

[54] **SCINTILLATION SCANNER WITH REMOTE CONTROL APERTURE**

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[58] Field of Search 250/71.5 S, 71.5 R; 346/107 R; 95/36 R, 12.5; 355/84

[56]

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UNITED STATES PATENTS

R26,014	5/1966	Stickney	250/71.5 S
3,410,189	11/1968	Spokowski	95/12.5

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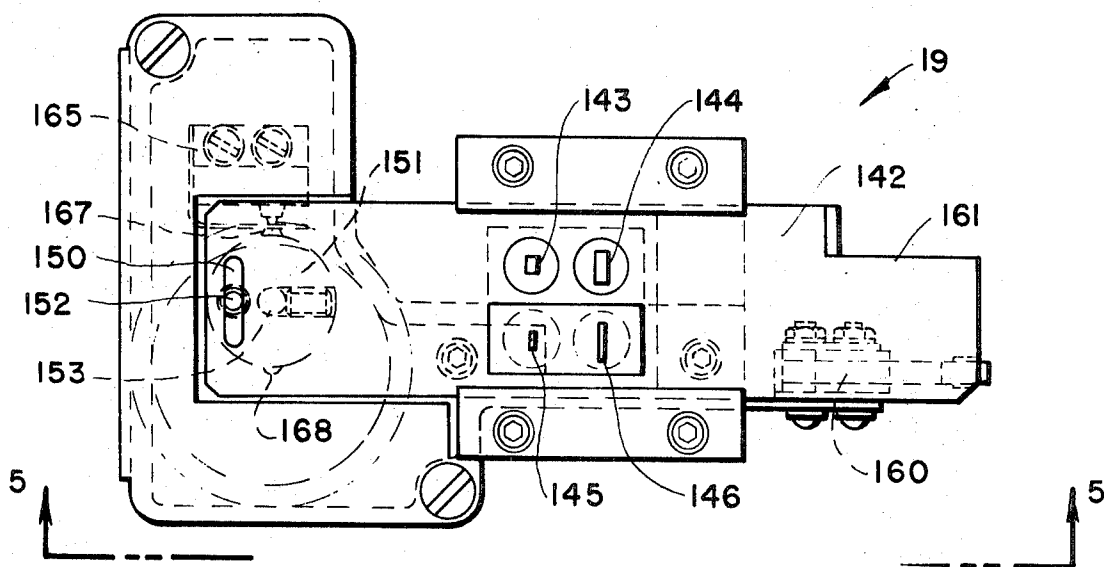
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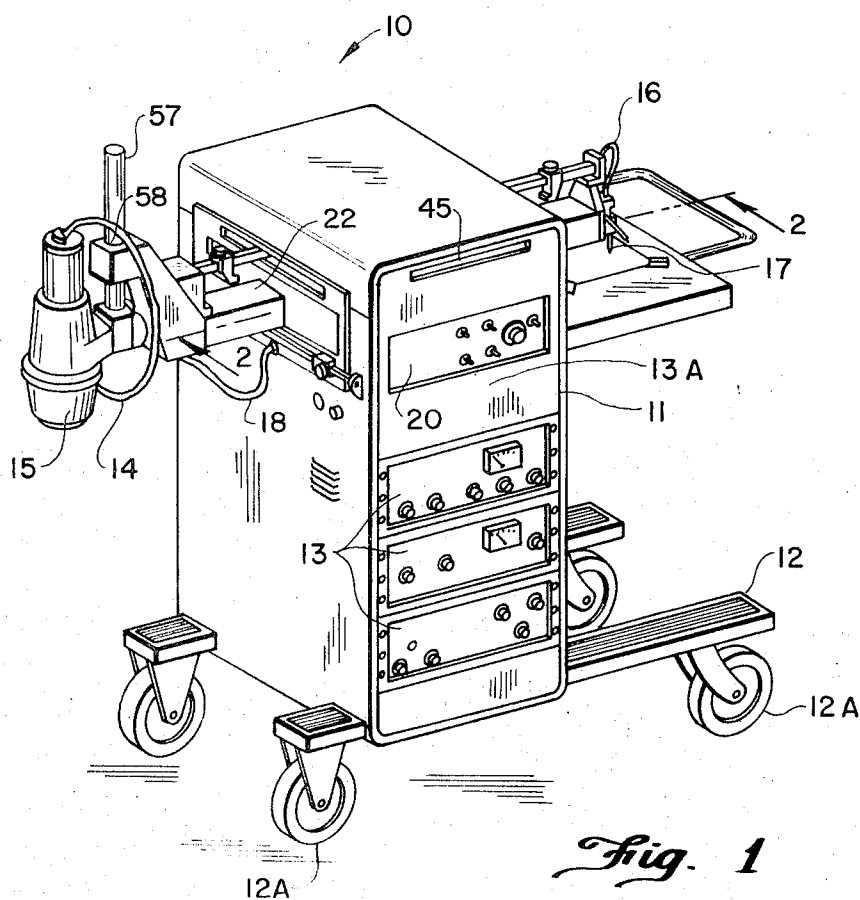
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ABSTRACT

A scintillation scanner having a visual image producing means coupled to the boom which supports the scintillation detector. The image producing means includes a light source for producing a beam of light along a path. An adjustable aperture controls the size of the image produced.

11 Claims, 7 Drawing Figures





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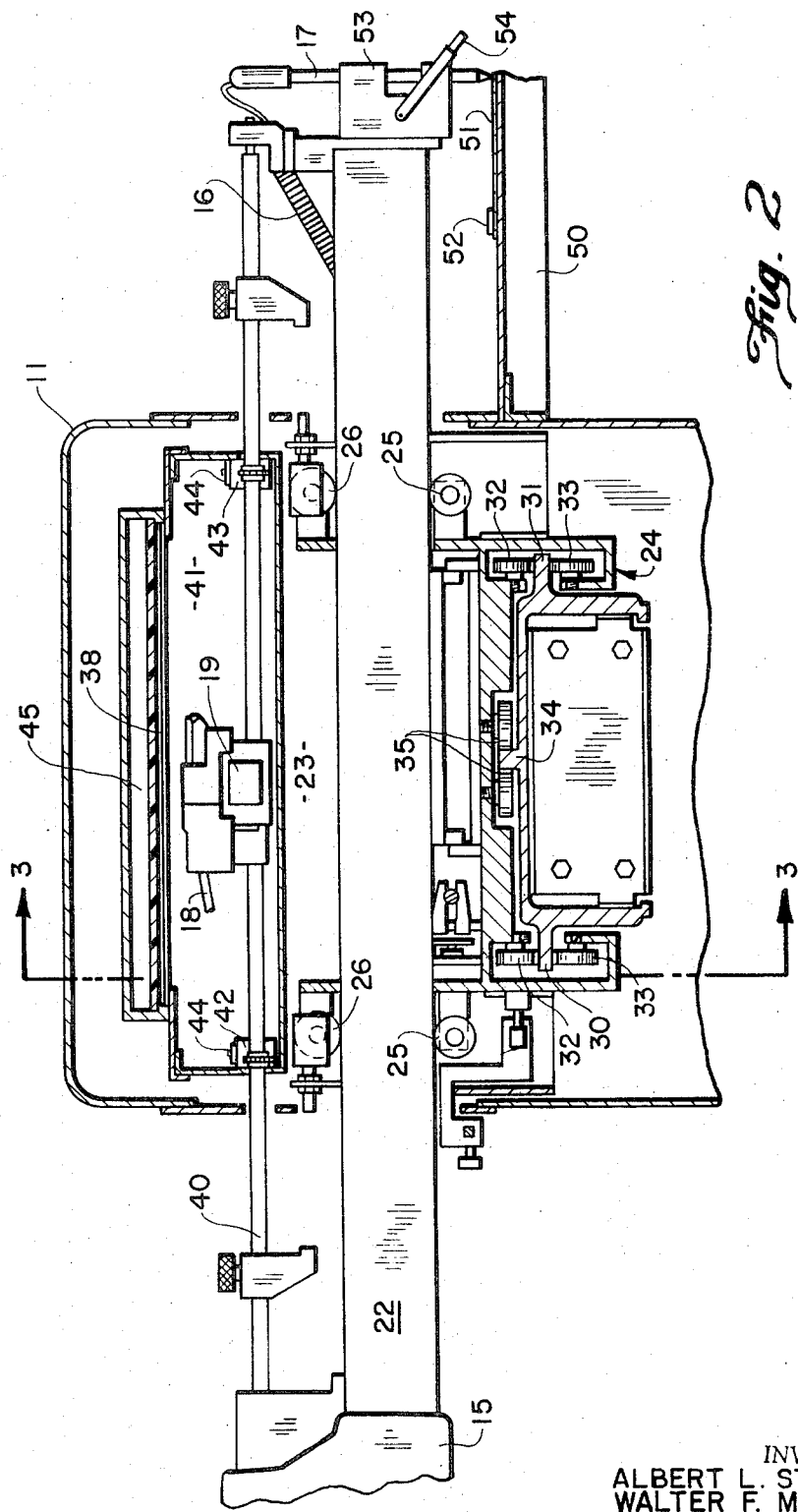


Fig. 2

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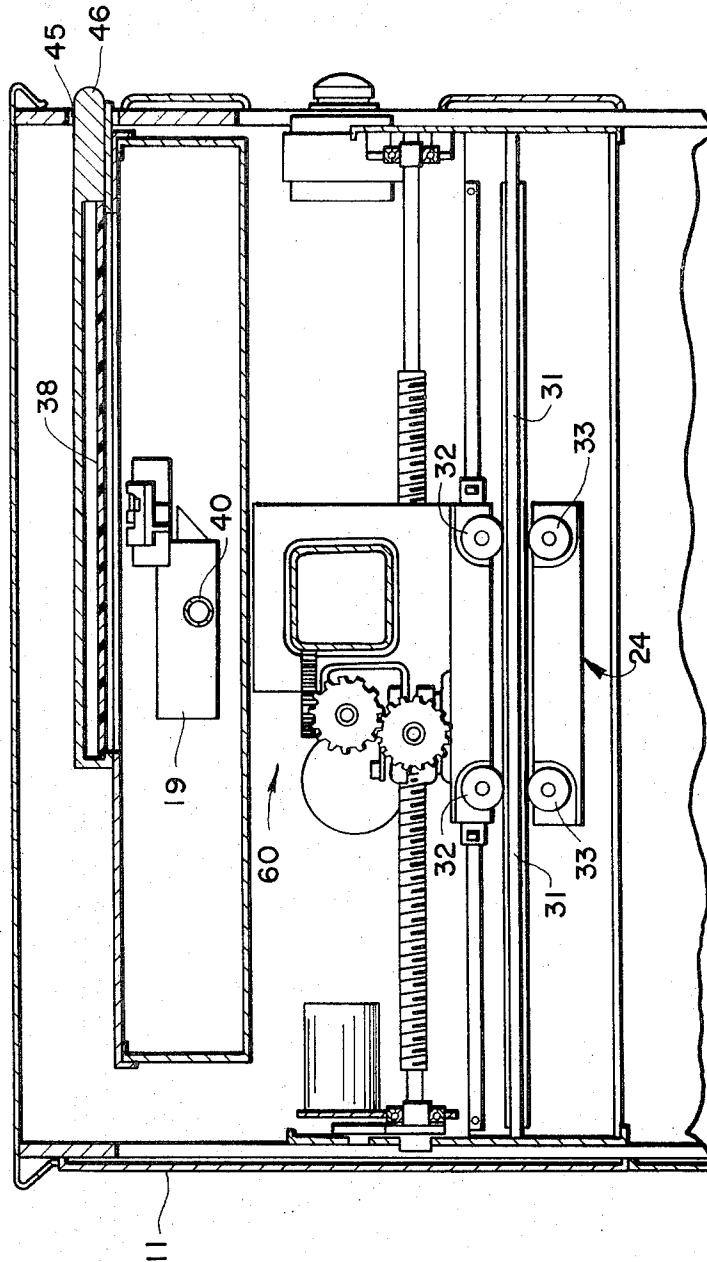


Fig. 3

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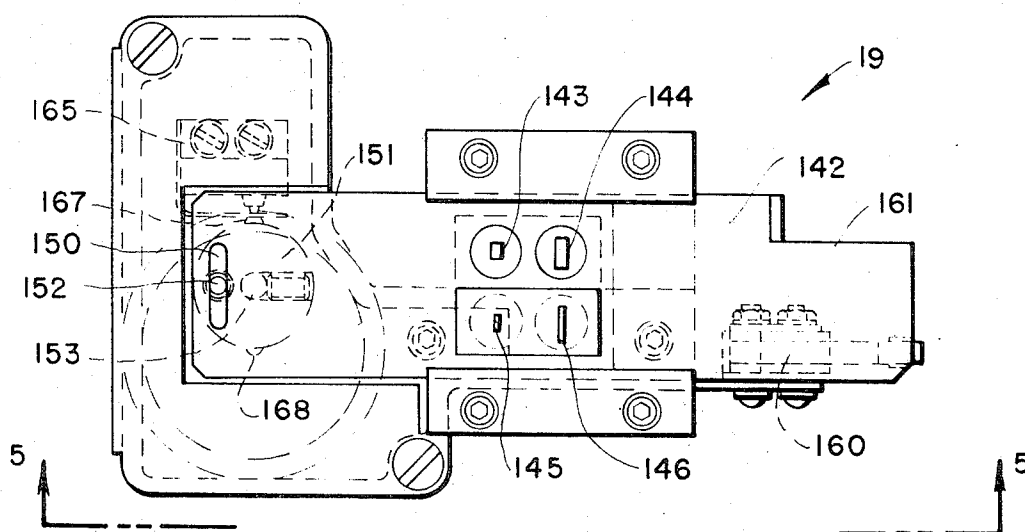


Fig. 4

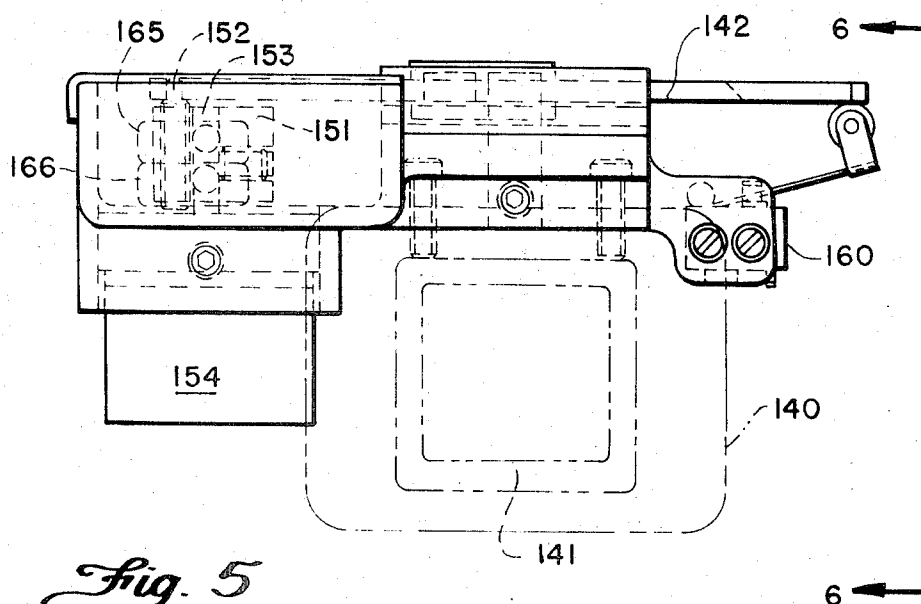


Fig. 5

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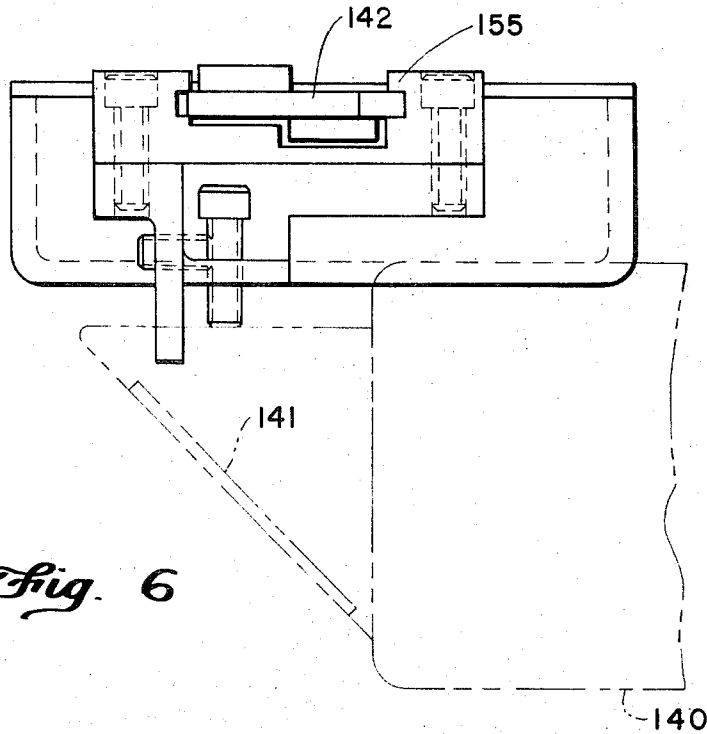


Fig. 6

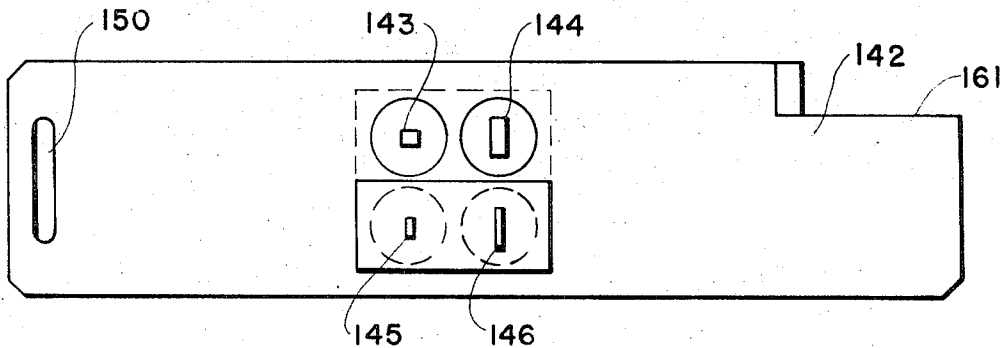


Fig. 7

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SCINTILLATION SCANNER WITH REMOTE CONTROL APERTURE

CROSS REFERENCE TO RELATED APPLICATION AND PATENTS

Scintillation Scanner, U.S. Reissue Pat. No. 26,014, reissued May 3, 1966 to J. B. Stickney et al. on original U.S. Pat. No. 3,070,695 issued Dec. 25, 1962. This patent will be referred to as the "Apparatus Patent."

Scintillation Scanner Photo-Circuit, U.S. Pat. No. 3,159,744 issued Dec. 1, 1964 to J. B. Stickney et al. This patent will be referred to as the "Circuit Patent."

Scintillation Scanner, Ser. No. 149,744 filed concurrently herewith by A. W. Mehrbrodt et al.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a scintillation scanner and more particularly to an improved scintillation scanner including an adjustable aperture for controlling the size of the image produced.

2. Prior Art

In a number of modern medical diagnostic procedures a quantity of radioactive substance is administered to a patient. The distribution of the radioactive substance in the patient's body is then studied. Such studies are useful for many purposes such as locating cancerous tissue and determining the condition of body organs such as the thyroid gland.

Mechanisms known as "scintillation scanners" have commonly been used to conduct such tracer studies. They include a means to move a scintillation probe over an area being studied and a means to provide a graphic reproduction of the activity measured by the probe.

The scintillation scanner of the referenced Apparatus Patent comprises a portable unit which can readily be moved to a patient's bed or other location where a study is to be conducted. The scintillation probe is supported in cantilevered fashion over the patient or other object to be studied. The probe is movable manually to a desired location whereupon its supporting boom is operably connected to an automatic drive to move the probe through a predetermined geographic pattern for a tracer study. The scan is then conducted by moving the probe at a selected speed across a series of parallel paths which are at selected spaced intervals.

A light source and a stylus are carried by the boom and move simultaneously with it. This simultaneous movement permits production of both a dot graphic and a photographic reproduction of the distribution of the isotopes over an area under investigation.

One problem encountered with scintillation scanners is that it is frequently desirable to adjust spacing between the parallel scan paths. When this spacing is increased or decreased, the size of the image produced by the light source on the photographic film, however, has remained the same. This results in either an incomplete or an overlapping image.

SUMMARY OF THE INVENTION

The present invention overcomes the foregoing drawbacks of the prior art through the provision of a scintillation scanner having an adjustable aperture for varying the size of the light image produced.

A movable aperture plate having apertures of various dimensions is provided for varying the size of the light

image produced. The plate has pairs of apertures formed along spaced parallel axes. The plate may be positioned to selectively align the apertures of one pair with the light beam path, or may be manually inverted to selectively align the apertures of the other pair with the light beam path.

A remotely controlled motor is provided for adjusting the aperture plate position. Limit switches engage the aperture plate control mechanism to sense which of the apertures is in alignment with the light beam.

Accordingly, it is the principal object of the present invention to provide a novel and improved scintillation scanner.

Other objects and a fuller understanding of the invention may be had by referring to the following description and claims taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the scintillation scanner;

FIG. 2 is an enlarged sectional elevational view of a portion of the scanner;

FIG. 3 is a sectional view as seen from the plane indicated by the line 3—3 in FIG. 2;

FIG. 4 is a plan view of the light source disposed within the light-tight enclosure of the scanner;

FIG. 5 is an elevational view as seen from the plane indicated by the line 5—5 in FIG. 4;

FIG. 6 is an end elevational view as seen from the plane indicated by the line 6—6 in FIG. 5; and,

FIG. 7, is an enlarged plan view of the aperture plate carried by the light source.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a scintillation scanner is shown generally at 10. The scanner 10 includes a housing 11 supported on a base 12. A plurality of wheels 12a support the base for movement of the scanner.

A plurality of control modules 13 are mounted in the housing and have front panels which are essentially aligned with front wall 13a of the housing 11. The control modules 13 include various operator actuated and adjusted circuits of the scintillation scanner. These circuits include a conductor 14 which transmits impulses from a scintillation probe 15. The impulses are transmitted, monitored, and amplified. The impulses are then transmitted through a conductor 16 to a stylus 17, and through a conductor 18 to a light source 19, as shown in FIG. 2.

There are known circuits which are suitable for this purpose, one of which is shown in the referenced Circuit Patent. These circuits do not form a part of the present invention and accordingly are not described in detail here.

A control panel 20 is provided in the upper front wall portion of the housing 11. This control panel 20 includes various operator controlled devices for selectively controlling the movement of the probe 15 during a study. These devices will subsequently be described in greater detail.

Referring to FIG. 2, a boom 22 is supported in a space 23 in the upper portion of the housing 11. The boom 22 supports the scintillation probe 15, the stylus 17, and the light source 19. The boom 22 is supported by a transverse carriage 24. The boom 22 is movable

reciprocally along a longitudinal path relative to the carriage 24 and the housing 11. The boom 22 is supported for such reciprocal travel by spaced pairs of rollers 25 which are rotatably supported at the front and rear of the carriage 24. Upper guide rollers 26 are similarly provided at the front and rear of the carriage 24 to coact with the vertical support rollers 25 in vertically positioning the boom 22. Spaced side rollers, not shown, are also similarly mounted on the carriage 24 to transversely position the boom 22 against shifting in a horizontal direction.

The carriage 24, in turn, is supported on front and rear guide tracks 30, 31 for rectilinear travel along a path which is transverse to the path of longitudinal boom travel. Since the boom 22 is carried by the carriage 24, the boom will move transversely with the carriage. The guide tracks 30, 31 form a part of the frame structure of housing 11. A plurality of spaced carriage support rollers 32 and a plurality of coacting carriage positioning rollers 33 support and position the carriage on the guide tracks 30, 31. A central horizontal positioning track 34 also forms a part of the frame of housing 11. A plurality of horizontal positioning rollers 35 are mounted on the carriage 24 to engage the track 34 and horizontally position the carriage.

A light source support 40 is carried by the boom 22 and forms a part of it. The light source support 40 extends through a light-tight region 41 formed in the housing 11. The light source 19 is carried by the support 40 and is positioned within the light-tight region 41.

A pair of constant tension coil springs 42, 43 are carried at the front and the rear of the housing and extend across access apertures to the light-tight region 41. Suitable springs are sold under the trademark "Negator" by the Hunter Spring Company. The light source support 40 projects through apertures in the Negator springs 42, 43. The ends of the Negator springs are carried on spaced rotatable coils 44 which are mounted at either end of each light-tight region access aperture. The springs 42, 43 move back and forth with the light source support 40 coiling and uncoiling on the reels 44 to maintain the region 41 light-tight.

A suitable film access slot 45 is provided through the front wall of the housing 11 to permit the insertion of a photographic film holder 46, shown in FIG. 3. The film holder 46 positions a sheet of photographic film 38 for exposure by the light source 19 when a scan is being conducted, as will subsequently be described in greater detail.

A graph support 50 projects laterally of the housing 11 beneath the stylus end of the boom 22 to hold a sheet of graph paper 51. The sheet of paper 51 is of a type which silently records a graphic visual image when an electric charge is passed through the stylus 17 to burn a dot into the paper. One such paper is known as Teledeltos paper and sold by the Western Union Company. The paper 51 is held in position by a plurality of magnets 52.

The stylus 17 is carried by a stylus support 53 of electrically insulating material. A stylus positioned member 54 is pivotally mounted on the support 53 and serves to press the stylus 17 against the paper 51.

Referring to FIG. 1, the probe 15 is supported on a support bar 57. The support bar 57 projects through an aperture 58 formed at the outer end of the boom 22. A rack and pinion arrangement, now shown, is pro-

vided for elevating and lowering the probe 15 on its support bar 57 relative to the boom 22.

An automatic mechanism indicated generally by the numeral 60 in FIG. 3 is provided for driving the boom 22 in reciprocal paths both longitudinally and transversely. Such a mechanism is described in detail in the referenced Apparatus Patent, and will not be described here.

Suitable indexing control circuitry for causing the boom to reciprocate longitudinally at any of a wide range of selected speeds is shown in the referenced Apparatus Patent. This patent also describes circuitry for transversely indexing the carriage any selected distance within a wide range of distances.

The referenced application filed concurrently herewith discloses and claims an adjustable delay error correction system for delaying the reciprocation of the light support bar 40 relative to the boom 22. Since this adjustable correction system does not form a part of the present invention, it will not be described here in detail.

In accordance with the present invention, the light source 19 is provided with an automatically adjustable aperture for controlling the size of the light image produced on the photographic film 38. Referring to FIGS. 4-6, the light source 19 includes a bulb, not shown, disposed within a housing 140. A mirror 141 directs light from the bulb upwardly toward an aperture plate 142. The aperture plate 142, as is best seen in FIG. 7 is provided with four apertures 143, 144, 145, 146 which may be selectively aligned with the light beam to produce a spot image on the film 38.

The aperture plate 142 is provided with a transverse slot 150 adjacent its left end as viewed in FIGS. 4, 5 and 7. A rotatable disc 151 is provided beneath the slot 150. A pin 152 is carried by the disc 151 and extends upwardly into the slot 150. The disc 151 is mounted on the drive shaft 153 of a motor 154. By this arrangement, the motor 154 may rotate the disc 151. Rotation of the disc will cause the pin 152 to move in the slot 150, thereby effecting movement of the plate 142.

Referring to FIG. 6, the plate 142 is positioned within a slotted guide bracket 155 which defines a path of travel longitudinal of the plate 142. With the disc 151 in the position of FIGS. 5 and 6, the aperture 146 is aligned with the light beam path. Rotation of the disc 151 such that the pin 152 is positioned 180° from the position of FIG. 4 will move the aperture 145 into the light beam path.

In order for the apertures 143, 144 to be positioned in the light beam path, the plate 142 is simply manually inverted. With the plate 142 inverted, the motor 154 may then selectively position either of the apertures 143, 144 in the light beam path.

A limit switch 160 is provided for sensing the orientation of the plate 142. When the plate 142 is positioned for use with the apertures 145, 146, the plate 142 engages the limit switch 160. When, however, the plate 142 is inverted for use with the apertures 143, 144, a notch 161 in the plate 142 assures that the plate 142 will not engage the limit switch 160.

The longitudinal position of the plate 142 is sensed by a pair of limit switches 165, 166, as best seen in FIG. 5. The switches 165, 166 engage the periphery of the disc 151. Raised projections 167, 168 formed on the periphery of the disc 151 serve to actuate one of the switches 165, 166 whenever one of the apertures is

aligned with the light beam path. Hence, by combining the information provided by the light switches 160, 165, 166, it is possible to remotely ascertain exactly which of the apertures 143, 144, 145, 146 is aligned with the light beam path.

It will be understood that the light beam is controlled as described in the referenced Apparatus Patent to project through whichever of the apertures is aligned with the beam path in response to a signal from the detector 15. The light beam thereby serves to form an image on the film 38.

The apertures 143, 144, and 145, 146 are of differing widths in order to provide narrow and wide light signals for use with closely spaced and widely spaced scan paths, respectively. The apertures 143, 144 are of equal thickness in order to provide substantially equal lengths of exposure along the scan path. The apertures 145, 146 are similarly of an equal thickness which is less than the thickness of the apertures 143, 144. By this arrangement, the apertures 143, 144 are better suited for low speed scans while the apertures 145, 146 are better suited for high speed scans.

Although the invention has been described in its preferred form with a certain degree of particularity, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

1. A scintillation scanner comprising:
 - a. a frame structure and a boom structure movably carried by said frame structure;
 - b. signal emitting means carried by said boom structure for producing a signal in response to incident radiation stimuli and including a scintillation producing mechanism for receiving incident radiation stimuli and a signal producing mechanism for providing an output signal in response to scintillations occurring in said scintillation producing mechanism;
 - c. a drive assembly interposed between said structures for effecting relative movement of said structures along a preselected drive path;
 - d. media support means carried by one of said structures and adapted to receive and support an image producing media;
 - e. media stimulating means carried by the other of said structures and operably connected to said signal emitting means for stimulating a media carried by said media support means in response to signals from said signal emitting means;
 - f. said media stimulating means including:
 - i. a light source for projecting a beam of light along a path;
 - ii. beam delineating means positioned in the beam path for delineating the beam perimeter to one of a plurality of preselected dimensional configurations;
 - iii. said beam delineating means comprising an apertured member positioned to intersect the beam path at substantially right angles thereto, and defining a plurality of distinct spaced apertures formed therethrough;
 - iv. said apertures being of different dimensional configurations for delineating the beam perimeter

ter selectively to one of a plurality of preselected dimensional configurations;

- v. said apertured member being movable transversely of the beam path to selectively position said apertures one at a time within the beam path to delineate the beam perimeter; and
 - vi. positioning means coupled to said apertured member for moving said apertured member transversely of the beam path between selected positions wherein selected ones of said apertures are positioned one at a time in the beam path.
2. The scintillation scanner of claim 1 wherein:
 - a. said media stimulating means further includes mounting means mounting said apertured member for movement between first and second positions along a path of movement intersecting the beam path;
 - b. said apertures include first and second apertures of differing dimensional configuration located at spaced positions along said path of movement;
 - c. said first aperture being aligned with the beam path when said apertured member is in said first position; and,
 - d. said second aperture being aligned with the beam path when said apertured member is in said second position.
 3. The scintillation scanner of claim 2 wherein said mounting means confines the movement of said apertured member relative to the beam path to a rectilinear path of movement between said first and second positions.
 4. The scintillation scanner of claim 2 wherein:
 - a. said apertures further include third and fourth spaced apertures, neither of which are brought into alignment with the beam path as said apertured member is moved along said path of movement; and
 - b. said apertured member is repositionable on said mounting means and said mounting means is adapted to movably mount said repositioned apertured member for movement between positions wherein said third and fourth apertures are selectively positioned one at a time in the beam path.
 5. The scintillation scanner of claim 1 wherein selected ones of said apertures differ in dimensional width in directions transverse to the directions of the scan paths defined by said drive path, whereby a substantially complete exposure of said media can be achieved with controlled image overlap regardless of the spacing between adjacent scan paths by selecting an aperture having a dimensional width which corresponds to the particular scan path spacing being used.
 6. The scintillation scanner of claim 1 wherein selected ones of said apertures differ in dimensional length in directions paralleling the direction of the scan paths defined by said drive path, whereby a substantially complete exposure of said media can be achieved with controlled image overlap regardless of the scan speed by selecting an aperture having a dimensional width which is correlated to the scan speed.
 7. In a scintillation scanner of the type including a frame structure, a boom structure movably carried by the frame structure, a drive means interposed between the boom structure and the frame structure for moving the boom structure relative to the frame structure along a drive path including spaced scan paths, a signal emitting means carried by the boom structure for pro-

ducing signals in response to incident radiation stimuli, a media support device carried by one of the structures for receiving and supporting an image producing media, and a media stimulating device carried by the other structure and including a light source operably connected to the signal emitting means for directing a beam of light along a beam path toward a media carried by the media support device to effect exposure of selected portions of the media in response to signals emitted by the signal emitting means, the improvement comprising a beam delineation mechanism interposed between the light source and the media for delineating the dimensional configuration of the beam to one of a plurality of preselected dimensional configurations, said beam delineation mechanism comprising a member having a plurality of distinct spaced apertures formed therethrough, said member being movable relative to the beam path to delineate the beam, selected ones of said apertures when in the beam path having dimensional widths which differ in directions transverse to the direction of the scan path then being traversed, whereby a substantially complete exposure of the media can be made with controlled image overlap regardless of the spacing which is being used between adjacent scan paths, by selecting an aperture having a dimensional width which is correlated to the scan path spacing being used, dimensionally wider apertures being used with wider scan path spacings and dimensionally narrower apertures being used with narrower scan path spacings.

8. In a scintillation scanner of the type including a frame structure, a boom structure movably carried by the frame structure, a drive means interposed between the boom structure and the frame structure for moving the boom structure relative to the frame structure at a desired speed along a drive path including spaced scan paths, a signal emitting means carried by the boom structure for producing signals at constant predetermined intervals of time in response to incident radiation stimuli, a media support device carried by one of the structures for receiving and supporting an image producing media, and a media stimulating device carried by the other structure and including a light source operably connected to the signal emitting means for directing a beam of light along a beam path toward a media carried by the media support device to effect exposure of selected portions of the media in response to signals emitted by the signal emitting means, the improvement comprising a beam delineation mechanism interposed between the light source and the media for delineating the dimensional configuration of the beam to one of a plurality of preselected dimensional configurations, said beam delineation mechanism comprising a member having a plurality of distinct spaced apertures formed therethrough, said member being movable relative to the beam path to selectively position said apertures one at a time in the beam path to deline-

ate the beam, selected ones of said apertures when positioned in the beam path having dimensional lengths which differ in directions paralleling the direction of the scan path then being traversed, whereby a substantially complete exposure of the media can be made with controlled image overlap regardless of the selected scan speed, by selecting an aperture having a dimensional length which is correlated to the scan speed being used, dimensionally longer apertures being used with faster scan speeds and dimensionally shorter apertures being used with slower scan speeds.

9. A scintillation scanning device comprising:

- a. a housing and frame structure;
- b. a scan boom movably supported by said housing and frame structure;
- c. reciprocal drive means carried in said housing and operably connected to said boom to drive said boom reciprocally in a longitudinal scanning path;
- d. transverse drive means carried in said housing and operably connected to said boom to move said boom transversely in a scan indexing path;
- e. scintillation responsive signal emitting means carried by said boom;
- f. an image device support means carried by said boom, said image device support means being adjustably movable relative to said boom in directions paralleling the path of said longitudinal movement of said boom;
- g. visual image record producing means carried by said image device support means;
- h. said visual image device including adjustable means for varying the size of the image produced, comprising an apertured member having at least two groups of distinct spaced apertures formed therethrough and disposed along spaced parallel paths;
- i. said apertures being of different dimensional configurations one from another;
- j. said apertured member being positionable in a first orientation to selectively align the apertures of one group with said light beam, and being positionable in a second orientation to selectively align the apertures of the other group with said light beam.

10. The scintillation scanner of claim 9 wherein the apertures have different dimensional lengths in directions paralleling the scan path but have substantially identical dimensional widths in directions transverse to the scan path, whereby the length of the image produced can be varied without changing the width of the image by selecting different ones of the apertures within a group for alignment with the beam path.

11. The scintillation scanner of claim 10 wherein the apertures of one group are dimensionally wider in directions transverse to the scan path than are the apertures of the other group.

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