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J. H. THOMPSON
X-RAY BEAM COLUMNATOR

2,806,146

Filed Jan. 12, 1953

2 Sheets-Sheet 1

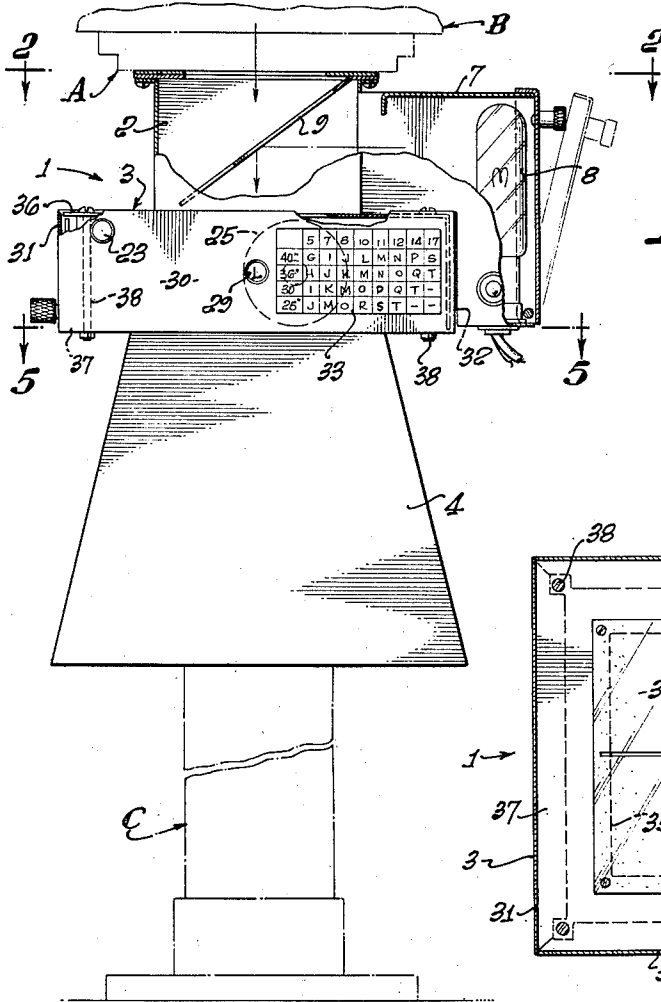


FIG. 1.

FIG. 5.

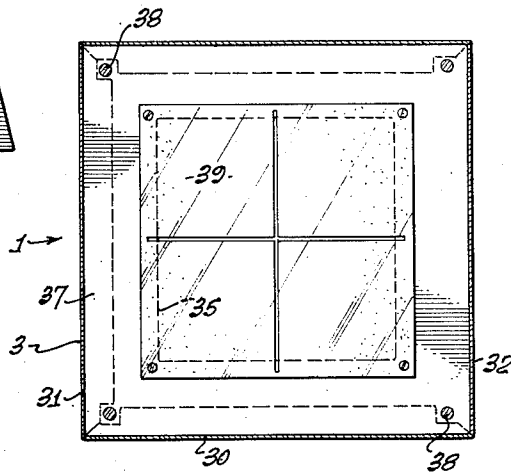
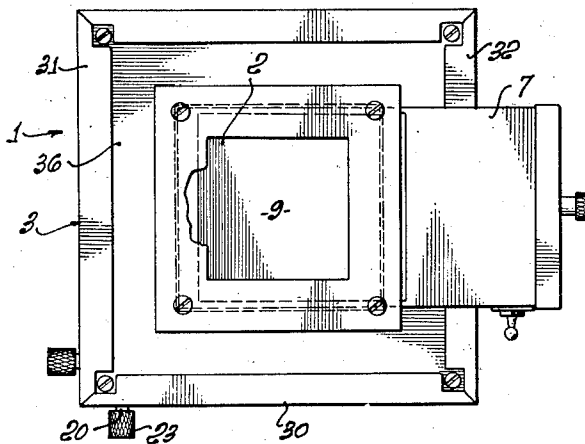


FIG. 2.

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FIG. 3.

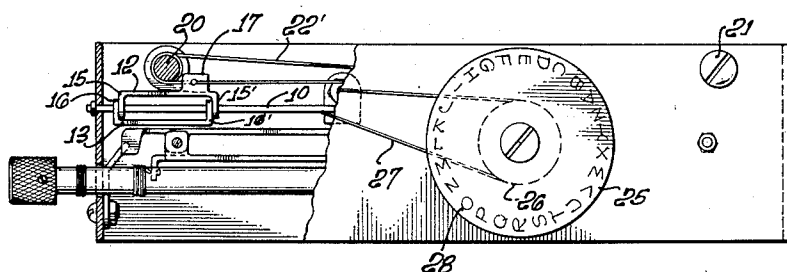
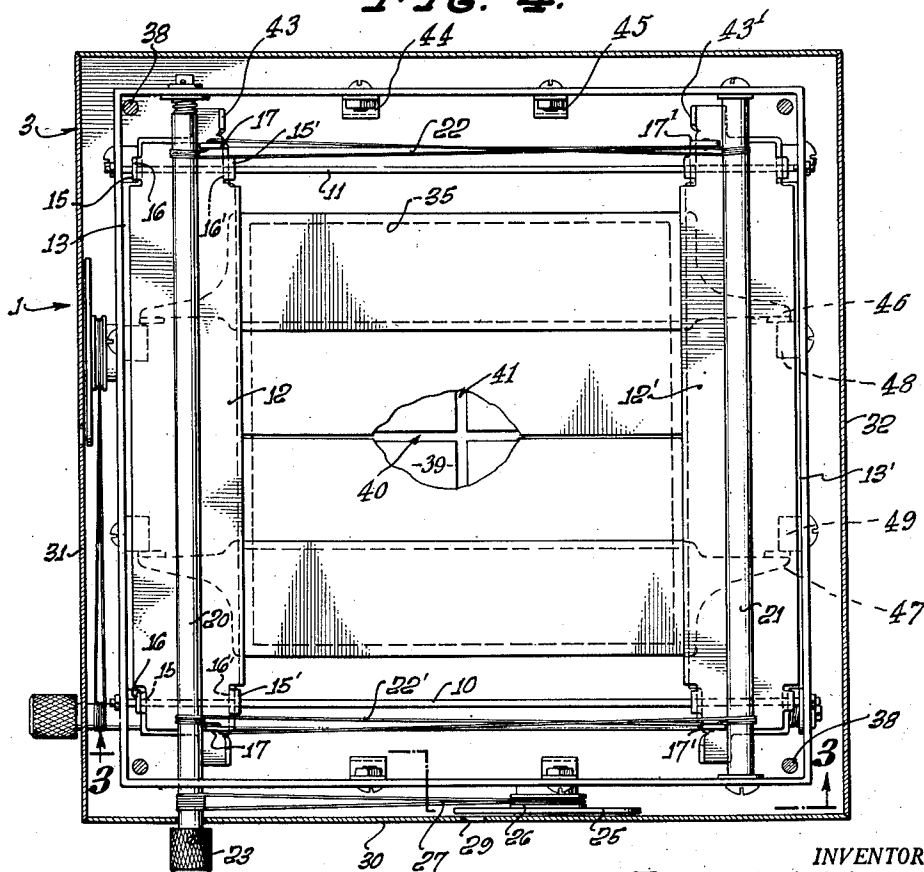


FIG. 4.



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2,806,146

X-RAY BEAM COLUMNATOR

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13 Claims. (Cl. 250-105)

This invention relates to a cone assembly mountable on an X-ray tube stand.

The purpose of the conventional cone assembly is to control the cross-sectional area of an X-ray beam during medical examinations and treatments as well as radiographic exposures. It has been found that in fluoroscopic work it is most essential that the X-ray beam is confined to the exact size and shape required in each case in order to eliminate all danger of injury to both the patient and the person conducting the examination or making the exposures.

It is in view of this the object of the present invention to provide an X-ray cone assembly of novel construction and which is convenient to operate. A further object is to provide within the cone assembly an improved type of shutter or diaphragm mechanism. Another object is to provide means in connection with this shutter mechanism for indicating any desired adjustment thereof in relation to the distance between the X-ray tube and the focal spot or field to be examined or radiographed. Still another object is to provide means in connection with the shutter or diaphragm mechanism for clearly indicating the center of the field to be examined.

Other objects together with the many advantageous features of the invention will become apparent upon perusal of the following detailed description and by referring to the accompanying drawings in which a preferred form of the invention is illustrated.

In the drawings:

Fig. 1 is a side elevational view of a device embodying the invention and with portions thereof broken away for the sake of clearness;

Fig. 2 is a substantially corresponding plan view of the device.

Fig. 3 illustrates portions of the shutter mechanism of the invention as it appears when removed from the cone assembly;

Fig. 4 is a plan view of this shutter mechanism showing parts thereof in fully closed and other parts thereof in fully open position; and

Fig. 5 illustrates elements of the cone assembly which are provided more clearly to define and to centralize the spot or field exposed to the X-ray beam.

The device of the invention, in the form illustrated in the drawings, includes a frame assembly 1 which at the top is suitably attached to the under surface of a conventional support A for an X-ray tube carriage B, such as employed in diagnostic radiology. The support is mounted for vertical adjustment on a suitable floor stand C.

The assembly 1 comprises an upper chamber 2 to the bottom of which a much larger frame 3 is secured. These parts of the framing are both square in horizontal cross-section and they support a cone in the form of a pyramidal guide 4 for directing the emanations from the X-ray tube.

A casing 7 extends horizontally from the chamber 2

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to support therein a light bulb 8 and the rays emanating from this bulb are by a mirror 9 within the chamber 2 deflected through the guide to illuminate a portion of the X-ray field to be diagnosed, as will be hereinafter fully explained.

Within the frame 3 is mounted two series of slides which constitute a manually operable shutter or diaphragm for adjusting the opening through the frame assembly thereby to determine the size and shape of the field. As best shown in Figs. 3 and 4, the two series of slides are set at right angles to each other, one above the other and, as the construction and arrangement of both series may be exactly alike, the following description of the upper series applies equally to the lower series. For the sake of clearness, the upper set of slides are shown in fully open position and the lower set fully closed.

Rods 10, 11 extend transversely across the frame in parallel relation to each other and they are rigidly mounted in position within the frame. The upper series of slides consist, for reasons which will be hereinafter explained, of four metal slats which are arranged to form a pair of upper slide elements 12, 12' and a pair of lower elements 13, 13'. The elements of each pair may be identical in shape and the elements 12, 12' are made with downwardly bent ears 15, 15' which are perforated to ride on the rods 10, 11. The lower elements are similarly provided with upwardly projecting ears 16, 16' which also ride on the rods and it is important to note that the ears 16' of the lower elements take a position between the ears 15, 15' of the upper elements. In addition it is noticed that the upper elements are provided at one side edge thereof with upwardly bent lugs 17, 17' for the purpose which will now be described.

Shafts 20, 21 are hung for rotation within the frame near the side walls thereof, above and parallel with the slide elements, and cords 22, 22' are hung on these shafts near the ends thereof. One end of each cord is fastened to a lug 17 of one element from which it extends around the shaft 21 to return to the shaft 20, about which it is bent, finally to reach the adjacent lugs 17' of the other element. The shaft 20 is extended a distance beyond the wall of the frame to receive on the end thereof a knob 23 which may be manually rotated to move the elements 12, 12' in opposite directions thereby to adjust the width of the opening between these elements of the upper series of slides. It was above stated that the lower series of slides may be, and preferably is, identical with the upper series; also that the lower series is set at right angles to the upper series. In addition, it is now pointed out that two similar shafts and cord connections are added to adjust the lower slide elements in like manner. However, in order to bring the elements of the lower series as close as possible to the upper series of elements, it has been found advantageous to invert the lower series assembly.

On the outer side wall through which the end of the shaft 20 extends is rotatably mounted a dial 25 to the inner surface of which a grooved pulley 26 is secured. A belt in the form of a cord 27 is hung in the groove of the pulley and its extends about the end of the shaft. It follows that rotation of the shaft to adjust the slide elements also imparts rotation to this dial. It should be mentioned that it becomes necessary to wind the belts 22 and 27 a few times about the shafts in order to obtain firm grips thereon. But, of course, more elaborate belt connections may be substituted if preferred.

As indicated in Fig. 3, a series of equidistantly spaced symbols 28 are placed at the periphery of the dial for registration with a window 29 of a cover plate 30 which in any suitable manner is secured in position on the

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front wall of the frame. Similar cover plates 31, 32 are fastened to the side walls of the frame to cover the dials and dial connections and to enhance the appearance of the device. A chart 33 is mounted on the plate 30 at one side of the window 29. This chart is divided horizontally to indicate by the numbers at the left the elevation of the X-ray tube above the field to be radiographed and it is divided vertically to show by the numbers on the upper line of the chart various degrees of opening between the slides which are operatively connected with this dial. The dial is, in Fig. 1, shown rotated to cause the letter L to appear through the window and so to indicate that, at an elevation of 40", the extent of the field in one direction will be 10". The dial of the lower series of slides is similarly rotated to determine the extent of the field in the other direction.

The slides are made in two pieces merely for the purpose of reducing the size of the frame 3. If the slots 12, 12' were made wide enough completely to control the passage through the frame, it is seen that a very much larger frame would be required. But by dividing each slide it is found that, in the fully open position of Fig. 4, the upper element thereby substantially reduces the size of the frame 3. And by placing the ears 16, 16' of the lower element between the ears of the upper element, it is found that the latter will, as it is moved forward, pick up the lower element so that, when the passage for the X-ray beam is reduced to its smallest width, the rest of the opening 35 through pyramidal guide 4, at the upper end thereof will be fully covered.

It is to be understood that the slide element as well as all the inner wall surfaces of the frame assembly should be lined with lead or other X-ray impenetrable substance. It is also found advantageous to provide means for checking the closing movement of the slides. The upper slots of the slides 12, 12' are for this purpose shown made with ears 43, 43' which engage brackets 44, 45 of the casing wall to limit forward movement of the slats. The slats of the lower set of shutter slides are similarly fitted with ears 46, 47 engaging brackets 48, 49 of the casing wall, substantially as indicated in dotted outline in Fig. 4.

The chamber 2 and the pyramidal guide 4 are fitted with flanges 36 and 37, respectively, and bolts 38 extend through these flanges and through the space within the frame 3 rigidly to combine the frame assembly. A translucent plate 39 is placed on the upper surface of the flange 37 and this plate is covered with a substance which checks the rays reflected from the light bulb 8 and a crucial slot 40 is cut centrally through this covered portion of the plate. With this arrangement, it is found that a bright cross will appear on the field clearly to designate the center of the field. This cross-shaped field center illumination has been found a great help to the diagnostician.

I claim:

1. An X-ray cone assembly comprising, a casing, a fluoroscopic shutter mechanism within said casing for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, a manually operable adjusting mechanism for said shutter mechanism, a source of light, a reflector directing the beam from said source of light through the diaphragm opening, and means appearing on the outer surface of the casing and operatively connected with said shutter operating mechanism for indicating the correct setting thereof to produce a required size and shape of diaphragm opening.

2. An X-ray cone assembly comprising, a casing, a fluoroscopic shutter mechanism within said casing for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, a manually operable adjusting mechanism for said shutter mechanism, a source of light, a reflector directing the beam from said source of light through the diaphragm

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opening, a plate having a light impervious coating and transversely seated in the passage through the cone assembly, the impervious coating of the plate being centrally cut to provide a narrow cross-shaped light conducting passage therethrough, and means appearing on the outer surface of the casing and operatively connected with said shutter operating mechanism for indicating the correct setting thereof to produce a required size and shape of diaphragm opening.

3. An X-ray cone assembly comprising, a casing, two sets of rectangular slides combining to form a fluoroscopic shutter mechanism within said casing for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, one set of slides being set at right angles to the other, a manually operable adjusting mechanism for each set of slides, and means appearing on the outer surface of the casing and operatively connected with said slide adjusting mechanisms for indicating the correct operation thereof to produce a required size and shape of diaphragm opening.

4. An X-ray cone assembly comprising, a casing, two sets of rectangular slides combining to form a fluoroscopic shutter mechanism within said casing for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, one set of slides being set at right angles to the other, a manually operable adjusting mechanism for each set of slides, a light bulb, a reflector directing the beam from said light bulb through the diaphragm opening, and means appearing on the outer surface of the casing and operatively connected with said slide adjusting mechanism for indicating the correct operation thereof to produce a required size and shape of diaphragm opening.

5. An X-ray cone assembly comprising, a casing, two sets of rectangular slides combining to form a fluoroscopic shutter mechanism within said casing for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, one set of slides being set at right angles to the other, a manually operable adjusting mechanism for each set of slides, a light bulb, a reflector directing the beam from said light bulb through the diaphragm opening, a plate having a light impervious coating transversely seated in the cone assembly, the impervious coating of said plate being centrally cut to provide a narrow cross-shaped light passage therethrough, and means appearing on the outer surface of the casing and operatively connected with said slide adjusting mechanisms for indicating the correct operation thereof to produce a required size and shape of diaphragm opening.

6. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, the casing walls having windows therein, two sets of slides mounted within said casing and combining to form a fluoroscopic shutter mechanism for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, one set of slides being set at right angles to the other, a manually operable adjusting mechanism for each set of slides, dials within the walls of the casing rotatably connected with said slide adjusting mechanisms, said dials having symbols along the peripheries thereof for registration with said windows, and charts on the outer surface of the casing adjacent the windows thereof denoting the symbols of the dials appearing through the windows representing required sizes and shapes of diaphragm openings relative to variations of cone assembly positions on said stand.

7. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, the casing walls having windows therein, two sets of slides mounted within said casing and combining to form a fluoroscopic shutter mechanism for regulating the size and shape of a diaphragm opening for the passage therethrough of an

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X-ray beam, one set of slides being set at right angles to the other, a light bulb, a mirror within the casing for deflecting rays of light from said bulb through the diaphragm opening, a manually operable adjusting mechanism for each set of slides, dials within the walls of the casing rotatably connected with said slide adjusting mechanisms, said dials having symbols along the peripheries thereof for registration with said windows, and charts on the outer surface of the casing adjacent the windows thereof denoting the symbols of the dials appearing through the windows representing required sizes and shapes of diaphragm openings relative to variations of cone assembly positions on said stand.

8. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, the casing walls having windows therein, two sets of slides mounted within said casing and combining to form a fluoroscopic shutter mechanism for regulating the size and shape of a diaphragm opening for the passage therethrough of an X-ray beam, one set of slides being set at right angles to the other, a light bulb, a mirror within the casing for deflecting rays of light from said bulb through the diaphragm opening, a plate transversely seated in the passage through the cone assembly below the shutter mechanism, said plate having thereon a light impervious coating, the coating being cut to provide a narrow cross-shaped centrally positioned light conducting passage therethrough, a manually operable adjusting mechanism for each set of slides, dials within the walls of the casing rotatably connected with said slide adjusting mechanisms, said dials having symbols along the peripheries thereof for registration with said windows, and charts on the outer surface of the casing adjacent the windows thereof denoting the symbols of the dials appearing through the windows representing required sizes and shapes of diaphragm openings relative to variations of cone assembly positions on said stand.

9. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, two pairs of rods transversely seated in said casing at right angles to each other, two sets of rectangular shutter members hung on said rods to provide a diaphragm opening for an X-ray beam through the cone assembly, a shaft rotatably mounted in the casing parallel with each set of shutter members, one end of each shaft projecting beyond the walls of the casing, belts hung on said shafts and extending to the said members, and knobs on the projecting ends of the shaft for manual rotation of the shafts to move the members on the rods thereby to determine the size and shape of the diaphragm opening.

10. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, two pairs of rods transversely seated in said casing at right angles to each other, two sets of rectangular shutter members hung on said rods to provide a diaphragm opening for an X-ray beam through the cone assembly, each member consisting of a pair of plates having perforated lugs rising from the ends thereof to ride on said rods, one lug at the ends of one plate being positioned between the lugs of the other plate, a shaft rotatably mounted in the casing parallel with each set of shutter members, one end of each shaft projecting beyond the walls of the casing, belts hung on said shafts and extending to the lugs of one of the plates of the said members, and knobs on the projecting ends of the shaft for manual rotation of the shafts to move the members on the rods thereby to determine the size and shape of the diaphragm opening.

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11. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, the casing walls having windows therein, two pairs of rods transversely seated in said casing at right angles to each other, two sets of rectangular shutter members hung on said rods to provide a diaphragm opening for an X-ray beam through the cone assembly, a shaft rotatably mounted in the casing parallel with each set of shutter members, one end of each shaft projecting beyond the walls of the casing, belts hung on said shafts and extending to the said members, dials within the walls of the casing having symbols along the periphery thereof for registration with said windows, charts on the outer surface of the casing walls adjacent the windows thereof denoting the symbols of the dials representing required sizes and shapes of diaphragm openings relative to variations of cone assembly positions on said stand, a belt interconnecting each dial with one of said shafts, and a knob on one end of each shaft, manual rotation of said knobs to set the dials to cause required symbols thereof to appear through the windows imparting sliding movement to the shutter members correspondingly to regulate the size and shape of diaphragm opening.

12. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, a light bulb, a mirror directing light from said bulb through the cone assembly, two pairs of rods transversely seated in said casing at right angles to each other, two sets of rectangular shutter members hung on said rods to provide a diaphragm opening for an X-ray beam through the cone assembly, a shaft rotatably mounted in the casing parallel with each set of shutter members, one end of each shaft projecting beyond the walls of the casing, belts hung on said shafts and extending to the said members, and knobs on the projecting ends of the shaft for manual rotation of the shafts to move the members on the rods thereby to determine the size and shape of the diaphragm opening.

13. An X-ray cone assembly mounted for vertical adjustment on a floor stand, said assembly comprising, a rectangular casing above the cone thereof, a light bulb, a mirror directing light from said bulb through the cone assembly, a plate below said mirror arresting the reflected beam of light, there being a narrow cross-shaped transparent light passage through the plate, two pairs of rods transversely seated in said casing at right angles to each other, two sets of rectangular shutter members hung on said rods to provide a diaphragm opening for an X-ray beam through the cone assembly, a shaft rotatably mounted in the casing parallel with each set of shutter members, one end of each shaft projecting beyond the walls of the casing, belts hung on said shafts and extending to the said members, and knobs on the projecting ends of the shaft for manual rotation of the shafts to move the members on the rods thereby to determine the size and shape of the diaphragm opening.

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