Dec. 24, 1963 J. D. BREWER 3,115,580

X-RAY COLLIMATOR WITH SHUTTER TRACK AND ACTUATION MEANS ON EACH SIDE OF GUIDE MEANS

Filed Oct. 20, 1960

2 Sheets-Sheet 1

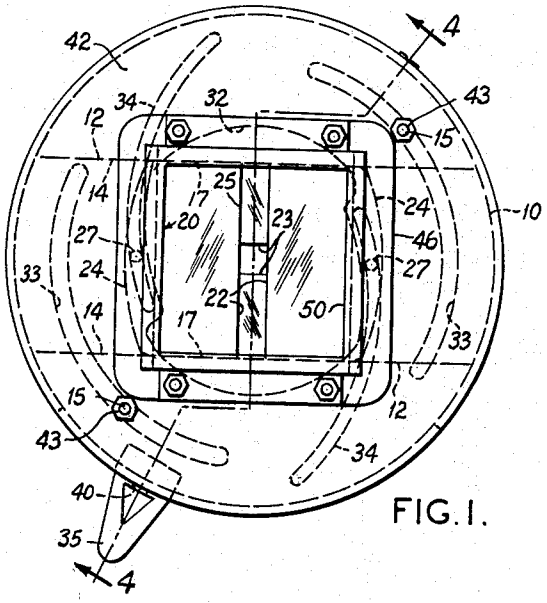


FIG. 1.

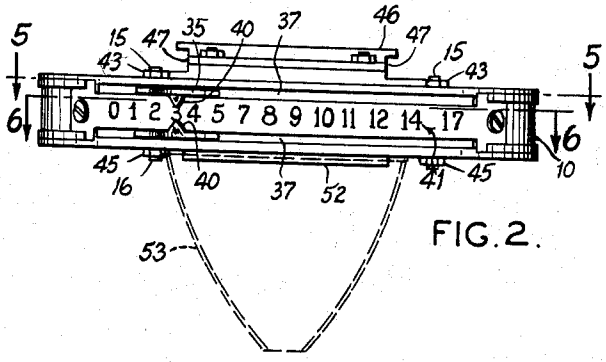


FIG. 2.

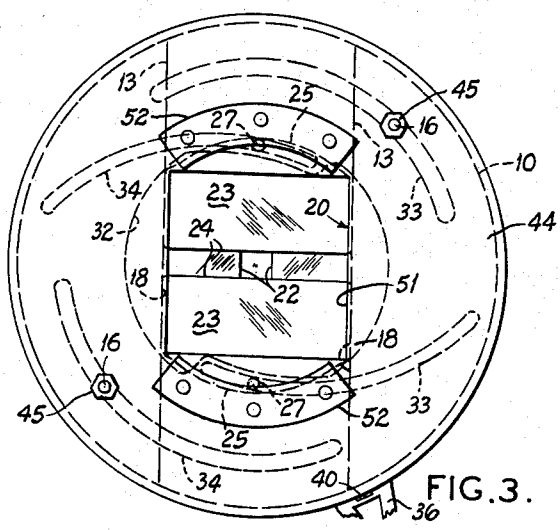


FIG. 3.

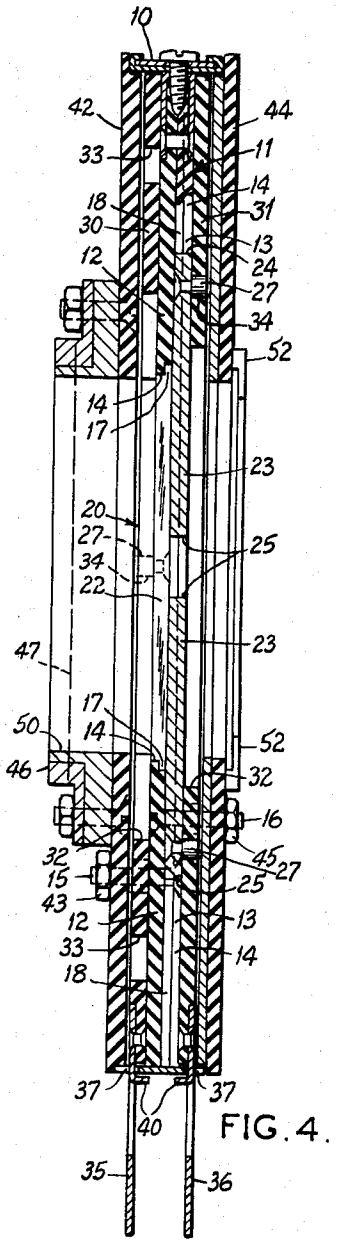


FIG. 4.

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2 Sheets-Sheet 2

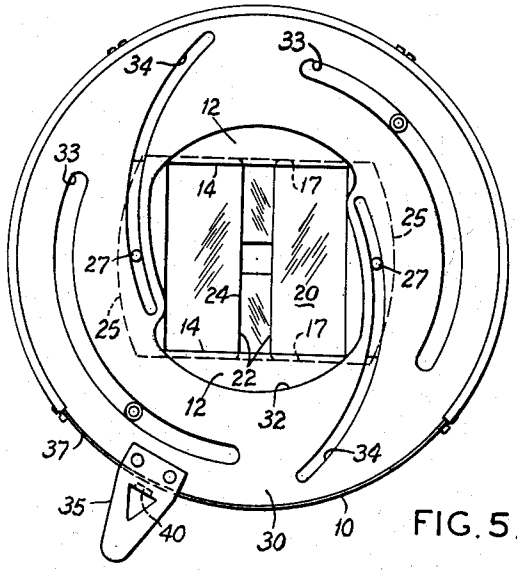


FIG. 5.

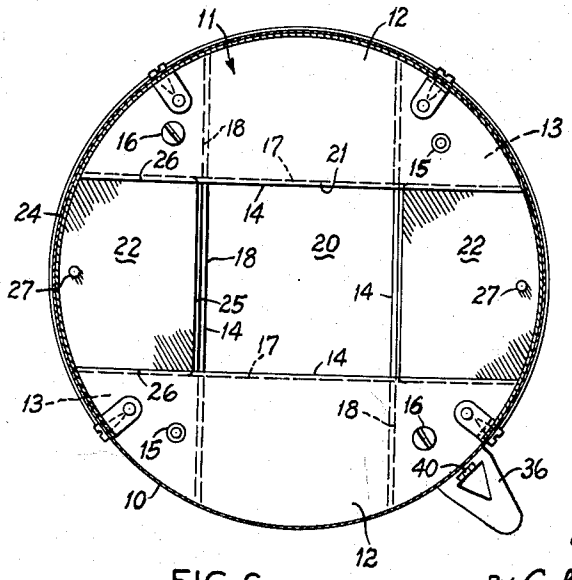


FIG. 6.

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X-RAY COLLIMATOR WITH SHUTTER TRACK AND ACTUATION MEANS ON EACH SIDE OF GUIDE MEANS

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13 Claims. (Cl. 250—105)

This invention relates generally to improvements in a collimator, and more particularly to an improved mechanism for defining a beam of radiation.

The heretofore conventional X-ray collimators were relatively large, bulky and heavy units utilizing an operating mechanism that was complex in nature and consisted of a multiplicity of parts. As a consequence, these units were extremely expensive.

Furthermore, many types of prior collimators used a series of differently shaped and sized cones that had to be selectively attached depending upon the field of radiation desired. This meant that a complete and extensive set of cones had to be maintained, which was not only expensive, but was not entirely satisfactory because all fields of radiation could not be defined. As for example, the fields that fell between those obtained by the particular cone sizes could not be defined. In addition, the selection and placement of the cones in the collimating unit was a time-consuming procedure.

It is an important object of the present invention to provide a collimator, for radiation, the aperture of which can be infinitely varied through a wide range of square and rectangular shapes.

An important object is achieved by constructing the collimator of relatively few parts to provide a small, compact and light-weight unit that is inexpensive to manufacture and which can be readily held and carried by the operator.

Another important object is realized by providing a collimator of a type that eliminates the use and need of cones, thereby affording a considerably economy in initial cost and in maintenance, as well as reducing the time needed to adapt the machine to a desired radiation field.

Yet another important object is afforded by the provision of a guide plate having a shutter track on each side, the tracks being arranged in right angular relation, and the guide plate being provided with an opening at the intersection of such tracks, by the provision of a pair of shutters slidably disposed in each track, and by the provision of an actuating means on each side of the guide plate operatively connected to the pair of shutters on the same side of the guide plate for moving the shutters toward or away from each other.

Still another important object is realized by the provision of a finger on each shutter which is adapted to interfit a curvilinear slot provided in a cam plate located immediately adjacent and at the same side of the guide plate, the cam plates being rotatively mounted and adapted to actuate the shutters to define the effective radiation beam.

Another important object is realized by the provision of a pair of posts extending outwardly from each side of the guide plate, the posts slidably interfitting arcuate slots formed in the cam plate that is disposed at the same side of the guide plate for constraining the cam plate to rotative movement.

An important object is achieved by the unique structure of the guide plate in providing the shutter tracks and the center opening therethrough. The guide plate consists of four matching arcuate members, each having a straight edge, a first pair of the arcuate members being arranged with their straight edges in spaced parallel relation. The second pair of the arcuate members are disposed over and secured to one side of the first pair. The second pair of arcuate members have their respective straight edges

arranged in spaced parallel relation yet arranged at right angles to the straight edges of the first pair of arcuate members. This structural arrangement provides a shutter track on each side of the guide plate and forms an opening at the intersection of such tracks.

An important objective is to provide an X-ray collimator that is simple and durable in construction, economical to manufacture, efficient in operation and which can be readily operated by the technician with little or no instruction.

The foregoing and numerous other objects and advantages of the invention will more clearly appear from the following detailed description of a preferred embodiment, particularly when considered in connection with the accompanying drawing, in which:

FIG. 1 is a top plan view of the collimator;

FIG. 2 is a front elevational view;

FIG. 3 is a bottom plan view;

FIG. 4 is an enlarged cross sectional view as seen along staggered line 4—4 of FIG. 1;

FIG. 5 is a view as seen along line 5—5 of FIG. 2, and

FIG. 6 is a view, partly in cross section, as seen along line 6—6 of FIG. 2.

Referring now by characters of reference to the drawings, and first to FIGS. 2 and 4, it is seen that the collimating unit includes a peripheral housing 10 that is preferably circular in configuration. Located within and extending across the housing 10 is a guide plate general indicated at 11. Perhaps as is best illustrated in FIGS. 4 and 6, the guide plate 11 consists of four matching arcuate members, one pair of arcuate members being indicated at 12 and the second pair of arcuate members being indicated at 13. Each of the arcuate members 12 and 13 have an arcuate margin adapted to conform with the circular configuration of the peripheral housing 10, and each arcuate member has a straight edge 14.

The first pair of arcuate members 12 are arranged in the same plane with their straight edges 14 in spaced parallel relation. The other pair of arcuate members 13 are disposed below the first pair of arcuate members 12 (as is best seen in FIG. 6) and arranged with their straight edges 14 in spaced parallel relation. It will be noted that the straight edges 14 of the first pair of arcuate members 12 are located in right angular relation to the straight edges 14 of the second pair of arcuate members 13. The arcuate members 12 and 13 are secured to the peripheral housing 10 and are secured together in their overlapping regions by posts 15 and 16.

The spaced edges 14 of the arcuate members 12 and 13 provide a pair of shutter tracks 17 and 18 arranged at right angles. One of the tracks 17 is located at one side of the guide plate 11 while the other track 18 is located at the other side of such guide plate. In addition, the particular structural arrangement of the arcuate members 12 and 13 provide a center opening 20 at the intersection of the shutter tracks 17 and 18. The straight edges 14 are provided with a stepped formation 21 adapted to retain the shutters and permit relative engagement of the shutters when they overlap the center opening 20.

A first pair of shutters 22 are slidably received in track 17 as is best seen in FIG. 6. A second pair of shutters 23 are located in track 18 as is best seen in FIG. 3. Each of the shutters is provided with an arcuate rear wall 24 adapted to conform to and abut the peripheral housing 10, and is provided with a straight front wall 25 that is adapted to form the effective shutter opening. Moreover, the lateral margins 26 of each shutter is provided with a stepped formation adapted to interfit the corresponding stepped formation 21 formed along the straight edges 14.

Extending outwardly from each shutter 22 and 23 is a finger 27 that is gripped by an actuating means to

move the two pairs of shutters 22 and 23 independently toward or away from each other.

The actuating means consists of a pair of cam plates 30 and 31 located on opposite sides of the guide plate 11. The cam plates 30 and 31 are of identical construction best illustrated by cam plate 30 in FIG. 5. For example, the cam plate 30 is circular in configuration and adapted to fit within the peripheral housing 10. Moreover, the cam plate 30 is provided with a center aperture 32 that is aligned with the center opening 20 in guide plate 11. Formed in cam plate 30 are a pair of arcuate slots 33, one such slot being located on each side of the center aperture 32. These arcuate slots 33 are adapted to slidably receive the posts 15 extending outwardly from the guide plate 11. The posts 15 moving along the arcuate slots 33 constrain the cam plate 30 to rotative movement. Of course, the posts 16 extending outwardly from the opposite side of the guide plate 11 are slidably interfitted with similar arcuate slots 33 formed in the opposite cam plate 31.

Each of the cam plates 30 and 31 is provided with a pair of curvilinear slots 34, as is best seen in FIG. 5. One of the curvilinear slots 34 is located on each side of the center aperture 32. The curvilinear slots 34 formed in cam plate 30 are adapted to slidably receive the fingers 27 on one pair of shutters 22. The other pair of curvilinear slots 34 formed in cam plate 31 are adapted to slidably receive the fingers 27 of the other pair of shutters 23 located at the opposite side of the guide plate 11.

Upon rotation of cam plates 30 and 31, the shutter fingers 27 of each pair of shutters respectively associated therewith slide relatively along the curvilinear slots 34 so as to move the associated pair of shutters toward or away from each other. Each pair of shutters 22 and 23 are movable independently from the other pair. Consequently the shutters 22 and 23 can form an aperture for radiation which can be varied infinitely through a wide range of square and rectangular shapes.

An actuating tab 35 is fixed to cam plate 30 and a similar tab 36 is fixed to the opposite cam plate 31. These tabs 35 and 36 extend outwardly through slots 37 formed in the peripheral housing 10. Of course, the tabs 35 and 36 can be advantageously gripped by the technician and manipulated to rotate the cam plates 30 and 31 to positions so as to effect a desired shutter opening for radiation.

To facilitate the selection of the desired shutter aperture, each of the tabs 35 and 36 is provided with a pointer 40 adapted to indicate on a scale 41, provided on the peripheral housing 10 between the peripheral slots 37, the particular shutter aperture preferably in terms of the size of the X-ray plate accommodated or in other words the size of the field of radiation at a predetermined distance from the shutter aperture. For example in FIG. 2 the pointers 40 of tabs 35 and 36 indicate the scale numeral 3. This condition would indicate that the effective size of the radiation field at a predetermined distance from the shutter aperture is three (3) inches by three (3) inches.

Closing the upper end of the peripheral housing 10 is a top closure plate 42 of a compatible circular configuration. The top closure plate 42 is secured in place closely adjacent the top cam plate 30 by a pair of nuts 43 threadedly attached to the posts 15.

A similar closure plate 44 of circular configuration encloses the lower end of peripheral housing 10. As is best seen in FIG. 3, the bottom closure plate 44 is fixed in place by the threaded attachment of nuts 45 to the other pair of posts 16. The bottom closure plate 44 is located closely adjacent the lower cam plate 31.

It will be apparent that the casing provided by the peripheral housing 10 and by the top and bottom closure plates 42 and 44 provide an extremely shallow, compact enclosure for the operating mechanism of the collimator.

The guide plate 11 bridges the peripheral housing 10 substantially medially between the closure plates 42 and 44. A pair of shutters 22 and 23 are located respectively on opposite sides of the guide plate 11, and the operating cam plates 30 and 31 are located respectively on the same side of the guide plate 11 as the shutters with which they are associated. The pointers 40 on the actuating tabs 35 and 36 are structurally related to the scale 41 so as to assure that the cam plates 30 and 31 will be located in proper position when assembled. For example, the side of each cam plate 30 and 31 to be located adjacent the pair of shutters with which it is associated is determined automatically when the pointer 40 of the tab on such cam plate is located in an indicating position on the scale 41.

Attached to the top of the uppermost closure plate 42 is an adaptor member 46. As is conventional, the adaptor unit 46 is provided with an undercut groove 47 on opposite sides adapted to accommodate a coacting member (not shown) on the X-ray unit for detachably fixing the collimator. The adaptor member 46 is provided with a square opening 50 that is aligned with the guide plate opening 20 and the cam plate apertures 32.

Of course, the bottom closure plate 44 is provided with a square opening 51 that is also axially aligned with the adaptor member opening 50. Located on opposite sides of the closure member opening 51 are a pair of arcuate retaining strips 52. These strips are adapted to hold a plastic cone 53 illustrated by broken lines in FIG. 2. The sole purpose of cone 53 is to center the collimator over the area to be X-rayed. Of course, the cone 53 is flexible and can be easily depressed along the sides to selectively remove its rim from under the retaining strips 52, if desired.

The operation and functional advantages of the collimating unit are thought to have become fully apparent from the foregoing detailed description of parts, but for completeness of disclosure such use will be briefly described. It will be assumed that the adaptor member 46 is attached to the X-ray unit, and that the cam plates 30 and 31 are rotatively moved to a position so that the pairs of shutters 22 and 23 are closed. This condition will be indicated by the pointers 40 on tabs 35 and 36 immediately adjacent the scale numeral 0. For convenience, the cone 53 is attached to the retaining strips 52.

The technician centers the collimator over the area to be X-rayed at a predetermined distance. The cone 53 assists the operator in visually centering the device. The shutters must now be located to provide the desired field of radiation. For example, if the desired field of radiation or the desired size of the X-ray plate to be exposed is eight (8) inches by twelve (12) inches, the operator merely moves one tab 35 along slot 37 until its pointer 40 indicates the scale numeral 8. Similarly, the other tab 36 is moved until its pointer 40 indicates the scale numeral 12.

As will be understood, upon movement of the tabs 35 and 36, the cam plates 30 and 31 are respectively rotated within the peripheral housing 10. The cam plate 30 moves one pair of shutters 22 away from each other as the tab pointer 40 moves from the scale numeral 0 to the higher scale numerals. This shutter action is accomplished by the camming action of the shutter fingers 27 along the curvilinear slots 34. A similar adjustment is accomplished by the other cam plate 31 upon rotation. More particularly, the other pair of shutters 23 are moved away from each other upon the camming action of the shutter fingers 27 along the curvilinear slots 34 formed in cam plate 31.

It will be noted that the shutters 22 and 23 overlap and engage each other in the region of the opening 20 formed in the guide plate 11. The shutters are made of lead and because they do contact in overlapping relation, radiation leakage is prevented. The particular construction of the guide plate 11 by the four matching arcuate members 12 and 13 in providing the right angularly related intersecting tracks enable this advantageous functional result.

After the X-ray has been made, the effective shutter opening can be adjusted to any other desired size for another field of radiation by re-adjusting the position of the cam plates **30** and **31** in the manner previously described. When finished with taking of the X-rays, the shutters **22** and **23** are closed by moving the tab pointers back to the scale numeral 0.

Although the invention has been described by making detailed reference to a single preferred embodiment, such detail is to be understood in an instructive, rather than in any restrictive sense, many variants being possible within the scope of the claims hereunto appended.

I claim as my invention:

1. In a simplfied X-ray collimator, guide means providing a shutter track on each side, said tracks being right angularly related, a pair of shutters slidably disposed in each track at each side of the guide means, actuating means on each side of said guide means adjacent the associated pair of shutters at the same side of the guide means, each actuating means being operatively connected to the associated pair of shutters on the same side of the guide means for moving said shutters toward or away from each other.

2. In a simplified X-ray collimator, guide means having a track on each side, said tracks being right angularly related, said guide means being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide means, a cam plate located on each side of said guide means adjacent the associated pair of shutters at the same side of the guide means, each cam plate being operatively connected to the pair of shutters on the same side of the guide means for moving the said pair of shutters toward or away from each other incident to opening and closing said opening.

3. In a simplified X-ray collimator, guide means having a track on each side, said tracks being right angularly related, said guide means being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide means, each shutter having an outwardly extending finger, a cam plate located on each side of said guide means adjacent the associated pair of shutters at the same side of the guide means, each cam plate being provided with a pair of curvilinear slots into which the fingers of the pair of shutters on the same side of the guide means are fitted, said fingers being relatively movable along the slots upon rotation of said cam plate for moving the shutters toward or away from each other incident to closing or opening the guide means opening.

4. In a simplified X-ray collimator, guide means having a track on each side, said tracks being right angularly related, said guide means being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide means, a cam plate located on each side of said guide means adjacent the associated pair of shutters at the same side of the guide means, said cam plates having apertures aligned with the opening in said guide means, a pair of posts attached to each side of said guide means and extending laterally outward, each cam plate being provided with a pair of arcuate slots into which the posts at the same side of the guide means are located for constraining said cam plate to rotative movement, means operatively interconnecting each cam plate with the pair of shutters on the same side of the guide means for moving the shutters toward or away from each other upon rotation of said cam plate.

5. In a simplified X-ray collimator, guide means having a track on each side, said tracks being right angularly related, said guide means being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide means, each shutter having an outwardly extending finger, a cam plate located on each side of said guide means adjacent the associated pair of shutters at the same side of the guide means, said cam plates having apertures aligned with the opening in said guide means, each cam plate being provided with a pair of curvilinear slots into which the fingers of the pair of shutters on the same side of the guide means are interfitted, the curvilinear slots in each cam plate being located on opposite sides of the aperture in said cam plate, a pair of posts attached to each side of said guide means and extending laterally outward, the posts on each side of said guide means being located on opposite sides of the opening therethrough, each cam plate being provided with a pair of arcuate slots in which the posts at the same side of the guide means are located for constraining said cam plates to rotative movement, said fingers of each pair of shutters being relatively movable along said slots upon rotation of their associated cam plate for moving the shutters toward or away from each other.

6. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate being provided with a shutter track on each side, said tracks being right angularly related, said guide plate being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide plate, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each said cam plate having an aperture aligned with said guide plate opening, means operatively constraining the cam plates to rotative movement, means operatively interconnecting each cam plate with the pair of shutters on the same side of the guide plate for moving said shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and closing the end of said peripheral housing.

7. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate consisting of four matching arcuate members, each member having a straight edge, a first pair of said arcuate members being arranged in coplanar relation with their respective straight edges in spaced parallel relation, the second pair of said arcuate members being arranged in coplanar relation and disposed over and secured to one side of said first pair of arcuate members, the second pair of arcuate members having their respective straight edges arranged in spaced parallel relation yet arranged at right angles to the straight edges of the said first pair of arcuate members, said arcuate members providing a track on each side of guide plate, a pair of shutters slidably disposed in each track at each side of the guide plate, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each said cam plate having an aperture aligned with the intersection of said tracks, means operatively interconnecting each cam plate with said guide plate for constraining the cam plate to rotative movement, means operatively interconnecting each cam plate with the pair of shutters on the same side of the guide plate for moving said shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and closing the end of said peripheral housing.

8. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate being provided with a shutter track on each side, said tracks being right angularly related, said guide plate being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of said guide plate, each shutter having an outwardly extending finger, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each cam plate having an aperture aligned with said guide plate opening, means opera-

tively constraining the cam plate to rotative movement, said cam plates being of substantially identical construction, each cam plate being provided with a pair of curvilinear slots into which the fingers of the pair of shutters on the same side of the guide plate are interfitted, said fingers being relatively movable along said slots upon rotation of their associated cam plate for moving the shutters toward or away from each other, a tab on each cam plate extending outwardly of said peripheral housing, and a scale on said housing, said tabs indicating on said scale the effective opening afforded by said shutters.

9. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate being provided with a shutter track on each side, said tracks being right angularly related, said guide plate being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide plate, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each said cam plate having an aperture aligned with said guide plate opening, a pair of posts attached to each side of said guide plate and extending laterally outward, the posts on each side of said guide plate being located on opposite sides of the opening therethrough, each cam plate being provided with a pair of arcuate slots in which the posts at the same side of the guide plate are located for constraining said cam plate to rotative movement, means operatively interconnecting each cam plate with the pair of shutters on the same side of the guide plate for moving said shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and attached to said posts extending through said cam plate, said closure plates enclosing the ends of said peripheral housing.

10. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate consisting of four matching arcuate members, each having a straight edge, a first pair of arcuate members being arranged in coplanar relation with their respective straight edges in spaced parallel relation, the second pair of said arcuate members being arranged in coplanar relation and disposed over and secured to one side of said first pair, the second pair of arcuate members having their respective straight edges arranged in spaced parallel relation yet arranged at right angles to the straight edges of said first pair of arcuate members, said arcuate members providing a track on each side of the guide plate, a pair of shutters slidably disposed in each track at each side of the guide plate, a post at each overlapping portion of said arcuate members, a pair of said posts extending laterally outward from each side of said guide plate, said posts on each side of said guide plate being located on opposite sides of the opening therethrough, a cam plate disposed adjacent the associated pair of shutters at the same side of the guide plate, each cam plate being provided with a pair of arcuate slots in which the posts at the same side of the guide plate are located for constraining said cam plate to rotative movement, means operatively interconnecting each cam plate with the pair of shutters on the same side of the guide plate for moving said shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and secured to said posts extending through said cam plate, said closure plates closing the ends of said peripheral housing.

11. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate consisting of four matching arcuate members, each having a straight edge, a first pair of said arcuate members being arranged in coplanar relation with their respective straight edges in spaced parallel relation, the second pair of said arcuate members being arranged in coplanar relation and disposed over and secured to one side of said first pair, the second pair of arcuate members having their respective straight edges arranged in spaced parallel relation yet arranged at right angles to the straight edges of said first pair of arcuate members, said arcuate members providing a track on each side of the guide plate, a pair of shutters slidably disposed in each track at each side of the guide plate, each shutter having an outwardly extending finger, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, means operatively constraining the cam plates to rotative movement, each cam plate being provided with a pair of curvilinear slots into which the fingers of the pair of shutters on the same side of the guide plate are interfitted, said fingers of each pair of shutters being rotatively movable along said slots on rotation of their associated cam plate for moving the shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and closing the ends of said peripheral housing.

12. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate being provided with a shutter track on each side, said tracks being right angularly related, said guide plate being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of the guide plate, each shutter having an outwardly extending finger, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each said cam plate having an aperture aligned with said guide plate opening, a pair of posts attached to each side of said guide plate and extending laterally outward, the post on each side of said guide plate being located on opposite sides of the opening therethrough, each cam plate being provided with a pair of arcuate slots in which the posts at the same side of the guide plate are located for constraining said cam plate to rotative movement, each cam plate being provided with a pair of curvilinear slots into which the fingers of the pair of shutters on the same side of the guide plate are interfitted, said fingers of each pair of shutters being relatively movable along said slots upon rotation of their associated cam plate for moving the shutters toward or away from each other, and a closure plate disposed on the outside of each cam plate and secured to the posts extending through said cam plate, said closure plates closing the ends of said peripheral housing.

13. In a simplified X-ray collimator, a peripheral housing, a guide plate extending across said housing, said guide plate consisting of four matching arcuate members, each arcuate member having a straight edge, a first pair of said arcuate members being arranged in coplanar relation with their respective straight edges in spaced parallel relation, the second pair of said arcuate members being arranged in coplanar relation and disposed over and secured to one side of said first pair of arcuate members, the second pair of arcuate members having their respective straight edges arranged in spaced parallel relation yet arranged at right angles to the straight edges of said first pair of arcuate members, said arcuate members providing a track on each side of the guide plate, said guide plate being provided with an opening at the intersection of said tracks, a pair of shutters slidably disposed in each track at each side of said guide plate, each shutter having an outwardly extending finger, a cam plate located in said housing and disposed at each side of said guide plate adjacent the associated pair of shutters at the same side of the guide plate, each said cam plate having an aperture aligned with said guide plate opening, a pair of posts attached to each side of said guide plate and extending laterally outward, the posts on each side of said guide plate being located on opposite sides of the opening therethrough, each cam plate being provided with a pair of arcuate slots in which the posts at the same side of the guide plate are located for constraining the cam plate

to rotative movement, each cam plate being provided with a pair of curvilinear slots in which the fingers of the pair of shutters on the same side of the guide plate are interfitted, said fingers of each pair of shutters being relatively movable along said curvilinear slots upon rotation of their associated cam plate for moving the shutters toward or away from each other, a closure plate disposed on the outside of each cam plate and secured to the posts extending through said cam plate, said closure plates closing the ends of said peripheral housing, a tab on each

cam plate extending outwardly of said peripheral housing adapted to rotate said cam plate, and a scale on said housing, said tabs indicating on said scale the effective opening afforded by said shutters.

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