Abstract

Disclosed in the present invention is a data slip ring system for use in the rack of CT equipment, said rack comprising a rotary part and a stationary part, with a data management system provided on the rotary part and an image reconstruction system provided on the stationary part, wherein said data slip ring system comprises a transmission antenna provided on said rotary part and a plurality of receivers provided on said stationary part; said transmission antenna forms an arc with a central angle smaller than 360 degrees, for transmitting data signals from the data management system to said receivers by way of electromagnetic coupling; and said receivers send the data signals to said image reconstruction system via a transmission line. Also disclosed in the present invention is CT equipment. By way of the above technical solution, the present invention reduces the costs of the data slip ring system and also reduces electromagnetic interference therein.

Claims

1. A data slip ring system for use in the rack of CT equipment, said rack comprising a rotary part (10) and a stationary part, with a data management system (12) provided on the rotary part and an image reconstruction system (36) provided on the stationary part, characterized in that

said data slip ring system comprises a transmission antenna (16, 18) provided on said rotary part (10) and a plurality of receivers (26, 28; 38, 40, 42) provided on said stationary part; said transmission antenna forms an arc with a central angle smaller than 360 degrees, for transmitting data signals from the data management system (12) to said receivers (26, 28; 38, 40, 42) by way of electromagnetic coupling; and said receivers (26, 28; 38, 40, 42) send the data signals to said image reconstruction system (36) via a transmission line.

2. The data slip ring system according to claim 1, characterized in that said transmission antenna (16, 18) is deployed along the edge of the rotary part.

3. The data slip ring system according to claim 1, characterized in that said receivers (26, 28; 38, 40, 42) are deployed on the periphery of the stationary part at equal intervals.

4. The data slip ring system according to claim 3, characterized in that said data slip ring system comprises two receivers (26, 28), and said transmission antenna forms an arc with a central angle greater than or equal to 180 degrees.

5. The data slip ring system according to claim 3, characterized in that said data slip ring system comprises three receivers (38, 40, 42), and said transmission antenna forms an arc with a central angle greater than or equal to 120 degrees.

6. The data slip ring system according to claim 1, characterized in that said data slip ring system further comprises:

a location detector for acquiring location information of the data management system (12) and providing the same to the image reconstruction system (36).

7. The data slip ring system according to claim 1, characterized in that said receivers (26, 28; 38, 40, 42) are always turned on during the operation of the CT equipment.

8. The data slip ring system according to claim 1, characterized in that said receivers (26, 28; 38, 40, 42) are turned on when the transmission antenna is passing them and are turned off when the transmission antenna is not passing them.

9. The data slip ring system according to claim 8, characterized in that said receivers (26, 28; 38, 40, 42) are turned on or off according to the control of the image reconstruction system (36) or turned on or off according to a preset time.

10. CT equipment, comprising a data slip ring system as claimed in any one of claims 1-9.

Dated this 11/04/2012

(HRISHIKESH RAY CHAUDHURY)
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANT[S]

201107223CN

1/4

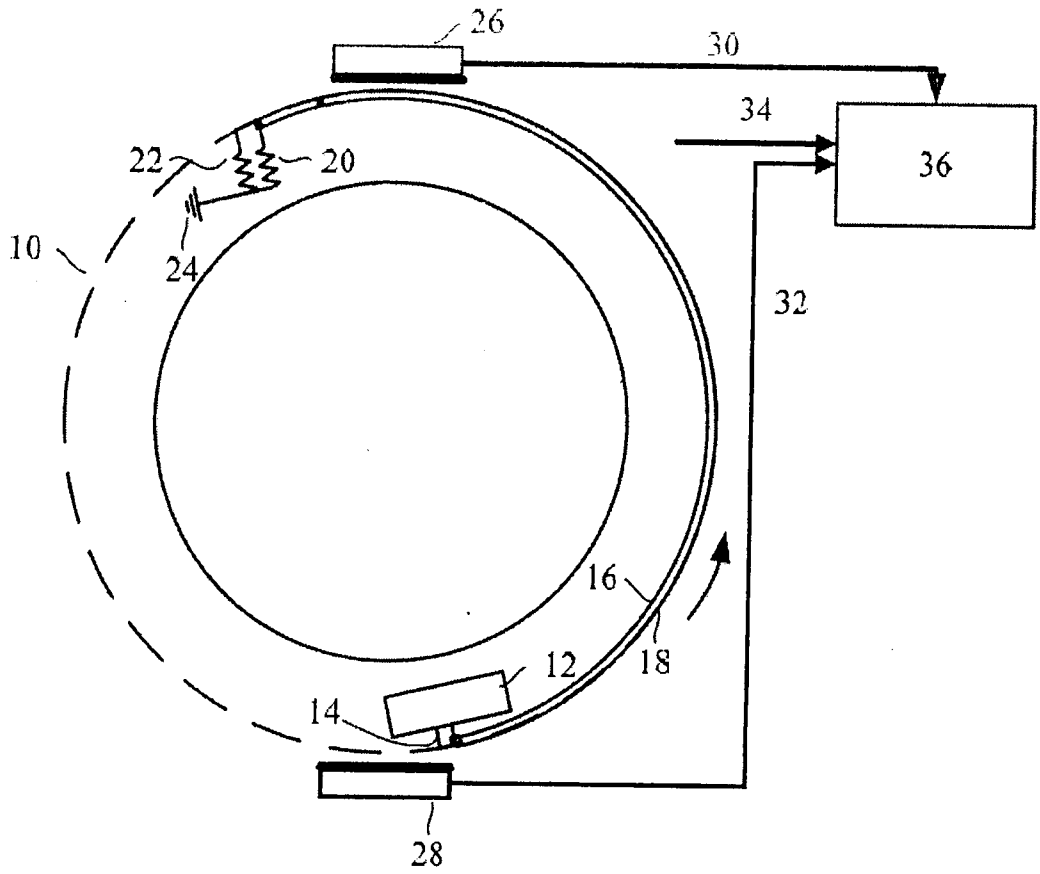

Fig. 1

[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

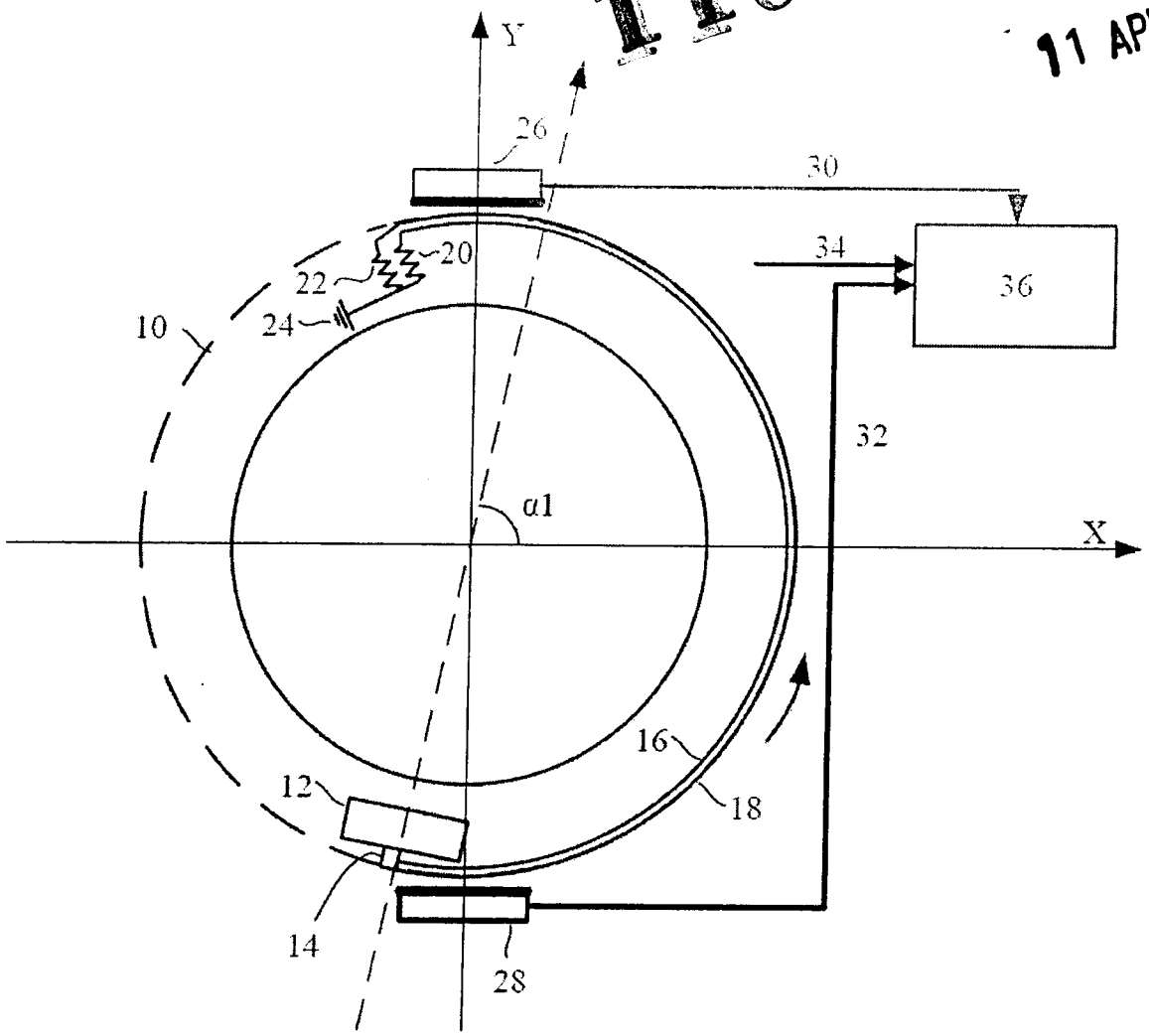

Fig. 2

[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

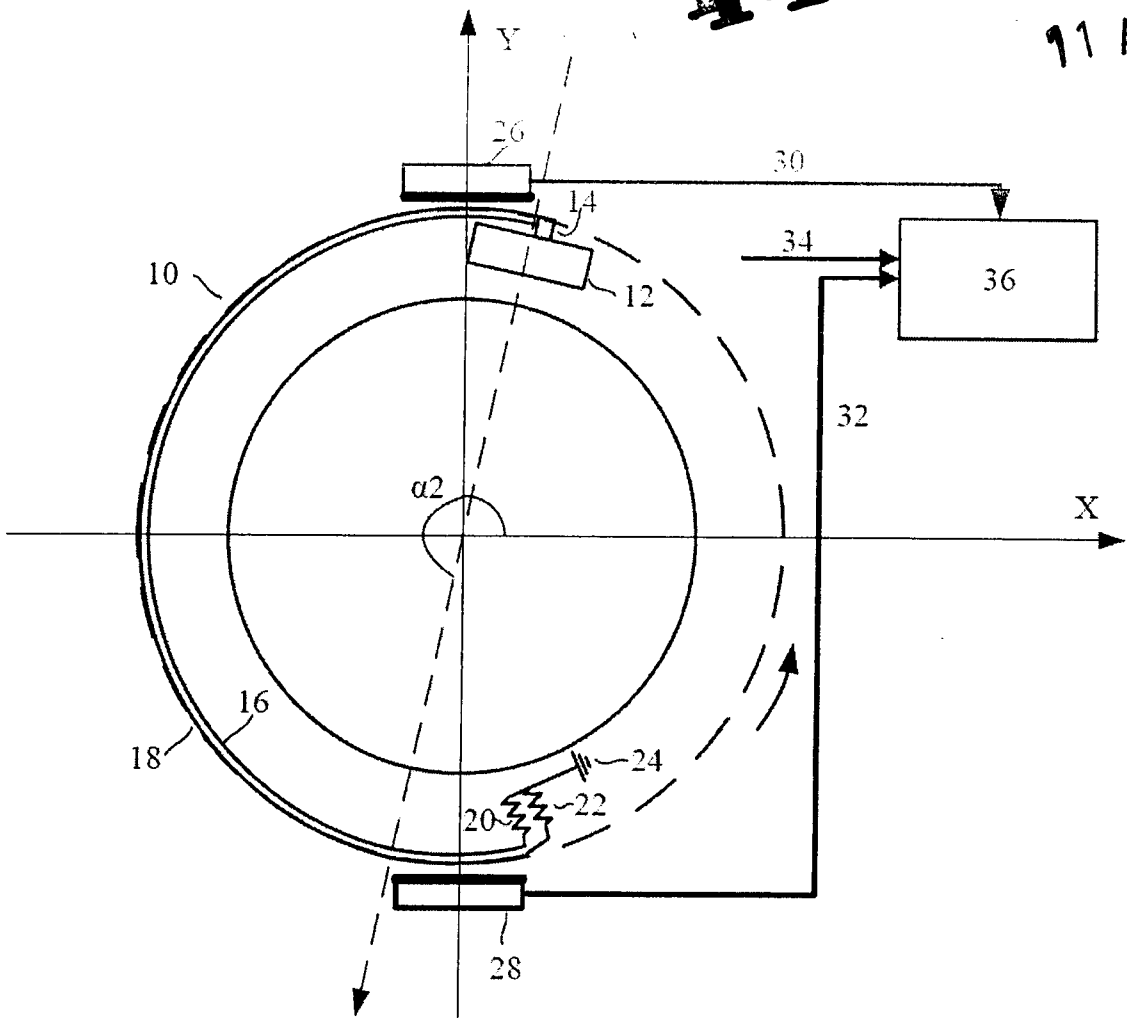

Fig. 3

[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

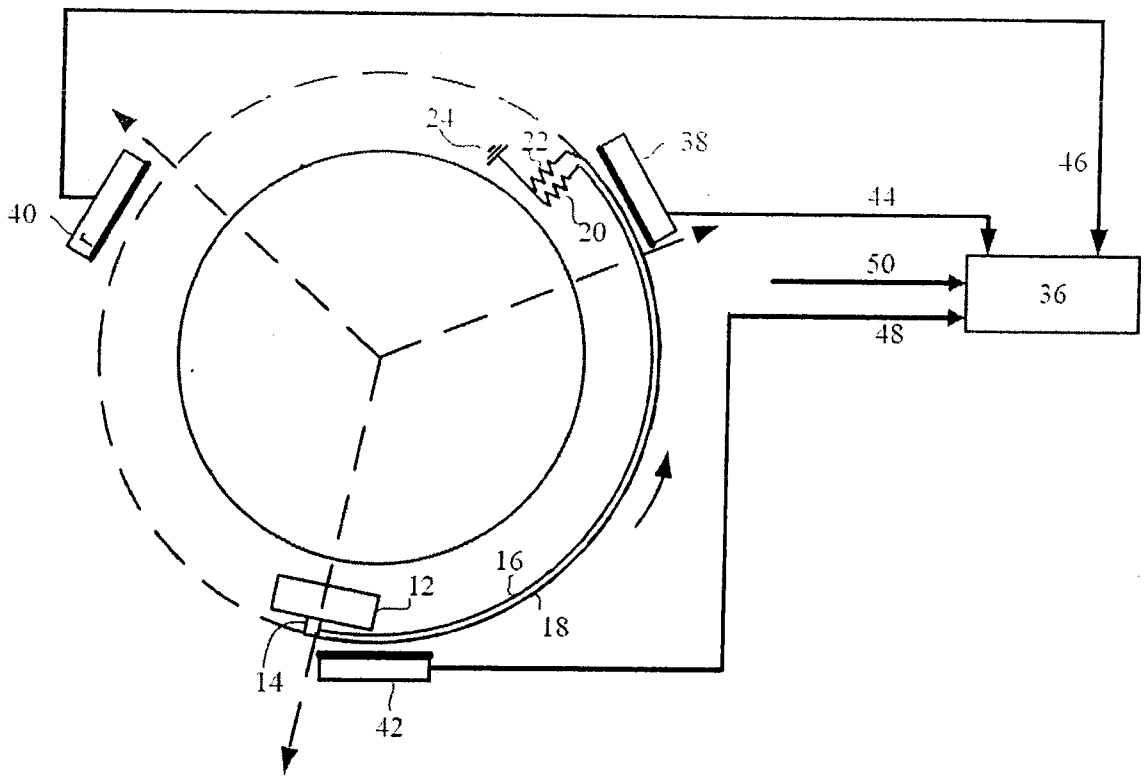

Fig. 4

[HRISHIKESH RAY CHAUDHURY]
OF REMFRY & SAGAR
ATTORNEY FOR THE APPLICANTS

Description

Data slip ring system and CT equipment

Technical field

The present invention relates to the technical field of X-ray computed tomography (CT) equipment and, particularly, to a data slip ring system and CT equipment.

Background art

Generally, the rack of CT equipment includes two parts, i.e. a stationary part and a rotary part. The stationary part is provided with an image reconstruction system (IRS); and the rotary part is provided with an X-ray tube, a corresponding detector array, and a data management system (DMS). The X-rays emitted by the X-ray tube, after passing an imaging space, are received by the detector array, and then the detector array sends analog signals to the data management system. The data management system is usually also referred to as a data acquisition system (DAS) and carries out amplification, integration and analog-digital conversion (conversion from analog signals to digital signals) of the analog signals, into data signals with properties capable of reconstructing an image. In order to obtain a CT image, the data signals of the data management system have to be sent to the image reconstruction system.

With the increase in column numbers in the detector arrays in CT equipment and the continuous increase in speed of rotating scans, the data acquired by the data management system per unit time is continuously increasing, and it is necessary to transmit the acquired data from the data management system to the image reconstruction system more rapidly.

One method of data transmission is to use optical fibers

to transmit data. For example, disclosed in Chinese patent no. CN100448402C is a CT slip ring system based on optical fiber data transmission. Disclosed in Chinese patent no. CN100486525C is a CT slip ring system based on optical fiber data transmission. Disclosed in Chinese patent no. CN100448403C is an optical signal transmission system for computed tomography imaging equipment. In these Chinese patents, a non-contact optical signal transmission method is used to transmit the data acquired by the data management system out of the rotary part.

Another method of data transmission is to transmit data by way of capacitive coupling. For example, disclosed in American patent no. US7,079,619 is a method of data transmission by way of radio capacitive coupling.

In the currently available data slip ring systems which use capacitive coupling to transmit data, since the transmission antenna has to be wound around the rotary part one turn and the materials used in the transmission antenna are rather expensive, the costs of the entire data slip ring system are quite high. In addition, since the transmission antenna is wound around the rotary part one turn, electromagnetic waves will be emitted in the range of 360 degrees, which will therefore generate rather high electromagnetic interference (EMI).

Contents of the invention

In view of this situation, a data slip ring system is proposed in the present invention in order to reduce the costs of such a system. It is also intended in the present invention to propose CT equipment including this data slip ring system.

For this reason, according to one embodiment of the present invention, a data slip ring system is provided for

use in the rack of CT equipment, said rack comprising a rotary part and a stationary part, with a data management system provided on the rotary part and an image reconstruction system provided on the stationary part, wherein said data slip ring system comprises a transmission antenna provided on said rotary part and a plurality of receivers provided on said stationary part; said transmission antenna forms an arc with a central angle smaller than 360 degrees, for transmitting data signals from the data management system to said receivers by way of electromagnetic coupling, and said receivers send data signals to said image reconstruction system via a transmission line.

It can be seen from the above solution that since the transmission antenna of the data slip ring system in the embodiments of the present invention is an arc with a central angle smaller than 360 degrees, the use of transmission antenna materials is reduced; although there are more receivers compared to the prior art, since the transmission antenna materials are far more expensive than the price of the receivers, the costs of the data slip ring system are reduced overall. In addition, since the transmission antenna is smaller than 360 degrees and will not emit electromagnetic waves over the entire range of 360 degrees, the solution according to the embodiments of the present invention also reduces electromagnetic interference.

Preferably, said transmission antenna is deployed along the edge of the rotary part and therefore is closer to the receivers, so the transmission of data signals can be accomplished with lower power.

Preferably, said receivers are deployed on the periphery of the stationary part at equal intervals. In this case, the shortest (maximum distance between adjacent receivers)

transmission antenna can be used to achieve the transmission of data signals.

According to an embodiment, said data slip ring system comprises two receivers, and said transmission antenna forms an arc with a central angle greater than or equal to 180 degrees.

According to another embodiment, said data slip ring system comprises three receivers, and said transmission antenna forms an arc with a central angle greater than or equal to 120 degrees.

Optionally, said data slip ring system further comprises a location detector for obtaining location information of the data management system and providing the same to the image reconstruction system, so that the image reconstruction system decides which receiver to receive data signals from or which receiver to control to receive data signals from the transmission antenna.

Said receivers can be turned on all the time during the operation of the CT equipment. In this way, the control for turning the receivers on/off can be simplified.

Preferably, said receivers are turned on when the transmission antenna passes them and turned off when the transmission antenna is not passing over them. By controlling the switching of the receivers on and off, the electrical energy consumed by the receivers can be saved.

Also provided in the embodiments of the present invention is a flexible way for control, so as to control the switching of the receivers on and off, for example, said receivers are turned on or off according to the control of the image reconstruction system, or turned on or off

according to a preset time.

Also provided in the embodiments of the present invention is a piece of CT equipment, with said CT equipment including a data slip ring system as described above. Due to the use of the data slip ring system described above, the cost of the entire CT equipment will also be reduced correspondingly, and at the same time electromagnetic interference in the CT equipment will also be reduced.

Description of the accompanying drawings

In order to make the above-described and other features and advantages of the present invention more apparent to those skilled in the art, preferred embodiments of the present invention will be described in detail hereinbelow by referring to the accompanying drawings, in which:

Fig. 1 is a schematic diagram of a data slip ring system according to one embodiment of the present invention.

Figs. 2 and 3 are schematic diagrams of a data slip ring system according to another embodiment of the present invention, wherein a first receiver in Fig. 2 receives the data signals and a second receiver in Fig. 3 receives the data signals.

Fig. 4 is a schematic diagram of a data slip ring system according to yet another embodiment of the present invention.

In the drawings, the reference numerals are as follows:

10 rotary part
12 data management system
14 transmission line
16, 18 transmission antenna
20, 22 resistors
24 ground terminal
26 first receiver
28 second receiver
30 transmission line

32 transmission line
34 transmission line
36 image reconstruction system
38 first receiver
40 second receiver
42 third receiver
44 transmission line
46 transmission line
48 transmission line
50 transmission line

Particular embodiments

In order to make the object, technical solutions and advantages of the present invention more apparent, the present invention will be further described in detail below by way of embodiments.

Fig. 1 shows schematically a data slip ring system according to one embodiment of the present invention. The data slip ring system is for use in the rack of CT equipment, with the rack of the CT equipment including a rotary part 10 and a stationary part. The rotary part 10 is provided with a data management system (DMS); and the stationary part is provided with an image reconstruction system (IRS) 36.

The data slip ring system comprises a transmission antenna 16 and 18 and a plurality of receivers 26 and 28, such as a first receiver 26 and a second receiver 28. The transmission antenna 16 and 18 is arranged on the rotary part 10 of the rack, deployed along the edge of the rotary part 10, so as to form an arc with a central angle less than 360 degrees. In the embodiment shown in Fig. 1, the transmission antenna 16 and 18 preferably forms an arc with a central angle greater than or equal to 180 degrees; accurately speaking, the arc is slightly greater than 180

degrees, so that it can be coupled to at least one receiver at any time, and the situation of data interruption will not occur, and a maximum saving of material is achieved. The receivers, such as the first receiver 26 and the second receiver 28, are deployed on the stationary part of the rack and they can be deployed at equal intervals. The transmission antenna 16 and 18 sends data signals from the data management system 12 to the receivers 26 and 28 by way of electromagnetic coupling.

Still referring to Fig. 1, during the imaging by the CT equipment, the X-ray tube (not shown in the figure) arranged on the rotary part of the rack emits X-ray beams, which X-ray beams, after passing through an imaging space and an object to be examined therein, are received by the detector array (not shown in the figure) arranged on the rotary part of the rack, and then the detector array sends signals to the data management system 12. The data management system 12 carries out amplification, integration, and analog-digital conversion (conversion from analog signals to digital signals) of the signals from the detector array, and then sends the digital signals to the transmission antenna 16 and 18 via the transmission line 14. One end of the transmission antenna 16 and 18 is connected to the data management system 12 via the transmission line 14, and the other end thereof is connected to the ground terminal 24 via resistors 20 and 22 respectively.

A plurality of receivers 26 and 28 are deployed on the stationary part of the CT rack. The structure as shown in Fig. 1 includes two receivers, i.e. a first receiver 26 and a second receiver 28. The transmission antenna 16 and 18 sends the data signals from the data management system 12 to the first receiver 26 and the second receiver 28 by way of electromagnetic coupling. Then, the first receiver 26 or the second receiver 28 sends the data signals to the image

reconstruction system 36 via the transmission line 30 or 32 respectively.

Furthermore, the data slip ring system also comprises a location detector (not shown in the figure) and a third transmission line 34. The location detector is used for obtaining location information (such as projection angle) of the data management system 12, and sending the location information of the data management system 12 to the image reconstruction system 36 via the third transmission line 34. The image reconstruction system 36 can choose which receiver to receive data signals from, or which receiver to control to receive the current data signals according to the location of the data management system 12.

Figs. 2 and 3 show schematic diagrams of receiving data signals using different receivers.

As shown in Fig. 2, the rotary part 10 of the rack rotates anticlockwise in the X-Y plane; at this moment the projection angle is $\alpha 1$, and the transmission antenna 16 and 18 is entering the range receivable by the first receiver 26. Accordingly, from this moment, the transmission antenna is passing the first receiver 26 and is coupled thereto, and the first receiver 26 receives the data signals from the transmission antenna 16 and 18. The first receiver 26 is turned on when the transmission antenna is passing it (such as from projection angle $\alpha 1$ to $\alpha 2$). Further, the first receiver 26 is turned off when the transmission antenna is not passing it (i.e. when the two are not coupled, such as from projection angle $\alpha 2$ to $\alpha 1$), therefore the power consumption of the first receiver 26 can be reduced.

As shown in Fig. 3, at this moment the projection angle is $\alpha 2$, and the transmission antenna 16 and 18 is entering the range receivable by the second receiver 28. Accordingly,

from this moment, the second receiver 28 receives the data signals from the transmission antenna 16 and 18. The second receiver 28 is turned on when the transmission antenna is passing it (such as from projection angle $\alpha 2$ to $\alpha 1$). Further, the second receiver 28 is turned off when the transmission antenna is not passing it (such as from projection angle $\alpha 1$ to $\alpha 2$), therefore the power consumption of the second receiver 28 can be reduced.

In the embodiments shown in Figs. 2 and 3, the location information (such as projection angle) of the data management system 12 can be obtained by the location detector and provided to the image reconstruction system 36, and the image reconstruction system 36 controls the switching of the first receiver 26 or the second receiver 28 on or off according to the location of the data management system 12, or the image reconstruction system 36 decides to receive the data signals from the first receiver 26 or the second receiver 28 according to the location of the data management system 12.

On the one hand, the first receiver 26 and/or the second receiver 28 can be turned on or off according to the control of the image reconstruction system 36. On the other hand, the first receiver 26 and/or the second receiver 28 can also be turned on or off according to a preset time, wherein the preset time is associated with the location information of the data management system 12; for example, within the time associated with the location information indicating that the transmission antenna 16 and 18 is passing the first receiver 26, the first receiver 26 is set to be turned on, and within the time associated with the location information indicating that the transmission antenna 16 and 18 is not passing the first receiver 26, the first receiver 26 is set to be turned off.

Fig. 4 shows a data slip ring system according to yet another embodiment of the present invention, which data slip ring system comprises three receivers such as a first receiver 38, a second receiver 40 and a third receiver 42, and these three receivers are deployed on the periphery of the stationary part of the rack at equal intervals. In the data slip ring system as shown in Fig. 4, the transmission antenna 16 and 18 forms an arc with a central angle greater than or equal to 120 degrees; accurately speaking, the arc is slightly greater than 120 degrees, so as to ensure that at least one receiver is coupled to the transmission antenna at any time and to achieve the maximum material saving.

The biggest difference between Fig. 4 and Figs. 1 to 3 is that the data slip ring system in Fig. 4 comprises three receivers and the transmission antenna is shortened further, therefore the cost of the transmission antenna and even the cost of the data slip ring system are further reduced.

The content in Fig. 4 which is the same as or similar to that in Figs. 1 to 3 will not be described here redundantly. On the basis of the above explanation of the description, those skilled in the art should know the content which is not specifically described.

According to the embodiments of the present invention, the data slip ring system can comprise a plurality of (it might well be referred to as N, with N being a natural number greater than or equal to 2) receivers and a transmission antenna with a central angle smaller than 360 degrees. Preferably, these N receivers are deployed on the periphery of the stationary part at equal intervals, then correspondingly the transmission antenna forms an arc with a central angle greater than or equal to 360/N degrees.

According to yet another embodiment of the present

invention, a piece of CT equipment comprises the above data slip ring system. Due to the use of the above data slip ring system, the costs of the entire CT equipment will also be reduced correspondingly, and at the same time electromagnetic interference in the CT equipment is also reduced.

Disclosed in the present invention is a data slip ring system for use in the rack of CT equipment, said rack comprising a rotary part and a stationary part, with a data management system provided on the rotary part and an image reconstruction system provided on the stationary part, wherein said data slip ring system comprises a transmission antenna provided on said rotary part and a plurality of receivers provided on said stationary part; said transmission antenna forms an arc with a central angle smaller than 360 degrees, data signals from the data management system are sent to said receivers by way of electromagnetic coupling, and said receivers send the data signals to said image reconstruction system via a transmission line. Also disclosed in the present invention is CT equipment. By way of the above technical solution, in the present invention the cost of the data slip ring system is reduced and electromagnetic interference therein is also reduced.

What are described above are merely preferred embodiments of the present invention, and are not to limit the present invention, and any modifications, equivalent replacements and improvements within the spirit and principles of the present invention should be included in the scope of protection of the present invention.