

May 27, 1958

J. L. SNARR ET AL

2,836,729

BEAM THERAPY DIAPHRAGM

Filed Sept. 24, 1956

5 Sheets-Sheet 1

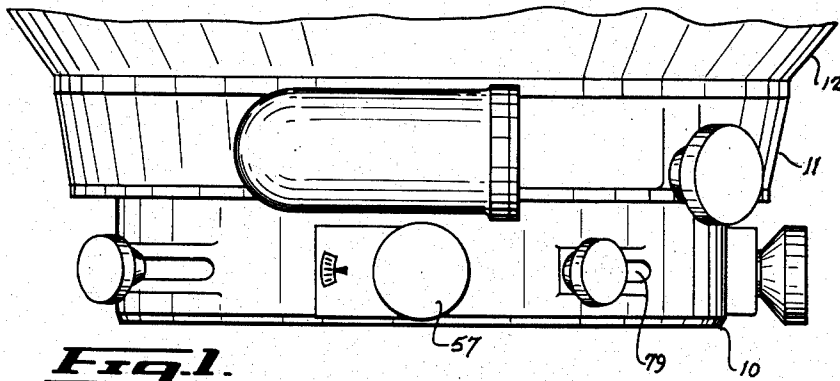


Fig. 1.

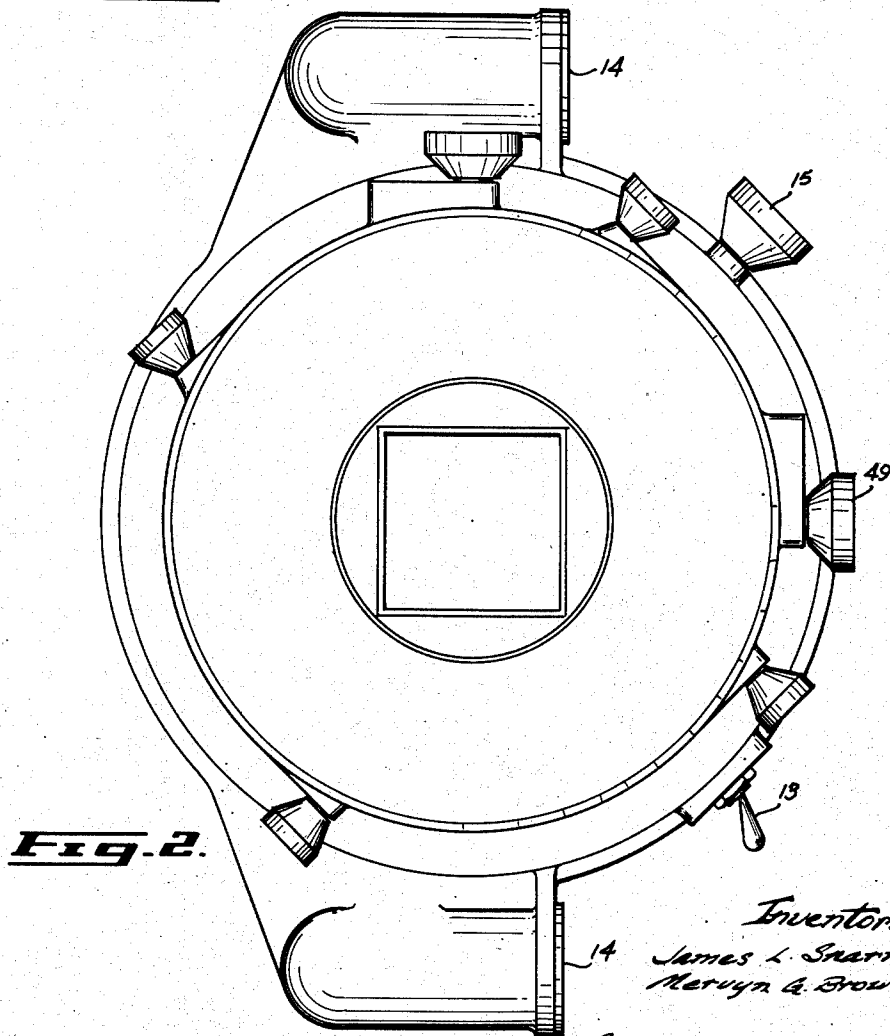


Fig. 2.

Inventors
James L. Snarr
Mervyn G. Brown

By *Bailey Stephens & Hurling*
Attorneys

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5 Sheets-Sheet 2

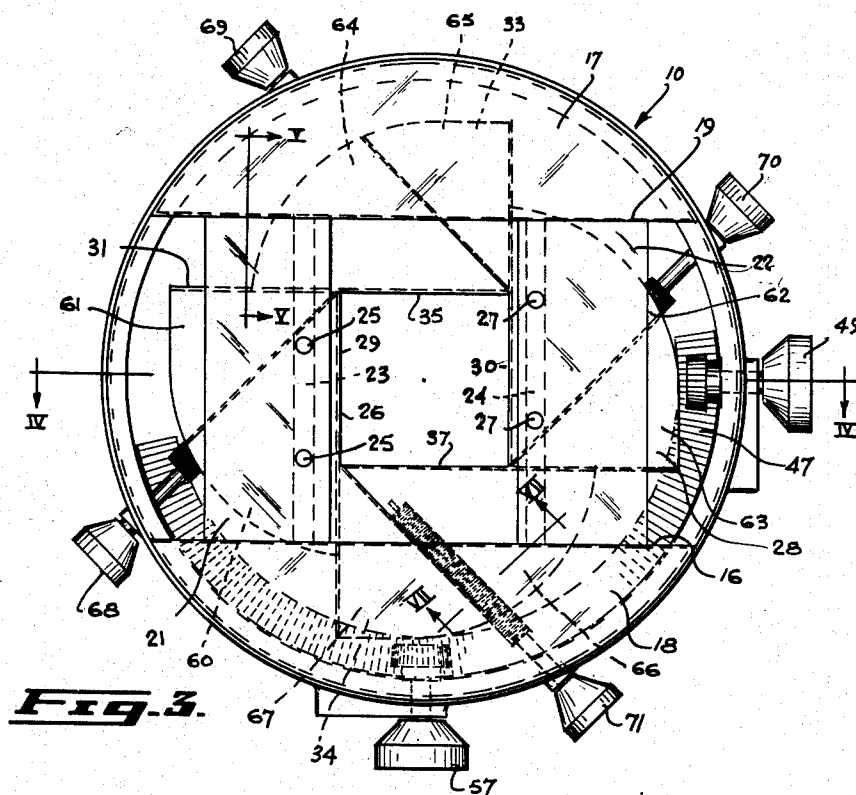


Fig. 3.

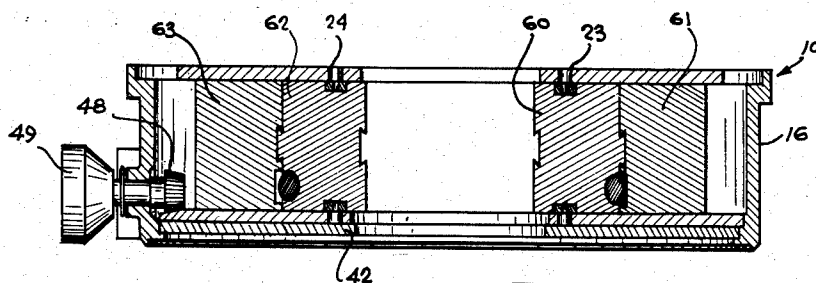


Fig. 4.



Fig. 5.

Inventors:
James L. Snarr
Mervyn C. Brown
By: *Barry Stephens & Co.*
Attorneys

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5 Sheets-Sheet 3

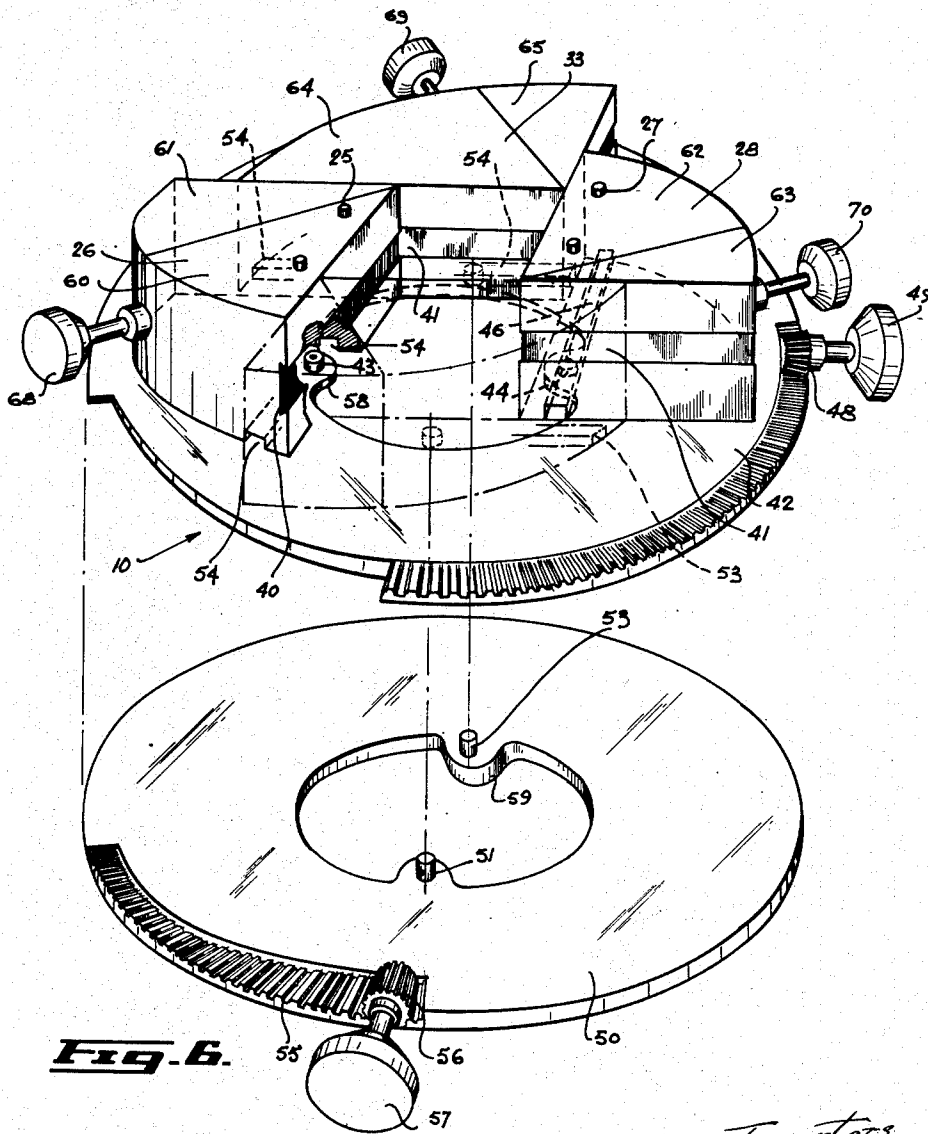


Fig. 6.

Inventors
James L. Snarr
Mervyn G. Brown
By Bailey Stephens Huntley
Attorneys

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BEAM THERAPY DIAPHRAGM

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5 Sheets-Sheet 4

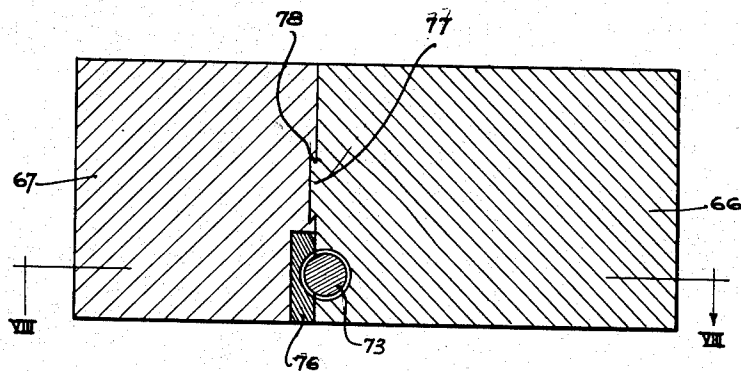


Fig. 1.

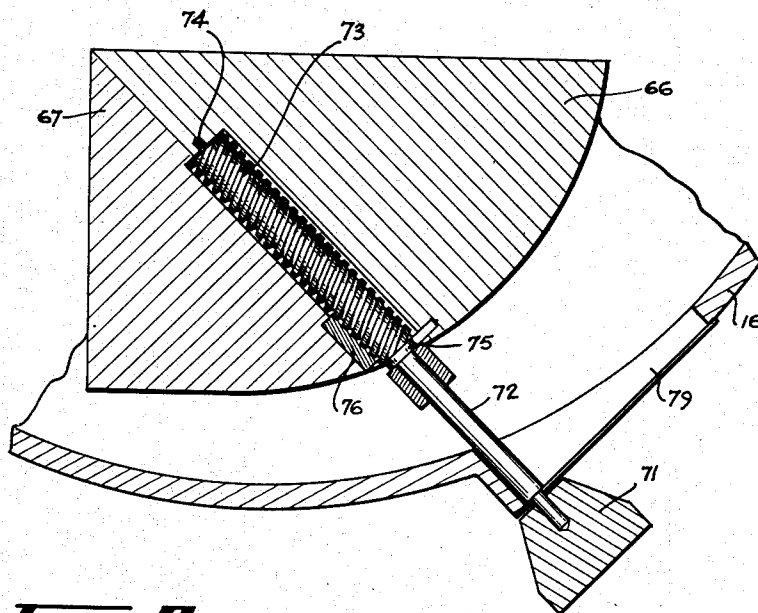


Fig. 2.

Inventors
James L. Snarr
Mervyn G. Brown
By: Bailey, Stephens & Pettig
Attorneys

May 27, 1958

J. L. SNARR ET AL

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5 Sheets-Sheet 5

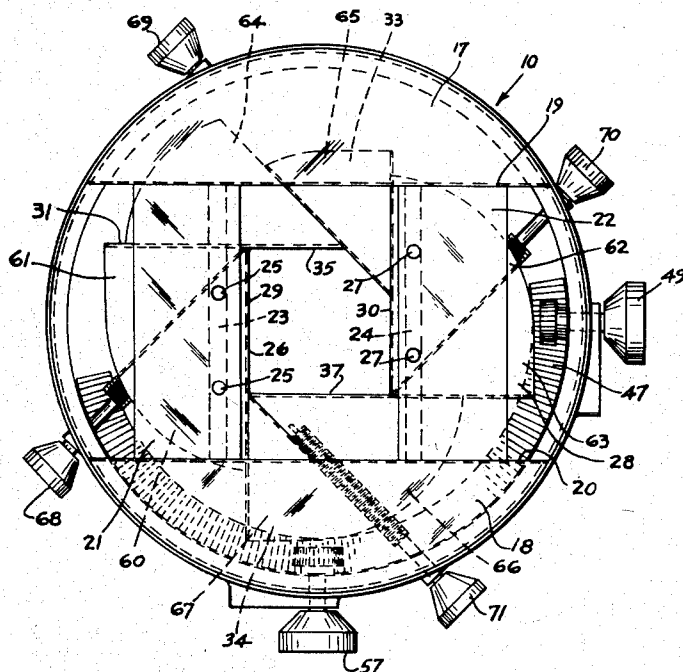


Fig. 9.

James L. Snare
Mervyn G. Brown
Inventors

By Bailey, Stephens & Huettig
Attorneys

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BEAM THERAPY DIAPHRAGM

James L. Snarr and Mervyn G. Brown, Ottawa, Ontario, Canada, assignors to Atomic Energy of Canada, Limited, Ottawa, Ontario, Canada, a corporation of Canada

Application September 24, 1956, Serial No. 611,656

Claims priority, application Canada July 18, 1956

5 Claims. (Cl. 250—105)

This invention relates to a collimator and more particularly to a collimator for defining a beam of radiation.

In Canadian Patent 514,793, issued July 19, 1955, for an invention of Donald T. Green and Clifford S. McCole a collimating unit was described in which the beam of radiation was defined by two pairs of blocks movable in a unitary plane which was substantially perpendicular to the axis of the beam of radiation. One end of each of the blocks was in abutment with the side of another block and the blocks of each pair were movable towards and away from each other. This enabled a square or rectangular aperture to be defined by a collimator which occupied little space and gave adequate shielding against radiation from the source of the beam of radiation. The structure described in Canadian Patent 514,793 suffered however from the disadvantage that the aperture had to be in the shape of a four sided figure. Where for example a cancerous growth is being treated it frequently is desirable that the aperture be shaped otherwise than square or rectangularly so as to enable the beam of radiation to conform to the shape of the growth being treated. This enables the beam to be concentrated on the growth being treated without over exposing healthy tissues.

The object of this invention is to provide an improved collimating unit in which at least one and preferably each corner of the basic rectangularly shaped aperture can be cut off to a desired extent thus giving an increased choice of aperture contour. Where each corner can independently be cut off, the aperture can be square, rectangular, five, six, seven or eight sided. Since the extent to which the corners can be cut off varies a wide variety of aperture shapes can be provided. Furthermore an equilateral eight sided figure will closely approximate a circle.

The foregoing object is accomplished by obliquely dividing one of said blocks and preferably each of said blocks along a line extending to the inner face of the last mentioned block at a point adjacent to the abutment of an end of said block with the side of another block to separate said last mentioned block into two segments. One of the segments is advanced or retracted with respect to the other while maintaining sliding engagement. The advancement of said one segment progressively cuts off a corner of the aperture while laterally displacing the other segment.

In the drawings which illustrate the preferred embodiment of this invention:

Figure 1 is an elevation view illustrating a diaphragm in accordance with this invention assembled with a unit containing a light system and a head containing a source of a beam of radiation.

Figure 2 is a bottom plan view corresponding to Figure 1.

Figure 3 is a top plan view of the diaphragm portion of the assembly shown in Figures 1 and 2.

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Figure 4 is a sectional view along the line IV—IV of Figure 3.

Figure 5 is a sectional view along the line V—V of Figure 3.

Figure 6 is a perspective view partially broken away of the diaphragm section.

Figure 7 is a detail sectional view on the line VII—VII of Figure 3.

Figure 8 is a sectional view on the line VIII—VIII of Figure 7.

Figure 9 is a top plan view of the diaphragm portion of the assembly shown in Figure 1 illustrating one of the auxiliary segments in an advanced position.

Referring now to the drawings. Figures 1 and 2. A diaphragm or collimating section 10 is connected by a light system containing unit 11 to a head 12 containing a suitably shielded source (not shown) of radiation. Head 12 can be similar to the corresponding portion of the unit illustrated in Canadian Patent 514,793. Light system containing unit 11 includes a light switch 13 to control lights contained in housings 14. Light system containing unit 11 can also include a field angulation locking knob 15 which in one position permits the entire diaphragm assembly 10 to be rotated about a vertical axis with respect to Figure 1 and in another position locks diaphragm 10. Since the light system containing unit and the treatment head do not form a part of this invention, they will not further be described.

The diaphragm unit 10 is shown in detail in Figures 3 to 8 inclusive and comprises an annularly shaped housing 16 at the upper edge of which is mounted a pair of segment shaped fixed guide plates 17 and 18. The inner edge 19 of fixed guide plate 17 is parallel to the inner edge 20 of fixed guide plate 18. A pair of moving guide plates 21 and 22 are slidably mounted with respect to edges 19 and 20 by means of tongue and groove joints 22. Moving guide plates 21 and 22 each have grooves 23 and 24 respectively to receive a pair of spaced rollers 25 mounted on a collimating block 26. Similarly groove 24 receives rollers 27 mounted on collimating block 28. Moving guide plate 21 moves inwardly and outwardly with block 26 but rollers 25 permit block 26 to move laterally with respect to moving guide plate 21. Similarly block 28 moves inwardly and outwardly with moving guide plate 22 but can be displaced laterally with respect thereto. Blocks 26 and 28 have inner surfaces 29 and 30 which are parallel to each other. Block 26 has an end surface 31 which is at right angles to surface 29 and similarly block 28 has an end surface 32 at right angles to surface 30. A second pair of blocks is provided by blocks 33 and 34. Block 33 has an inner surface 35 abutted by end surface 31 of block 26 and an end surface 36 at right angles to surface 35 and abutting inner surface 30 of block 28. Block 34 has an inner surface 37 abutted by end surface 32 of block 28 and has an end surface 39 at right angles to surface 37 and abutting inner surface 29.

Blocks 26, 28, 33 and 34 are disposed in a unitary plane and are mounted so that each block is capable of lateral movement. When blocks 26 and 28 are moved towards or away from each other, blocks 33 and 34 are displaced laterally. Similarly when blocks 33 and 34 are moved inwardly or outwardly, blocks 26 and 28 are displaced laterally. Interlocking tongue and groove joints are provided at the abutting surfaces 31 and 35, 30 and 36, 32 and 37 and 29 and 39 to permit slidable lateral movement of each block with respect to the block which abuts its inner surface while maintaining abutment between the blocks. For this purpose the inner surface of each of the blocks is provided with a groove 40 engaged by a tongue 41 on the abutting end surfaces.

The blocks are mounted on an upper cam plate 42.

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Cam plate 42 is fitted with rollers 43 and 44 which engage grooves 45 and 46 respectively in blocks 26 and 28. Upper cam plate 42 includes a peripheral rack 47 engaged by pinion 48. Pinion 48 is controlled by upper cam plate turning knob 49. When upper cam plate turning knob 49 is turned, cam plate 42 is rotated and rollers 43 and 44 cause blocks 26 and 28 to be moved towards or away from each other depending on the direction of rotation of knob 49. Lower cam plate 50 is provided with rollers 51 and 52 which engage groove 53 in block 34 and groove 54 in block 33. Lower cam plate 50 has a peripheral rack 55 controlled by pinion 56 and lower cam plate turning knob 57. Rotation of knob 57 moves blocks 33 and 34 towards or away from each other depending on the direction of rotation. The rollers or cam bearings 43, 44, 51 and 52 should be mounted on inwardly directed ears such as ears 58 and 59. This prevents the cam plates from encroaching on the beam emitting aperture and also permits the rollers mounted on the lower cam plate to operate blocks 34 and 35 without interference from the upper cam plate.

Each of blocks 26, 28, 34 and 35 is divided into two segments along an oblique line extending to the junction between the inner and end faces of the block. Thus block 26 is divided into a main segment 60 and an auxiliary segment 61. Block 28 comprises a main segment 62 and an auxiliary segment 63. Block 33 comprises a main segment 64 and an auxiliary segment 65. Block 34 comprises a main segment 66 and an auxiliary segment 67. The auxiliary and main segments are each wedge shaped. Auxiliary field adjusting knob 68 can be rotated to advance auxiliary segment 61 with respect to main segment 60 of block 26. This progressively cuts off the corner between blocks 26 and 33. Similarly auxiliary field adjusting knob 69 advances or retracts auxiliary segment 65 with respect to main segment 64. Auxiliary field adjusting knob 70 advances auxiliary segment 63 with respect to main segment 62 and auxiliary field adjusting knob 71 advances auxiliary segment 66 with respect to main segment 67. As each auxiliary segment is advanced its associated main segment is displaced laterally. This lateral displacement is permitted by the sliding engagement between tongue 41 and groove 40 and by the sliding engagement between the cam plate roller which controls the main segment in question and the cam plate roller engaging groove of the last mentioned main segment.

The manner in which the auxiliary field adjusting knobs operate to advance or withdraw the auxiliary segments is further illustrated in Figures 7 and 8 with respect to the operation of auxiliary field adjusting knob 71. Auxiliary field adjusting knob 71 is mounted on a shaft 72 which carries a screw threaded member 73. Shaft 72 and its associated screw threaded member 73 are mounted on main segment 66 by end bearing 74 and collar 75. A bearing member 76 threadably engaging screw threaded member 73 is mounted on auxiliary segment 67. When auxiliary field adjusting knob 71 is turned auxiliary segment 67 is advanced with respect to main segment 66. The main segment 66 and auxiliary segment 67 are slidably interlocked by a tongue 77 projecting from main segment 66 and engaging a groove 78 in auxiliary segment 67. A slot 79 is provided in casing 16 to accommodate shaft 72 at different positions of block 34.

Figure 9 further illustrates the manner in which advancing the auxiliary segments adjusts the shape of the aperture. In Figure 9, auxiliary segment 61 is shown in an advanced position to define a five-sided aperture. Main segment 60 has been displaced by the advancing of auxiliary segment 61.

We claim:

1. In a collimator for defining a beam of radiation, blocks movable in a unitary plane substantially perpendicular to the axis of the beam of radiation to define an

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aperture for the emission of the beam, said blocks comprising two pairs of blocks, the blocks of each of said pairs being on opposite sides of said aperture, each of said blocks having one end abutted against the side of one block of the other pair of blocks and having its inner face abutted by the other block of the other pair of blocks, means for maintaining the blocks in abutment as aforesaid, mounting means for said blocks permitting movement of said blocks within said unitary plane both in the direction of and in a lateral direction with respect to said aperture, means for increasing or decreasing the distance between one of said pairs of blocks, means for increasing or decreasing the distance between the other of said pairs of blocks, at least one of said blocks being obliquely divided along a line extending to the inner face of the last mentioned block at a point adjacent to the abutment of an end of said block with the side of another block to separate said last mentioned block into two segments, means maintaining said segments in slidable engagement and means for advancing or retracting one of said segments with respect to the other of said segments to change the shape of said aperture.

2. A collimator as in claim 1 in which each of the four blocks of the collimator is divided into two segments.

3. A collimator as in claim 2 in which the means for advancing or retracting one of the segments of each block is operable independently of the means for advancing or retracting the other blocks whereby segments can be adjusted to define the aperture in the shape of a figure having from four to eight inclusive sides.

4. A collimator as in claim 3 in which the means for advancing or retracting one of the segments of each block comprises rotatable screw means extending along the juxtaposed sides of the segments forming a block, said rotatable screw means being journaled on one of said segments and threadably engaging the other of said segments so that rotation of said rotatable screw means advances or retracts one of said segments with respect to the other.

5. In a collimator for defining a beam of radiation eight wedge shaped shielding members disposed and movable in a unitary plane to define a collimating aperture, said wedge shaped members being arranged in pairs comprising a main wedge shaped member and an auxiliary wedge shaped member, the wedge shaped members of each pair being arranged so that one wedge defining side of the main wedge shaped member is juxtaposed to one wedge defining side of the auxiliary wedge shaped member and the second wedge defining side of the main wedge shaped member extends at right angles to the second wedge defining side of the auxiliary wedge shaped member, said second wedge defining side of the auxiliary wedge shaped member being juxtaposed to the second wedge defining side of the main wedge shaped member of another pair of wedge shaped members, means for moving each pair of wedge shaped members inwardly or outwardly as a unit to decrease and enlarge respectively said aperture, mounting means for each pair of wedge shaped members to permit one pair of said wedge shaped members to be displaced laterally each time another pair of said wedge shaped members is moved inwardly or outwardly, and means for advancing or withdrawing said auxiliary wedge shaped member relatively to said main wedge shaped member while maintaining one side of each of the last mentioned wedge shaped members juxtaposed, the advancement of said auxiliary wedge shaped member acting to displace its main wedge shaped member laterally and progressively to cut off a corner of said aperture.

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