file history associated with same, any of same that is inconsistent with or in conflict with the present document, or any of same that may have a limiting affect as to the broadest scope of the claims now or later associated with the present document. By way of example, should there be any inconsistency or conflict between the description, definition, and/or the use of a term associated with any of the incorporated material and that associated with the present document, the description, definition, and/or the use of the term in the present document shall prevail.

[0111] It is to be understood that the embodiments of the application disclosed herein are illustrative of the principles of the embodiments of the application. Other modifications that may be employed may be within the scope of the application. Thus, by way of example, but not of limitation, alternative configurations of the embodiments of the application may be utilized in accordance with the teachings herein. Accordingly, embodiments of the present application are not limited to that precisely as shown and described.

WHAT IS CLAIMED IS:

1. An anti-scatter grid, comprising:
 - a plurality of first grid walls arranged in a first direction; and
 - a plurality of second grid walls arranged in a second direction, wherein
 - each pair of adjacent first grid walls of at least some of the plurality of first grid walls are spaced by a first distance in the first direction,
 - each pair of adjacent second grid walls of at least some of the plurality of second grid walls are spaced by a second distance in the second direction,
 - a distance ratio of the first distance to the second distance is set such that a maximum deflection of each first grid wall in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid, and
 - the first direction is orthogonal to the second direction.
2. The anti-scatter grid of claim 1, wherein the predefined range is less than 20um.
3. The anti-scatter grid of claim 1, wherein the distance ratio of the first distance to the second distance is lower than 1.
4. The anti-scatter grid of any one of claims 1-3, wherein
 - each pair of adjacent first grid walls of at least some of the plurality of first grid walls and each pair of adjacent second grid walls of at least some of the plurality of second grid walls define a region where a plurality of detector pixels are arranged,
 - a count of pixel types of the plurality of detector pixels corresponding to each region is less than a type threshold, and
 - each pixel type is associated with an effective area of a detector pixel.
5. The anti-scatter grid of any one of claims 1-4, wherein a second grid wall of at least some of the plurality of second grid walls is disposed between each pair of adjacent detector modules, and each detector module includes a plurality of detector pixels.
6. The anti-scatter grid of claim 5, wherein a thickness of a second grid wall of at least some of the plurality of second grid walls is less than or equal to a module gap between two adjacent detector modules in the first direction where the second grid wall is disposed.
7. The anti-scatter grid of claim 6, wherein each of at least some of the plurality of first grid walls is disposed between two adjacent detector pixels, and a pixel gap between the two adjacent detector pixels in the first direction is less than the module gap between the two adjacent detector modules.

8. The anti-scatter grid of any one of claims 4-7, further comprising a plurality of regions each of which is defined by a pair of adjacent first grid walls of at least some of the plurality of first grid walls and a pair of adjacent second grid walls of at least some of the plurality of second grid walls, wherein

for at least one of the plurality of regions, a thickness of a first grid wall of the at least some of the plurality of first grid walls defining the region or a thickness of a second grid wall of the at least some of the plurality of second grid walls defining the region is associated with an effective area ratio of an effective area corresponding to the region to a total area corresponding to the region.

9. The anti-scatter grid of claim 8, wherein the effective area ratio corresponding to the region is greater than an effective area ratio threshold.

10. The anti-scatter grid of any one of claims 1-9, wherein a height of a first grid wall of the plurality of first grid walls or a height of a second grid wall of the plurality of second grid walls is associated with a scatter primary ratio (SPR).

11. The anti-scatter grid of claim 10, wherein the SPR is less than a SPR threshold.

12. The anti-scatter grid of any one of claims 1-11, wherein a thickness of a first grid wall of the plurality of first grid walls equals a thickness of a second grid wall of the plurality of second grid walls.

13. The anti-scatter grid of any one of claims 1-12, wherein a thickness of a first grid wall of the plurality of first grid walls is different from a thickness of a second grid wall of the plurality of second grid walls.

14. The anti-scatter grid of any one of claims 1-13, wherein a height of a first grid wall of the plurality of first grid walls equals a height of a second grid wall of the plurality of second grid walls.

15. The anti-scatter grid of any one of claims 1-14, wherein a height of a first grid wall of the plurality of first grid walls is different from a height of a second grid wall of the plurality of second grid walls.

16. The anti-scatter grid of any one of claims 1-15, wherein

each of at least some of the plurality of first grid walls includes a first material; and
each of at least some of the plurality of second grid walls includes a second material; and
the first material and the second material are the same.

17. The anti-scatter grid of claim 1-16, wherein

each of at least some of the plurality of first grid walls includes a first material;
each of at least some of the plurality of second grid walls includes a second material; and
the first material and the second material are different.

18. The anti-scatter grid of claim 16, wherein the first material or the second material satisfies at least one of:

a stiffness of the first material is within a range of 60-80HRC;
a stiffness of the second material is within a range of 60-80HRC;
the first material is tungsten; or
the second material is tungsten.

19. The anti-scatter grid of any one of claims 1-18, wherein the distance ratio of the first distance to the second distance is further set such that a scatter primary ratio (SPR) is less than a SPR threshold.

20. An imaging apparatus, comprising an anti-scatter grid, wherein the anti-scatter grid includes:

a plurality of first grid walls arranged in a first direction; and
a plurality of second grid walls arranged in a second direction, wherein
each pair of adjacent first grid walls of at least some of the plurality of first grid walls are spaced by a first distance in the first direction,
each pair of adjacent second grid walls of at least some of the plurality of second grid walls are spaced by a second distance in the second direction,
a distance ratio of the first distance to the second distance is set such that a maximum deflection of each first grid wall in the first direction is within a predefined range determined based on a mechanical stability of the anti-scatter grid, and
the first direction is orthogonal to the second direction.

21. The anti-scatter grid of claim 20, wherein the predefined range is less than 20um.

22. The imaging apparatus of claim 20, wherein the distance ratio of the first distance to the second distance is lower than 1.

23. The imaging apparatus of any one of claims 20-22, wherein

each pair of adjacent first grid walls of at least some of the plurality of first grid walls and each pair of adjacent second grid walls of at least some of the plurality of second grid walls define a region where a plurality of detector pixels are arranged,
a count of pixel types of the plurality of detector pixels in each region is less than a type threshold, and
each pixel type is associated with an effective area of a detector pixel.

24. The imaging apparatus of any one of claims 20-23, wherein the distance ratio of the first distance to the second distance is further set such that a scatter primary ratio (SPR) is less than a SPR threshold.

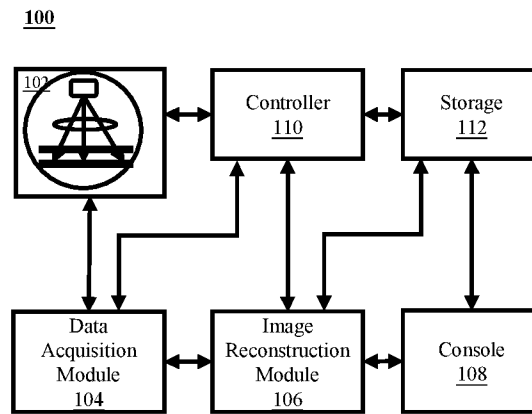


FIG. 1

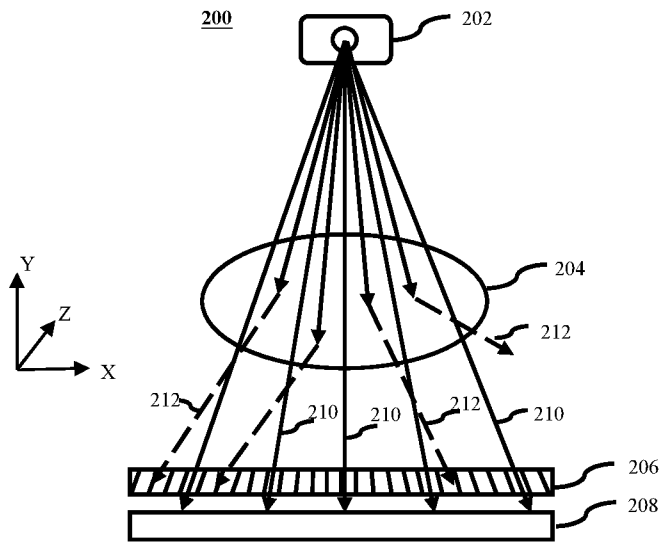


FIG. 2

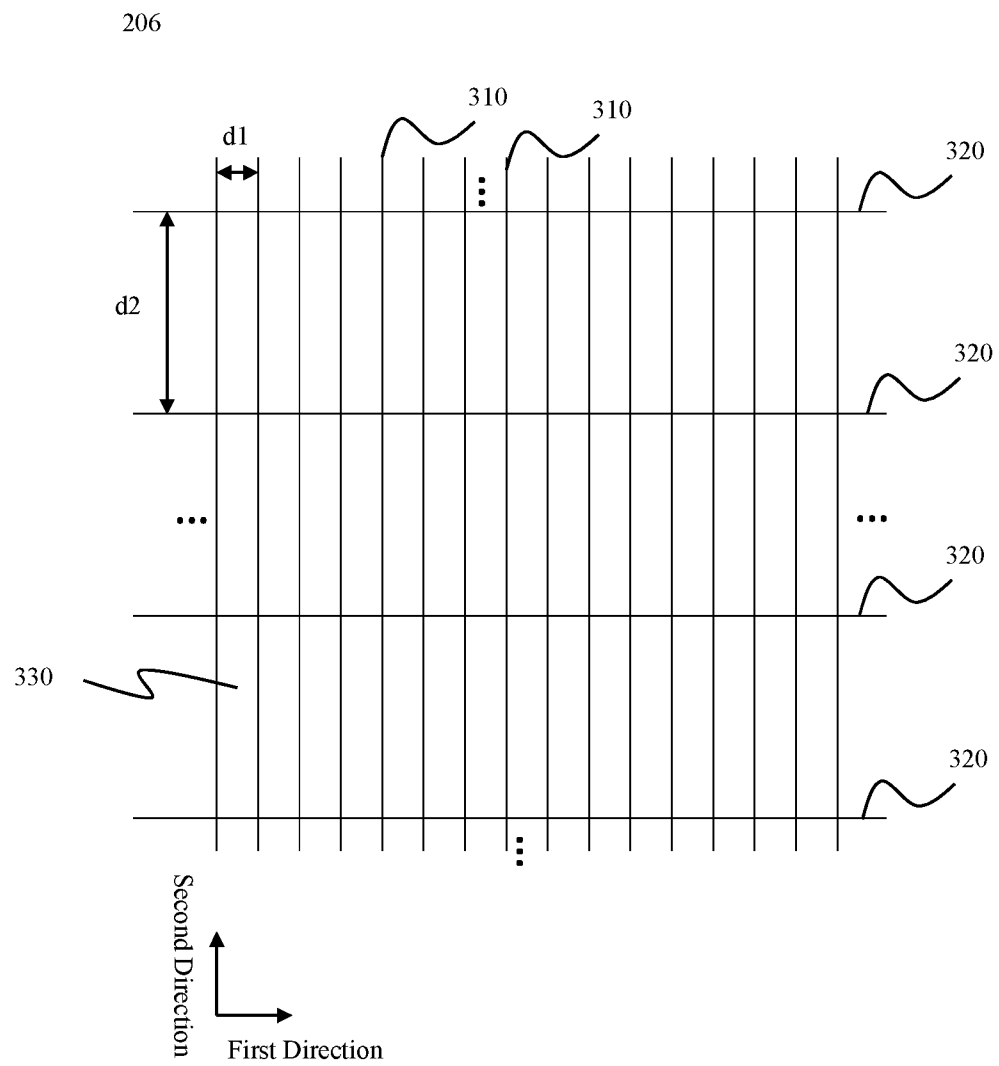


FIG. 3

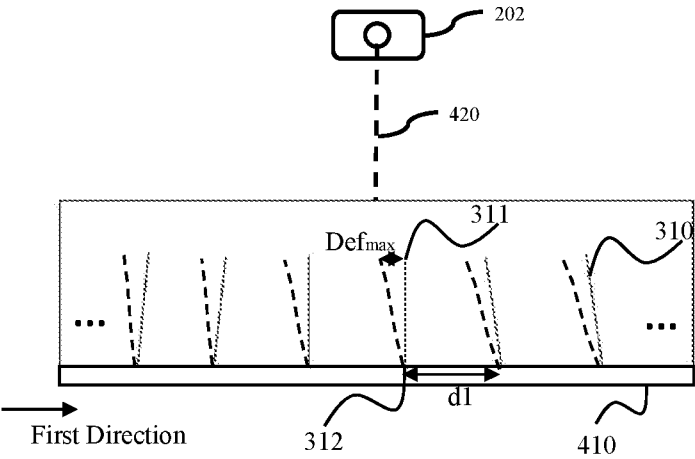


FIG. 4

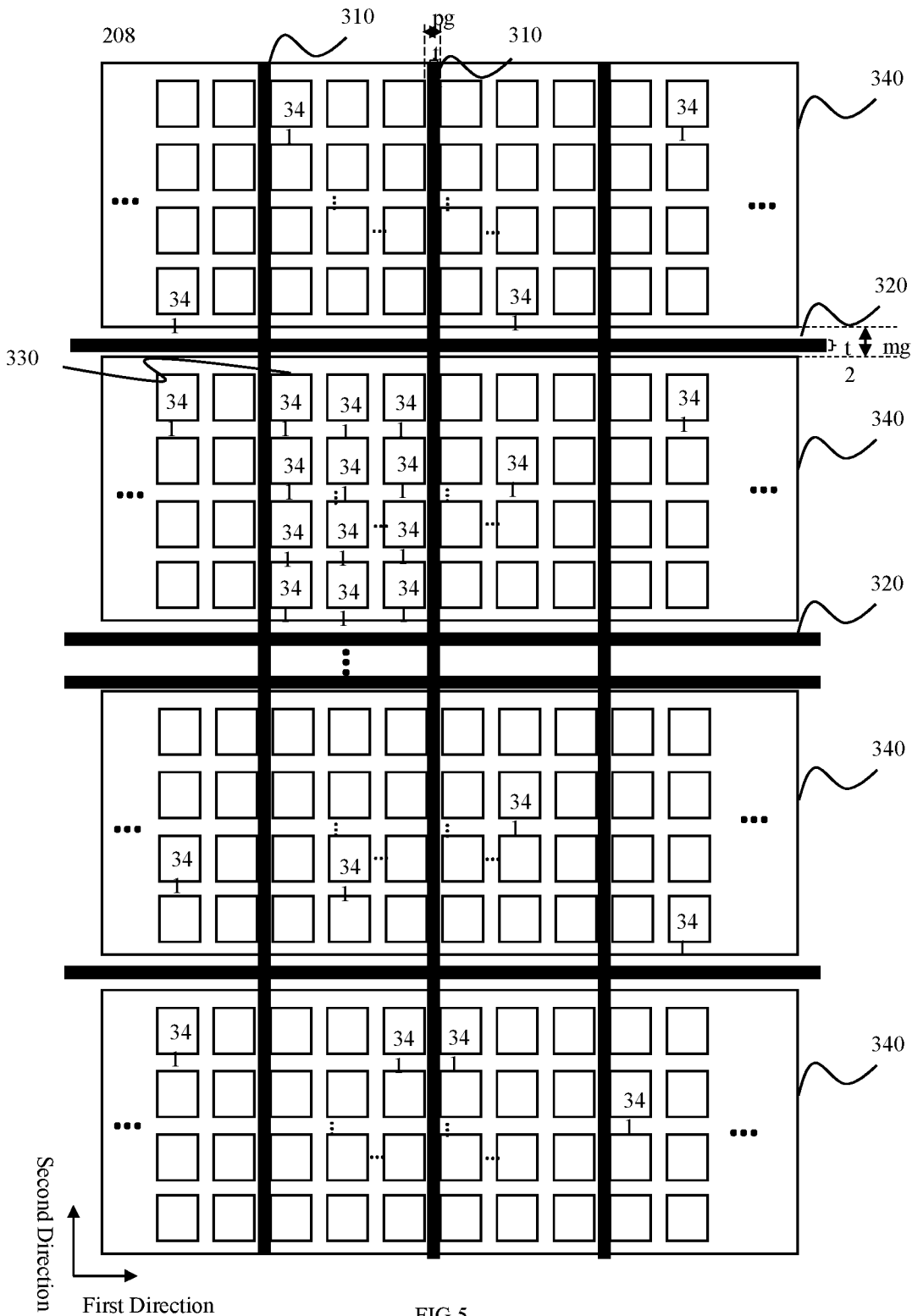


FIG.5

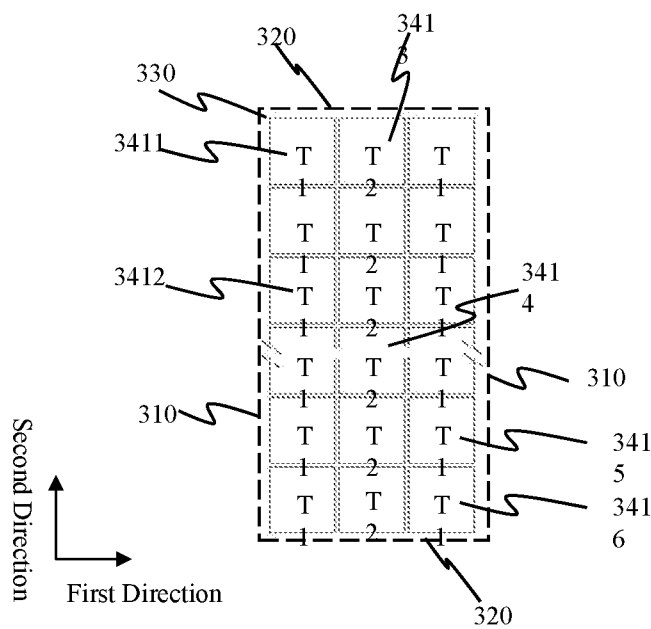


FIG. 6

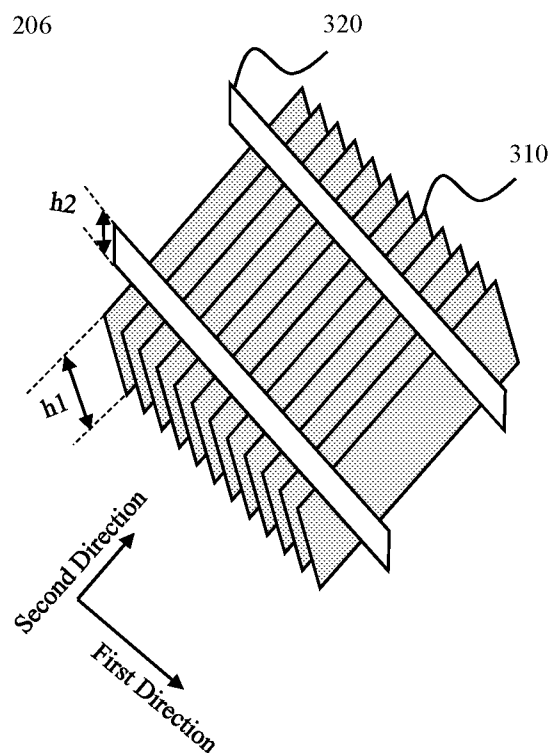


FIG. 7

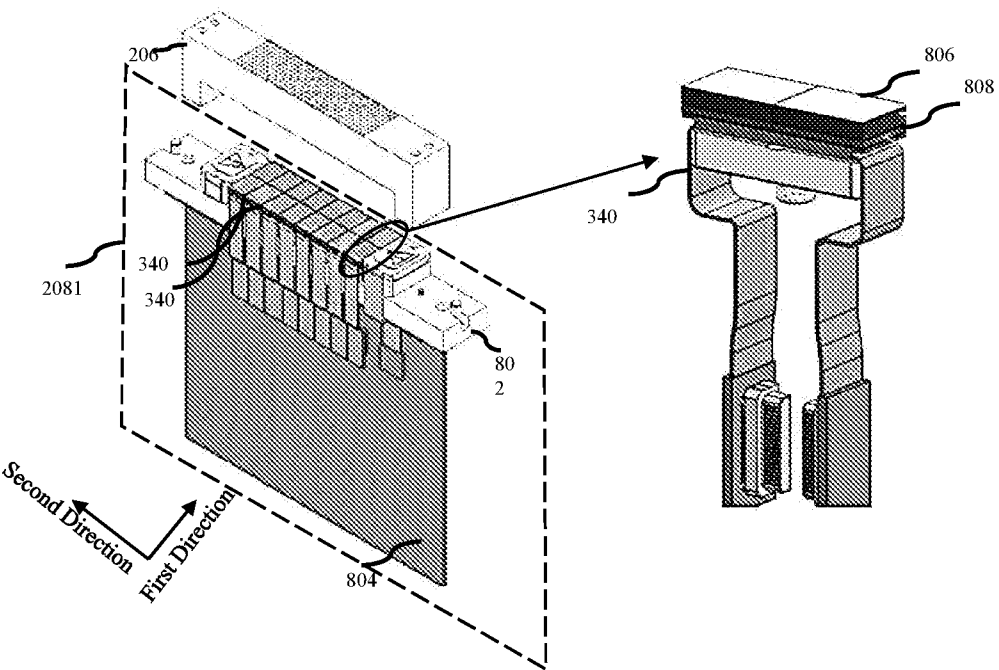


FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2023/107541

A. CLASSIFICATION OF SUBJECT MATTER

A61B 6/00(2006.01)i

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: A61B 6/-

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 practicable, search terms used)

CNTXT,ENTXT,WPABS: grid, shift, deflect, wall, anti-scatter, distance, ratio, direction, mechanic, stability, orthogonal, first, second

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2017265822 A1 (SHANGHAI UNITED IMAGING HEALTHCARE CO., LTD.) 21 September 2017 (2017-09-21) paragraphs [0077]-[0080] in the description, figures 6-7	1-24
A	JP 2001333896 A (FUJI PHOTO FILM CO., LTD.) 04 December 2001 (2001-12-04) the whole document	1-24
A	US 2018315516 A1 (UIH AMERICA, INC.) 01 November 2018 (2018-11-01) the whole document	1-24
A	CN 208659386 U (SHANGHAI LEADING TECHNOLOGY CO., LTD.) 29 March 2019 (2019-03-29) the whole document	1-24
A	CN 103135121 A (GE MEDICAL SYSTEMS GLOBAL TECHNOLOGY COMPANY, L.L.C.) 05 June 2013 (2013-06-05) the whole document	1-24
A	US 2007064878 A1 (HEISMANN, Bjorn) 22 March 2007 (2007-03-22) the whole document	1-24



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“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

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

14 December 2023

Date of mailing of the international search report

21 December 2023

Name and mailing address of the ISA/CN

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2023/107541

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
US	2017265822	A1	21 September 2017	WO	2017070961	A1	04 May 2017
				EP	3234950	A1	25 October 2017
				EP	3234950	B1	13 July 2022
				US	2020237324	A1	30 July 2020
				US	11103201	B2	31 August 2021
				US	10617369	B2	14 April 2020
				US	2021386387	A1	16 December 2021

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				EP	3396678	A1	31 October 2018
				EP	3396678	B1	25 January 2023
				PL	3396678	T3	19 June 2023
				US	2022172856	A1	02 June 2022
				US	11798705	B2	24 October 2023

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