BREVET CAMÉRA À POSITONS

FICHE N° 1723

Période de fabrication : 1950-1974
Fabricant : Inconnu
Domaines : Santé
Sous-domaines : Médecine nucléaire
Organisme : United States Patent and Trademark Office
Ville :
Modèle :
Matériaux :

Description

Brevet américain
Titre original: "Stereo positron camera for determining the spatial distribution of radioactive material in test body"
Le physicien américain Hal Anger a mis au point le premier prototype de la Gamma Camera, breveté en janvier 1957. Il dépose un second brevet pour un système de détecteurs de radiations qui surveillent la distribution de source radioactive en novembre 1961. Ces deux systèmes associés lui permettront de sortir l'année suivante la première Gamma Camera industrielle "la Pho-Gamma", construite par ANGER & NUCLEAR CHICAGO .
Puis, en 1967, H. Anger dépose le brevet de "Stereo positron camera for determining the spatial distribution of radioactive material in test body", le principe étant que la caméra détecte les particules nucléaires chargées et détermine la distribution spatiale de l'élément radioactif dans le corps humain.

Utilisation

L'appareil détecte les radiations gamma et est utilisée pour repérer les tumeurs cancéreuses.

United States Patent Office

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3,329,814

STEREO POSITRON CAMERA FOR DETERMINING THE SPATIAL DISTRIBUTION OF RADIOACTIVE MATERIAL IN A TEST BODY

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Filed Feb. 23, 1965, Ser. No. 434,725
9 Claims. (Cl. 250—61)

This invention relates to apparatus for detecting charged nuclear particles and more particularly to a positron camera for accurately determining the spatial distribution of radioactive material in the human body and the like.

A prior form of positron camera is described in the periodical "Nucleonics" published by McGraw-Hill Publishing Co., October 1963, volume 21, Number 10, pages 56–59. Such a radiation detecting camera is used, for example, to detect and accurately locate a tumor in a patient. Typically, a positron emitting substance such as Gallium 68 EDTA, which tends to accumulate in certain types of tumors, is introduced into the patient. After the radioactive substance has been accumulated in the tissue of interest, the emitted positrons will give rise to radiations which may be indicative of the location, configuration and other characteristics of the tissue. Specifically, when a positron is annihilated by combining with an electron, two 0.51 million electron volt gamma rays are produced which travel in opposite directions. In the positron camera, gamma ray detectors are disposed on opposite sides of the portion of the patient to be examined to indicate the relative intensity of radioactivity in various portions of the region viewed by the camera. Such an image may provide valuable assistance in diagnosing and treating tumors or other medical conditions in a patient.

The present invention provides superior results relative to prior cameras of this type in that stereoscopic images are formed so that the position of a radioactive region in a patient is accurately determinable in three dimensions. Such stereo images are obtained with a single camera and accompanying decoding system.

It is an object of the present invention to provide an improved radiation detecting camera.

It is another object of the present invention to provide a means for more accurately determining the spatial position and configuration of a radioactive region.

It is another object of the present invention to improve the accuracy of diagnosis for various physiological conditions in a patient.

It is another object of the present invention to produce simultaneous stereo images of a positron releasing substance.

It is another object of the present invention to obtain stereo images of a positron emitting substance conveniently and relatively inexpensively by utilizing a single radiation camera.

The invention will be better understood by reference to the accompanying drawing which is a block circuit diagram of a stereo positron camera with certain structural elements thereof shown schematically.

Before a stereo image is obtained, in a typical usage of the camera a positron emitting substance with an affinity for the type of tissue being investigated is injected into the subject. Arsenic 71 in the form of sodium arsenate, for example, will tend to accumulate in brain tumors, while fluorine 18 will accumulate in bones. After the substance has accumulated in the tissue, the subject is observed by a positron camera as in the present invention. As an example, in the drawing, a portion **11** of the subject is indicated including two small areas **12** and **13** where the positron emitting substance is concentrated. Areas **12** and **13** might typically be spaced apart.

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Considering now the structure of the camera, a thick lead camera housing **14** has an opening **9** across which a disc **16** of scintillation material is disposed. The scintillator **16** faces the subject **11** to intercept gamma rays resulting from annihilation of positrons at areas **12** and **13**. For instance, gamma ray **38** intercepted by the scintillator **16** causes a momentary spot of light **40** therein. A two-dimensional array of phototubes **17** within the camera housing **14** views the scintillator **16**, each phototube producing an output pulse having an amplitude proportional to the quantity of light received. The phototubes **17** may be disposed in any of various configurations for viewing the scintillator **16**. Preferably, however, six phototubes are equally spaced in a circle around a center phototube, as shown in the figure. The electrical output pulses from the phototubes **17** are combined in a resistive mixing network **18** to provide three different camera signals: an X signal and a Y signal each having amplitudes proportional to the corresponding rectangular coordinates of the location of a spot of light in the scintillator **16**, and a summation signal having an amplitude corresponding to the intensity of the light spot. The summation signal thus is proportional to the energy of the intercepted gamma ray. The X position signals are obtained by comparing in the mixing network **18** the amplitudes of the output signals from phototubes on the left side of the array with phototubes on the right side. That is, if a spot of light occurs near one side of the scintillator **16**, the resultant phototube pulses from the nearby phototubes will have a higher amplitude than those further away from the spot of light. Likewise, Y position signals are obtained by comparing signals from phototubes at the front of the array with those at the back. The summation signal is a mixture of the signals from all the phototubes **17**. A typical mixer and phototube array suitable for use in the present invention is shown and described in more detail, including specific mixer circuitry, in the periodical "Review of Scientific Instruments," volume 29, Number 1, January 1958, by Anger, pages 27–33.

The X and Y signals are applied to the X and Y (horizontal and vertical deflection) signal terminals **15** and **20** of an oscilloscope **19** and provide positioning control for the electron beam therein so that a spot of light may be produced on the oscilloscope screen **25** in a position corresponding to the position of the original spot of light on the scintillator **16**.

Apparatus as described above functions as a location detector for a gamma ray. However, it is necessary to derive another signal which in effect provides collimation of the image. The collimation is provided by detecting a portion of the second oppositely-directed gamma rays resulting from the positron annihilations. For this purpose, a pair of spaced apart left and right scintillators **21** and **22**, are disposed on the opposite side of subject **11** and are viewed by collimating photomultiplier tubes **23** and **24** respectively. The positioning of the scintillators **21** and **22** is analogous to the positioning of a pair of eyes, the positioning determining the view points of the resultant stereo images. A gamma ray passing through the left scintillator **21** will cause a light flash therein which is detected by the left photomultiplier tube **23** and an electrical output pulse is produced. Such electrical pulse is applied to a mixer circuit **26** which also receives similarly produced pulses from the right photomultiplier **24**. Ordinarily, a pulse is received from only one of the photomultipliers **23** and **24** at a time. Pulses out of the mixer **26** are applied to a pulse height discriminator **27** which passes only pulses above a pre-set amplitude level, such amplitude level being slightly below the level of an

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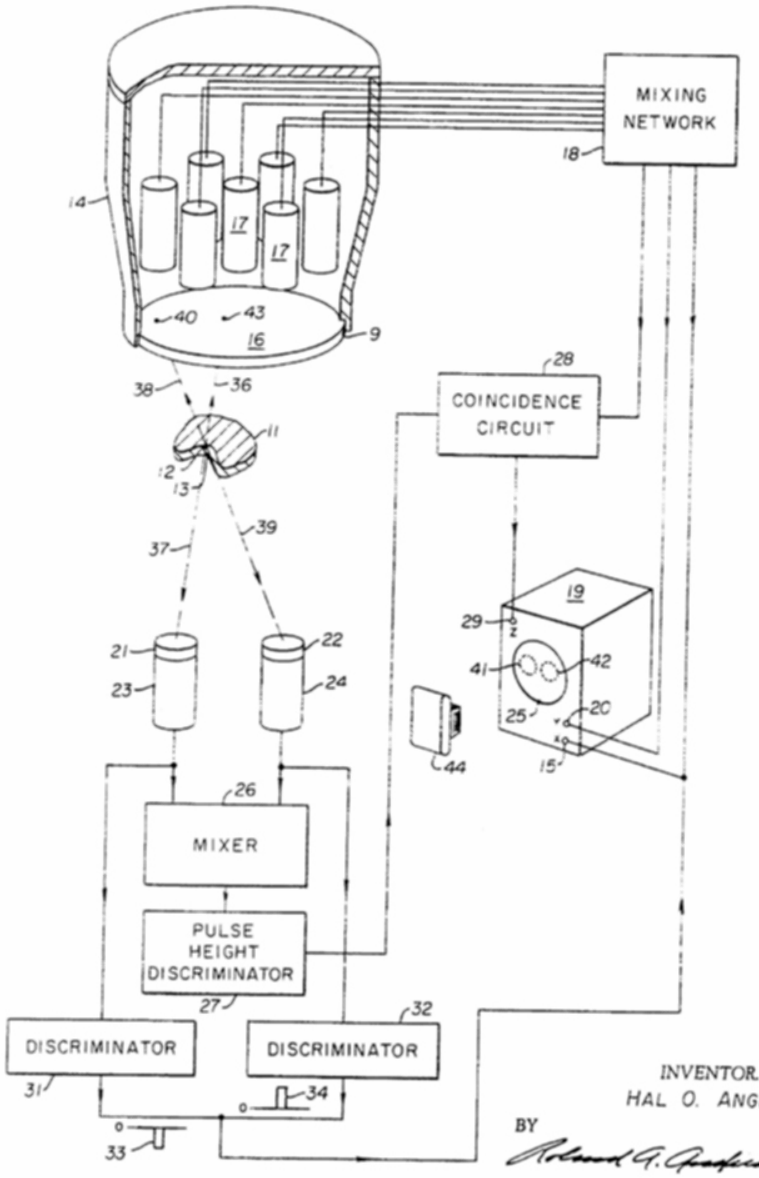

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