

June 28, 1949.

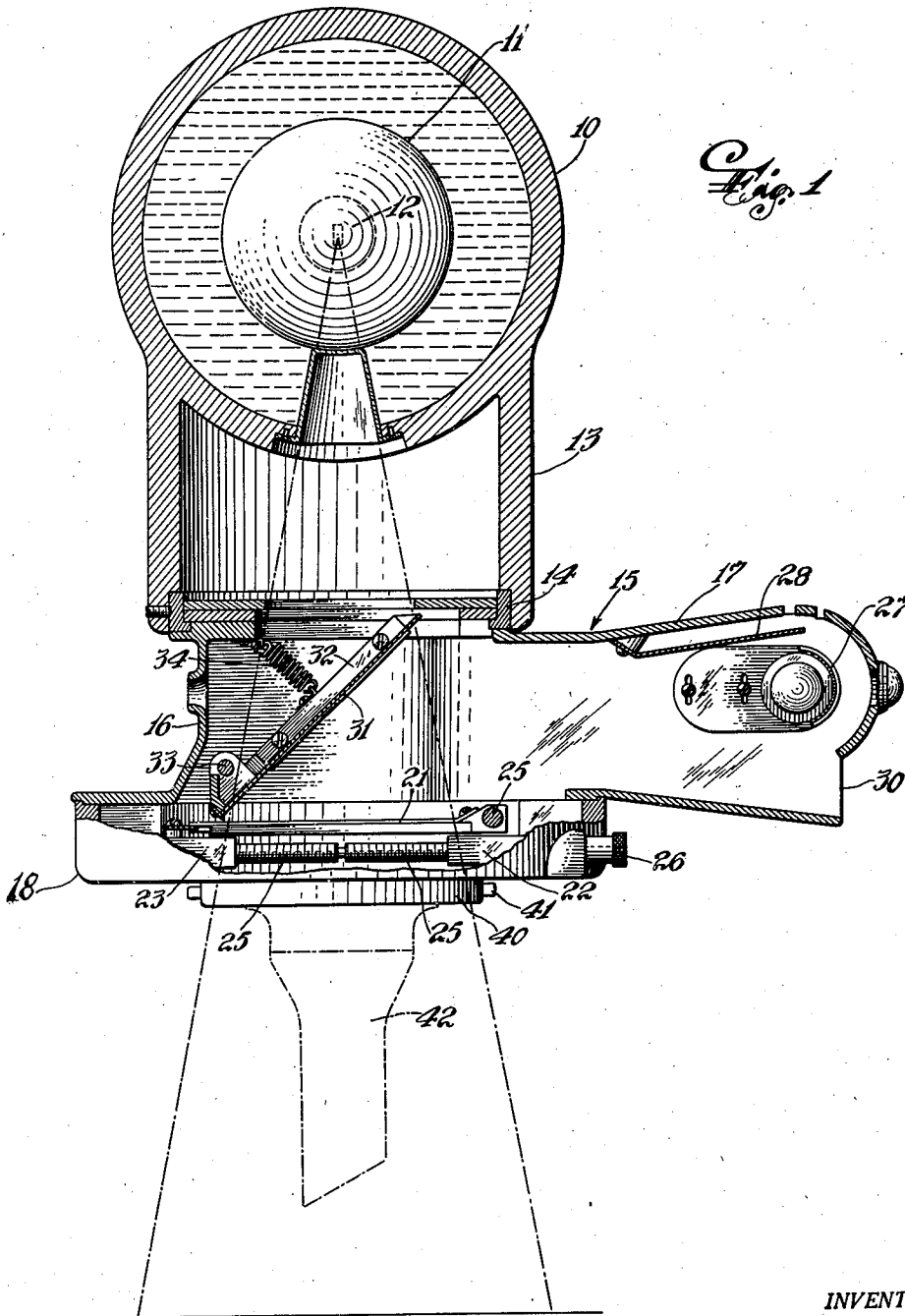
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X-RAY EQUIPMENT

Filed Nov. 20, 1947

2 Sheets-Sheet 1



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Fig. 2

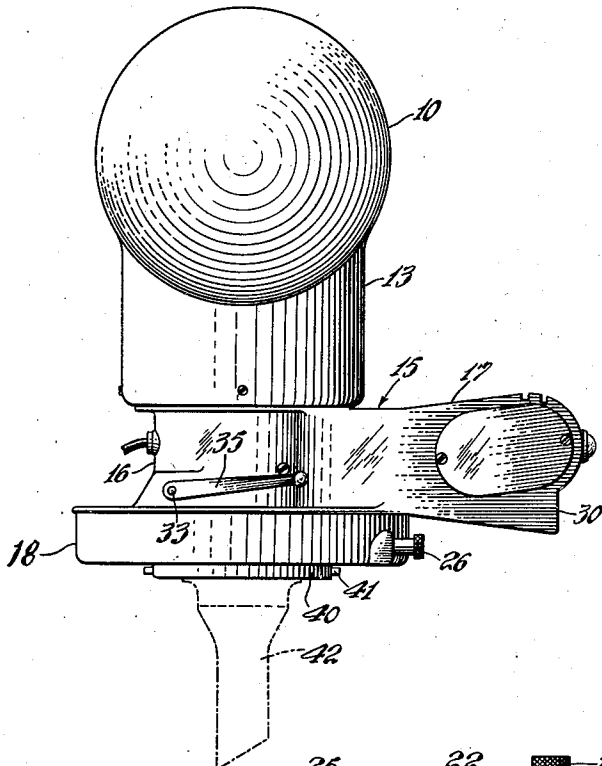


Fig. 3

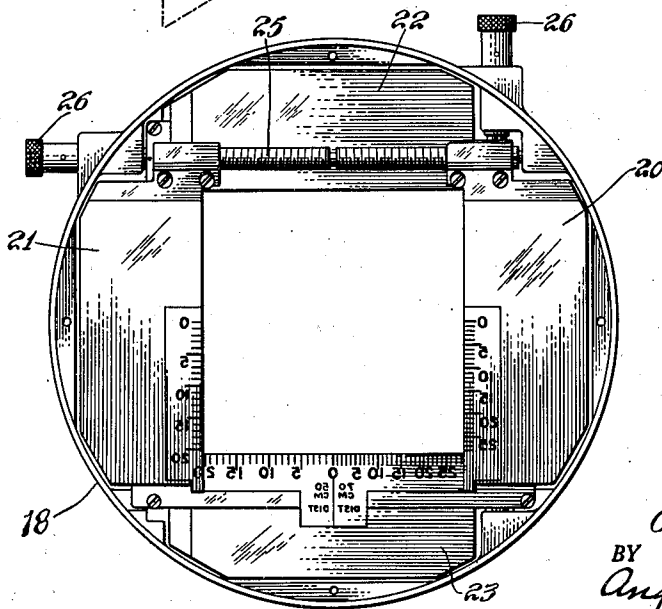
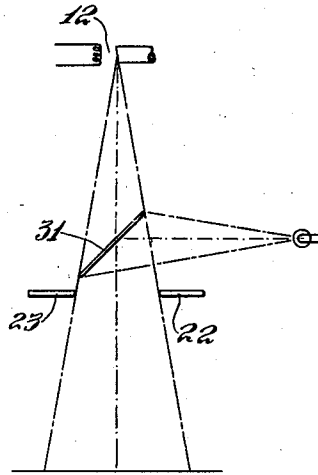


Fig. 4

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X-RAY EQUIPMENT

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This invention relates to novel apparatus for determining the position of the area of a body to be subjected to irradiation and particularly X-rays. More particularly this invention is directed to such apparatus and means for readily ascertaining conditions of setting so that adjustments may be readily and easily made.

Prior to this invention Juan A. Del Regato proposed coupling an X-ray tube housing containing an X-ray tube therein with an X-ray localizer. The localizer consisted essentially of a closed housing having an opening in both its upper and lower ends. Fixedly mounted in the housing and below the upper opening therein was a mirror. Located to one side of the mirror and mounted in the housing was a point source of light. Mounted on the bottom of the housing and at the opening in the lower end thereof was a shutter box containing two pairs of separately adjustable shutters for adjustably limiting the size of the opening whose center is always coincident with the central ray of the X-ray beam of said tube through which X-rays may pass. The X-ray tube and its housing was mounted on the upper part of the localizer housing at the upper opening therein. In this combination as proposed by Del Regato the central X-ray of the X-ray beam from the X-ray tube intersects the central light ray of the beam from the light source at substantially right angles and this intersection is located substantially at the mirror reflecting surface, with the distance of said central X-ray from the target of the X-ray tube to said reflecting surface of the mirror being substantially equal to the distance of said central light ray from said light source to said reflecting surface of the mirror. The mirror was fixedly and rigidly mounted in the housing at an angle of substantially 45° to both said central X-ray and said central light ray. With this combination, that portion of the X-ray beam below the mirror is coincident with the reflected light beam as shown schematically in Fig. 3.

With this construction a patient is placed on a table below the shutter housing and with the X-ray tube inoperative, but with the light source energized, a beam of light strikes the mirror and is reflected downwardly through the opening between the adjustable shutters and onto the patient (Fig. 3). The entire apparatus is of course movable vertically upwardly or downwardly until that portion of the body to be treated is located the desired distance from the target. This is ascertained by means of a measuring stick or tape. The entire apparatus may also be

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moved horizontally so that that portion of the body to be treated is located below the target. The location of that portion of the body to be treated may be ascertained by noting that portion of the body which is illuminated by the reflected light from the mirror. In order to limit the area to be treated, the four blade shutters may be adjusted so that the illuminated area of the body to be treated is of the desired size, and the dimensions thereof may be ascertained with a tape measure. The size and shape of the area to be treated is predetermined, with the shape usually being rectangular. Obviously, the size of the illuminated area of the patient is dependent upon the size of the opening at the shutters and the distance of the target from said area, which distance in greater part of practice is usually 50 or 70 centimeter focal skin distance. Then after all of these adjustments are made the X-ray tube is energized whereupon an X-ray beam of the desired size impinges upon the area of the body to be treated which area had been previously located with respect to the target and whose size has been set with said reflected light.

While the construction proposed by Del Regato has served an admirable purpose, it has only limited application. For example, it could not be used in the field of intra-oral or intra-cavity treatment where a tubular treatment cone is used in place of the shutters to confine the X-ray beam. When used for this purpose, the cone is inserted in the cavity and the opening at the free end of the cone is placed over the area to be subjected to X-rays, and with the periphery of the end of the cone being in contact with the skin. With the construction as proposed by Del Regato, it is not feasible to determine whether the opening at the free end of the cone is in line with the area to be treated because the visible light at that area cannot be seen. Consequently other types of apparatus must be and have been used for such intra-oral and intra-cavity treatment and these various apparatus are known as periscopic coning devices.

In the course of my experimentation with X-ray units, I have discovered that I may provide an X-ray unit which may serve equally well as a localizer and also an intra-cavity or an intra-oral X-ray unit. Besides providing a single instrument capable of performing the work which formerly required two separate instruments, each one designed for a particular purpose, I have also provided a novel localizer. The novel unit may be employed either as a localizer or for periscopic coning of an area to be treated,

My various inventions may be made by modifying the Del Regato construction so that full advantage may be taken of the Del Regato principle and at the same time increasing its field of use.

In order to be able to take advantage of the Del Regato principle, at least in a more practical and efficient manner, I have provided a viewing window located to one side of the mirror and preferably below the point source of light so that there is a substantially unobstructed view between said window and the reflecting surface of said mirror. In addition, the mirror is pivoted so that it may be swung back and forth on its pivot so that every part of the area to be treated may be seen in the mirror when set up for intra-cavity and intra-oral treatment. Consequently, with the X-ray tube inoperative and the point source of light energized it is possible by swinging the mirror about its pivot to accurately determine whether or not the entire area to be treated is in the X-ray field limited by the cone when the apparatus is set up for intra-cavity or intra-oral treatment.

Further, in order to ascertain directly the size of the area to be treated when located at a plurality of different distances from the target of X-ray tube, the shutter plates have calibrated scales thereon. These scales are so calibrated that the graduation marks thereof signify the length and width of the area to be treated when located at a predetermined distance from the X-ray tube target. The graduation marks are so arranged that their image in the mirror is upright and may be read directly when viewed through the window. By this construction, I have provided a novel localizer having adjustable shutters permitting fine control and scales permitting presetting of field size; permitting periscopic vision of radiated area on patient and the periscopic observations may be conducted at convenient distances from the X-ray tube and if desired tubular applicators may be coupled therewith for intra-oral and intra-vaginal therapy where periscopic vision is desired.

These and other objects and advantages of this invention will be readily apparent from the following description and appended drawings, wherein,

Fig. 1 is a view chiefly in section illustrating an embodiment of the invention.

Fig. 2 is a side view of the apparatus shown in Fig. 1.

Fig. 3 is a view diagrammatically showing the relationship of the X-ray tube target, source of visible light, mirror and shutters.

Fig. 4 is a top plan view of the shutters showing some of the shutters having calibrated scales thereon for different predetermined distances from the skin of the patient to the target of the X-ray tube.

As shown in the drawings there is an X-ray tube housing 10 in which is disposed an X-ray tube 11 having a target 12. A cylindrical skirt 13 depends from said housing 10 and is keyed to a ring 14. Connected to the upper end of ring 14 is a localizer body 15 rotatable relative to ring 14. The localizer body 15 is essentially a hollow chamber having a central portion 16 open at both the upper and lower ends thereof and having a hollow side projecting portion 17. Secured to the chamber 15 at the lower opening therein is a shutter box 18 having two pairs of shutter plates, with one pair of plates 20 and 21 being disposed at right angles to the other pair of plates

22 and 23. Each pair of shutter plates may be independently moved towards and away from each other by screws 25. There are provided two sets of screws 25 disposed at right angles to each other, the sets being independently actuatable by movement of knobs 26 located outside of the housing. With this construction, the operator may control the length and width of X-rays as well as visible light passing through the opening between the shutters which controls the corresponding dimension of the area treated by X-rays for particular shutter setting when the X-ray target is located at a particular distance from said area. A light source and preferably a point source of light 27 which may be an incandescent lamp of the so-called "projection lamp" type is mounted in the portion 17 at the free end thereof, and also mounted therein and at that end is a radiator 28 located above lamp 27.

According to this invention, the chamber 15 is provided with a viewing window 30 so located that the operator may have an unobstructed view of a reflector 31, such as a glass mirror, located in the central portion 16 of the chamber 15. In one of said embodiments the window 30 may be a rectangular cut-out of that side of portion 16 adjacent the lamp 27. This window 30 may extend across the entire width of portion 16 and it is as high as practical for maximum viewing. If desired the window 30 may have a glass or other transparent covering (not shown).

In further accordance with the invention, the mirror 31 is mounted in a bracket 32 pivotally mounted in the chamber 16 keyed to pivot rod 33 extending through the lower end of the bracket. A coil spring 34 has one end thereof connected to frame 32 and its other end to the upper side of the chamber 15 and tends to maintain said bracket against a stop whereby the mirror 31 is at 45° to the central ray of the X-ray beam from target 12 and when in this position, the central ray of the light beam from the filament of the lamp 27 is also at 45° to the mirror 31 and the central light ray and the central X-ray intersect at mirror 31 and the distance of the control X-ray and the central light ray to mirror 31 are equal. The mirror 31 extends diagonally in chamber 15 in the space between the upper and lower openings therein. Located outside of chamber 15 and keyed to the rod 33 is an actuator 35 in the form of a lever or knob for swinging the bracket 32 and mirror 31 carried thereby against the action of the spring 34. When the lever 35 is released, the spring 34 automatically returns the bracket 32 and mirror 31 carried thereby to its original position heretofore described. In this manner the angle of the reflecting surface of mirror 31 may be varied at will.

The lower side of the shutter box may have a pair of guide ways 40 accommodating the flange 41 of a demountable treatment cone 42 employed for intra-oral or intra-cavity treatment. When the device is to be used for those purposes and with the cone 42 in place, only partial view of the area illuminated is possible when the reflector 31 is at the 45° angle because of the off-side position of the observer's eye. Under these conditions, the illuminated area observed at the bottom of the treatment cone is essentially an oval and the remainder of that area is obstructed due to the off-side viewing and the mirror at 45° angle. This angular misalignment may be corrected in an easy and practical manner by pressing the lever 35 to tilt the mirror 31 towards the shutters and by this procedure the remainder of the

illuminated area adjacent the free end of the cone 42 may be seen.

In order to eliminate the necessity of tilting the mirror 31, I may have the outer end of chamber 17 carrying the lamp 27 in the form of a demountable head so that it may be replaced by another demountable head having a battery of lamps around a peep hole in a straight path whose center line intersects the longitudinal axis of the cone 42 at the reflector 31 and this center line and axis are at 90° to each other. When the first head is used, the apparatus serves as a localizer, and when the second head is substituted therefore, it is used for intra-oral or intra-cavity treatment and the entire illuminated area adjacent the free end of the cone 42 may be observed with the mirror in a single position at the 45° angle. However, I prefer to employ the single lamp and the tilting mirror arrangement, because of the economies and ease of use involved.

In further accordance with this invention each of said shutter plates may have associated therewith calibrated scales. This may be accomplished by having said shutters calibrated lengthwise to provide two sets of scales, with each set being on a different colored background to signify the particular graduations based upon a particular distance of the target from the skin of the patient to be treated. In the illustration as shown, the center of the length of the shutter 25 is marked zero and the calibrations to the sides thereof are respectively based upon 50 and 70 cm. focal lengths of the target to the skin, and each of the shutters 20 and 21 is marked zero at the center of its length and these shutters 20 and 21 are marked from the zero marks towards the shutter 23 and are respectively graduated or calibrated the same as the calibrations to either side of the zero of shutter 23. The shutter 22 may also be marked in the manner of shutter 23, but preferably graduated for two other focal lengths, and the shutters 20 and 21 may also be similarly calibrated on the other sides of the zeros thereof. Thus there may be provided graduations on the shutters so that they are useful for 4 different and predetermined focal lengths of X-ray target to the skin. These calibrations are so made that the length and width of the area of the X-ray beam on the skin of the patient may be read directly on the scales for the particular shutter opening at 50 or 70 cm. focal length as shown in the drawings. Thus once the shutter opening is set and the unit is properly positioned vertically so that the X-ray target is either 50 or 70 cm. from the skin of the patient, the exact size X-ray beam on the skin of the patient may be read directly by reading the reflection of the scales in the mirror. The reflection of the scales on the shutters is upright because the scales are in reverse position on the shutters as shown. Because of this arrangement, when the unit, is used as a localizer, the operator after adjusting the unit horizontally and vertically disposes the X-ray target at the proper distance for example 50 or 70 cm. from the skin of the patient and over the area to be treated. After these adjustments have been made with the lamp 27 energized and the X-ray tube inoperative, the operator operates the turn knobs 26 to set the size of the shutter opening and by reading the reflection of the proper calibrated scales reads directly thereon, length and breadth of the light beam on the skin of the patient at the 50 cm. or 70 cm. focal length, or at any focal length for which the scales may have been calibrated. This shutter opening adjust-

ment may be made before the horizontal and vertical adjustments are made.

I claim:

1. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of the light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and of the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector an image of a surface outside of said means and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said means and said window.

2. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a tiltable light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and of the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface outside of said means and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said means and said window.

3. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, adjustable shutters coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and the reflected light beam emitted downwardly through said housing and whose incident light beam ema-

nates from said source of light, calibrated scales associated with said shutters, a window through which an observer may view in said reflector an image of said scales illuminated by said reflected light beam and may also view in said reflector an image of a surface outside of said means and illuminated by said reflected light beam and may also view in said reflector an image of a surface outside of said means and illuminated by said reflected light beams, said viewing window being in said housing, the effective reflecting surface of said reflector facing said shutters and said window.

4. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a tiltable light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, adjustable shutters coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted there- through and the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, calibrated scales associated with said shutters, a window through which an observer may view in said reflector an image of said scales illuminated by said reflector light beam and may also view in said reflector when tilted to various positions images of a surface outside of said means and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said shutters and said window.

5. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a tiltable light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, an X-ray treatment cone coupled with said housing and located below said reflector for controlling the size of said X-ray beam and the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface adjacent the free end of said cone and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said cone and said window.

6. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said hous-

ing, a tiltable light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, manually operable means outside of said housing for tilting said mirror, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam and the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface outside of said last mentioned means and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said last mentioned means and said window.

7. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a tiltable light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, means tending to maintain said reflector at said 45° angle to said light ray, and manually operable means for tilting said reflector to vary the angle between said reflector and said light ray, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam and the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface outside of said last mentioned means and illuminated by said reflected light beam, said viewing window being in said housing, the effective reflecting surface of said reflector facing said last mentioned means and said window.

8. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a pivoted light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and of the reflected light beam emitted downwardly through said housing and whose incident

light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface outside of said means and illuminated by said reflected light beam, said viewing window being in said housing, and means outside of said housing for actuating said reflector, the effective reflecting surface of said reflector facing said first mentioned means and said window.

9. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and normally to be located below said source, a substantially point source of light located in said housing, a pivoted light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, means coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and of the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, a window through which an observer may view in said reflector when tilted to various positions images of a surface outside of said means and illuminated by said reflected light beam, said viewing window being in said housing, resilient means tending to maintain said reflector at said 45° angle and means outside of said housing for actuating said reflector against the action of said resilient means, the effective reflecting surface of said reflector facing said first mentioned means and said window.

10. In an X-ray apparatus, a housing adapted to be coupled with a source of X-rays and nor-

mally to be located below said source, a substantially point source of light located in said housing, a pivoted light reflector located in said housing, said reflector disposed in the path of a beam of X-rays from said source of X-rays and in the path of a beam of light from said source of light, the central rays of said beams being at right angles to each other and intersecting each other at said reflector, said source of X-rays and said source of light being equidistant from said point of intersection, said central light ray being at an angle of 45° to said reflector at said point of intersection, adjustable shutters coupled with said housing and located below said reflector for controlling the size of said X-ray beam emitted therethrough and the reflected light beam emitted downwardly through said housing and whose incident light beam emanates from said source of light, calibrated scales associated with said shutters, a window through which an observer may view in said reflector an image of said scales illuminated by said reflected light beam and may also view in said reflector when tilted to various positions images of a surface outside of said shutters and illuminated by said reflected light beam, said viewing window being in said housing, resilient means tending to maintain said reflector at said 45° angle and means outside of said housing for actuating said reflector against the action of said resilient means, the effective reflecting surface of said reflector facing said shutters and said window.

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