WHAT IS CLAIMED IS:

1. A ray scanning apparatus, comprising:

a conveying device, for conveying an object under inspection to pass through a scanning area of the ray scanning apparatus;

a ray source assembly, comprising a plurality of ray source modules, each ray source module comprising at least one ray source point emitting a ray beam, and when observed in a conveying direction of the object under inspection, the plurality of ray source modules being arranged around the scanning area in a non-enclosed structure opened on one side of the scanning area; and

a detector assembly, for detecting rays transmitting through the object under inspection during scanning and comprising a plurality of detector sets, when observed in the conveying direction of the object under inspection, the plurality of detector sets being connected to each other at their end portions and arranged around the scanning area in a non-enclosed structure opened on one side of the scanning area,

wherein an opening of the non-enclosed structure of the ray source assembly is opposite to an opening of the non-enclosed structure of the detector assembly, and

the plurality of detector sets of the detector assembly are fixed in a same plane perpendicular to the conveying direction of the object under inspection, and the plurality of ray source modules of the ray source assembly are arranged in a plurality of different planes perpendicular to the conveying direction of the object under inspection.

2. The ray scanning apparatus according to claim 1, wherein the ray source module of the ray source assembly that is located on the open side of the non-enclosed structure of the detector assembly and the plurality of detector sets of the detector assembly are fixed in the same plane perpendicular to the conveying direction of the object under inspection, while other ray source modules of the ray source assembly are fixed in another plane(s) perpendicular to the conveying direction of the object under inspection.

3. The ray scanning apparatus according to claim 2, wherein the other ray source modules of the ray source assembly are fixed in another same plane perpendicular to the conveying direction of the object under inspection.

4. The ray scanning apparatus according to claim 3, wherein the plurality of ray source modules can be mounted and detached independently of each other.

5. The ray scanning apparatus according to any of claims 1-4, wherein each of the plurality of ray source modules is a distributed ray source, and when observed in the conveying direction of the object under inspection, the plurality of distributed ray sources are arranged on three sides of the scanning area respectively to form the non-enclosed structure around the scanning area and opened on one side.

6. The ray scanning apparatus according to claim 5, wherein the distributed ray sources are in a straight line, arc, or broken line shape or any combination thereof, so that the ray source assembly is formed into a right-angled rectangular, rounded rectangular, polygonal, or elliptical structure opened on one side of the scanning area when observed in the conveying direction of the object under inspection.

7. The ray scanning apparatus according to any of claims 1-4, wherein each of the plurality of ray source modules is a single-point source group, and each single-point source group comprises at least two single-point sources.

8. The ray scanning apparatus according to any of claims 1-4, wherein each ray source module comprises a separate chamber to accommodate a respective ray generating device, the chamber comprises a separate vacuum chamber for accommodating a plurality of target spots, and is provided with a mounting-positioning structure, which is adapted for mounting and positioning the ray source module and rotating the ray source module to adjust an output angle of the ray beam.

9. The ray scanning apparatus according to claim 8, wherein a distance between the target spots in each ray source module is smaller than a distance between the target spots of end portions of adjacent ray source modules.

10. The ray scanning apparatus according to any of claims 1-9, wherein each detector set is a detector array comprising a plurality of detector units, and the detector array comprises a straight line detector array, an arc-shaped detector array, or a combination of the both.

11. The ray scanning apparatus according to claim 10, wherein each detector set is a straight line detector array, the detector assembly comprises three straight line detector arrays, and the three straight line detector arrays are arranged on three sides of the scanning area respectively to form a rectangular or square structure opened on one side of the scanning area.

12. The ray scanning apparatus according to claim 10, wherein each detector set is a straight line detector array, the detector assembly comprises a plurality of first straight line detector arrays and a plurality of second straight line detector arrays, the second straight line detector arrays are shorter than the first straight line detector arrays, and the plurality of first straight line detector arrays and the plurality of second straight line detector arrays are arranged alternately around the scanning area to form a polygonal structure opened on one side of the scanning area.

13. The ray scanning apparatus according to claim 10, wherein the respective detector sets of the detector assembly can be mounted and detached independently of each other, and wherein the detector sets of the detector assembly are configured to move perpendicular to or parallel to the conveying direction of the object under inspection for being mounted and detached.

14. The ray scanning apparatus according to claim 13, wherein each detector set of the detector assembly comprises a detector arm, the ray scanning apparatus comprises a support frame being stationary relative to a mounting platform of the ray scanning apparatus, and the detector set is mounted to the support frame or detached from the support frame via the detector arm.

15. The ray scanning apparatus according to any of claims 1-14, wherein when observed in the conveying direction of the object under inspection, the detector assembly is arranged between the ray source assembly and the scanning area; and

in the conveying direction of the object under inspection, the other ray source modules overlap at least partially with the detector sets on the same side as them relative to the scanning area.

16. The ray scanning apparatus according to claim 15, wherein each detector set of the detector assembly on the same side as each of the other ray source modules relative to the scanning area is configured to avoid the ray beam of the ray source module on the same side and to receive rays from the ray source modules on all the remaining sides except the ray source module on the same side.

17. The ray scanning apparatus according to claim 15, wherein each detector unit of the detector set comprises a detector crystal for receiving rays transmitting through the object under inspection during scanning, and the detector crystal is arranged at an end portion of the detector unit in the conveying direction of the object under inspection;

the detector crystal of the detector set of the detector assembly on the same side as each of the other ray source modules relative to the scanning area is arranged to be, in the conveying direction of the object under inspection, immediately adjacent to emission area of the ray beam of the ray source module on the same side, but not to obstruct the ray beam.

18. The ray scanning apparatus according to claim 17, wherein each of the other ray source modules of the ray source assembly on the same side as a detector set relative to the scanning area is arranged so that its ray beam avoids said detector set and illuminates the detector crystal of the detector set on the opposite side of the ray source module.

19. The ray scanning apparatus according to claim 18, wherein each of the other ray source modules is configured to rotate around a target spot axis to illuminate the detector crystal of the detector set on the opposite side of the ray source module with a center position of the ray beam.

20. The ray scanning apparatus according to any of claims 1-19, further comprising an image processing module, which is configured to compensate for missing projection data at end portions of the ray source modules and/or repair a reconstructed image to obtain a complete reconstructed image, and wherein the image processing module is configured to perform image reconstruction by an iterative method, an image domain repair method, or a combination of the both.