

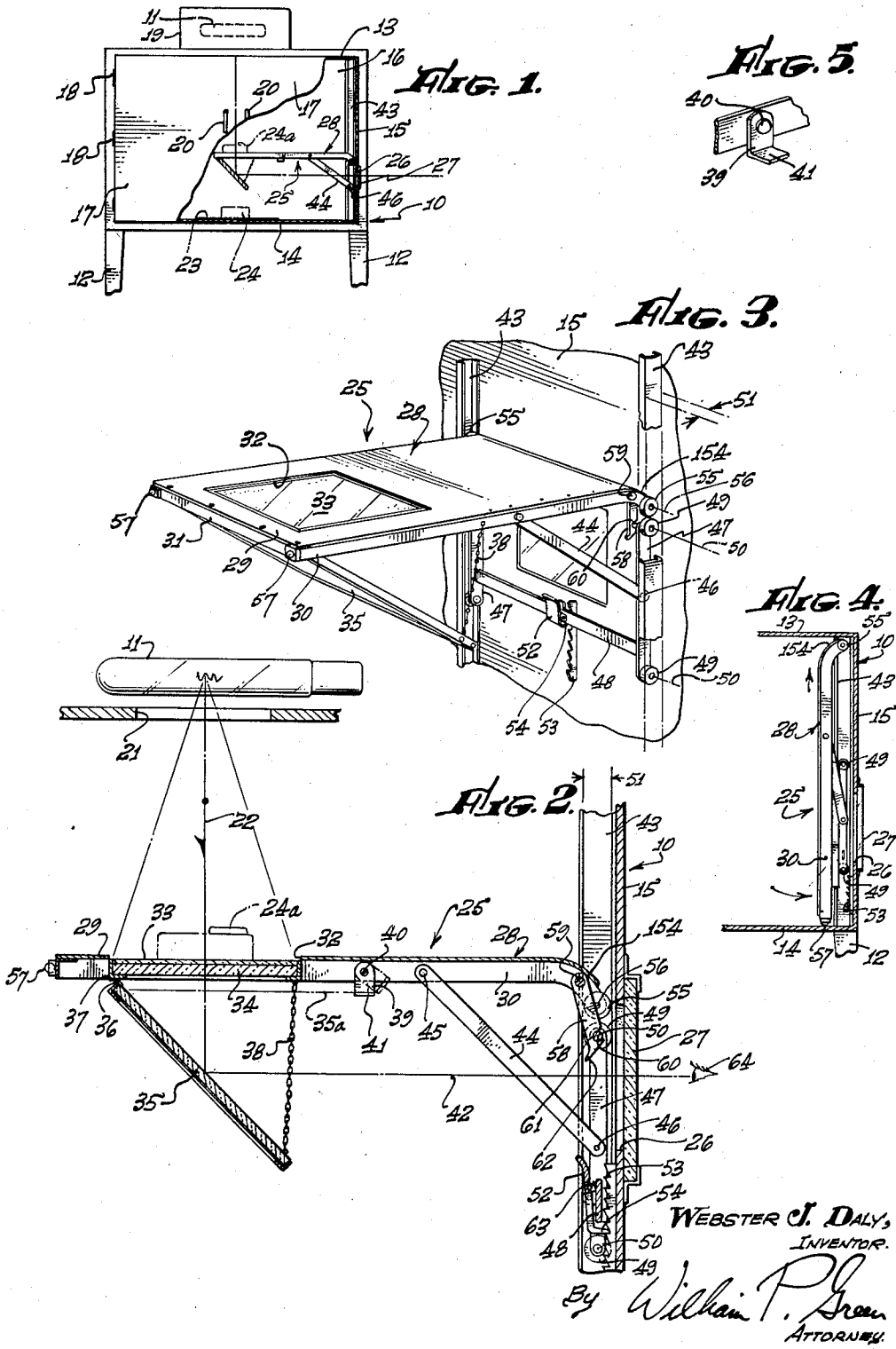
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FLUOROSCOPIC X-RAY APPARATUS

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FLUOROSCOPIC X-RAY APPARATUS

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This invention relates to improved apparatus for utilizing X-rays or similar radiation, that is, high frequency radioactive radiation capable of penetrating opaque solid substances. More particularly, the invention is especially concerned with the provision of means for supporting an object in a manner allowing it to be fluoroscopically viewed within an X-ray chamber or cabinet.

In the manufacture of certain critical types of metal castings and other parts, it is customary to make X-ray photographs of the parts to obtain an indication of the internal condition of the metal. This is conventionally done within a special X-ray cabinet or chamber, into which the part and the X-ray film are placed, and within which the X-rays are then directed through the object and onto the film to obtain a picture.

The general object of the present invention is to provide apparatus for adapting a cabinet or chamber of the above discussed type in a manner allowing for fluoroscopic viewing from the outside of the chamber, of a work piece or object positioned in the chamber. More specifically, the invention has to do with special means for supporting a work piece in the chamber in a manner allowing such viewing, while at the same time preferably permitting for retraction of the support structure to a position in which the interior of the cabinet is unobstructed and available for the making of an X-ray photograph if desired.

Structurally, the support includes a platform on which the work piece may be placed and having a fluorescent screen as a portion of the platform. The X-rays or other radiation are directed through the object and onto the screen to produce an image showing the interior condition of the object. For reflecting this image in a direction allowing it to be viewed through a viewing window, there is desirably provided a mirror, which may be located at the underside of the platform, and may function to reflect the image horizontally toward a side wall of the cabinet.

To allow for retraction of the support, I provide means mounting the support platform for movement between an active generally horizontal position in the cabinet and a retracted position adjacent a wall of the cabinet. The mirror may be carried by the platform for retracting movement therewith, and may also be hinged to the platform for relative folding movement, so that the entire platform and mirror assembly can fold to a very small dimension condition adjacent the cabinet wall. The mounting means preferably include a pair of spaced vertical guides by which the platform supporting parts are mounted for vertical movement to expand and retract the platform.

The above and other features of the present invention will be better understood from the following detailed description of the typical embodiment illustrated in the accompanying drawing in which:

Fig. 1 is an elevational view, partially broken away, of an X-ray unit constructed in accordance with the invention;

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Fig. 2 is an enlarged fragmentary central vertical section through the Fig. 1 apparatus;

Fig. 3 is a fragmentary perspective view, partially broken away, of the inner work supporting platform or tray and associated parts;

Fig. 4 is a fragmentary vertical section showing the platform or tray in its retracted position; and

Fig. 5 is an enlarged fragmentary perspective view of the mirror supporting latch element.

Referring first to Fig. 1, I have shown at 10 an X-ray cabinet having at its upper side a radiation head 11. Head 11 directs X-rays or other similar radiation downwardly within the interior of cabinet 10, to pass through an opaque work piece, to indicate the internal condition of the work piece. Cabinet 10 may be supported on a number of legs 12, and is desirably of rectangular configuration. More specifically, the cabinet 10 may have two parallel horizontal top and bottom walls 13 and 14, two vertical parallel end walls 15 (only one shown), a rear vertical wall 16 extending perpendicular to end walls 15, and two doors 17 for closing the front side of the cabinet. Doors 17, when closed, extend parallel to rear walls 16, and are mounted by hinges 18 to swing outwardly or forwardly to open positions in which they allow free access to the interior of the cabinet. Handles 20 may be provided for opening and closing the doors, and of course suitable latch means are provided for retaining the doors in closed positions.

The upper radiation producing head 11 is contained within a housing 19 formed at the upper side of the cabinet 10. The head 11 is typically represented as an X-ray tube, but may also be any other suitable source of X-rays or similar radiation capable of passing through opaque solid substances. For example, the head 11 might be a radiation source containing a substance such as radio active phosphorus (P-32), thorium-X, radium, radon gas, radio active cobalt, or any other suitable radio active substance or isotope capable of producing the desired radiation. The radiation passes downwardly from the upper housing 19 through an opening 21 formed in the upper side of top wall 13 of cabinet 10, to then pass downwardly within the cabinet toward the center of bottom wall 14, with the center of the beam being represented by the vertical arrow 22 in Fig. 2.

When it is desired to take an X-ray photograph in cabinet 10, the film may be placed on bottom wall 14 of the cabinet, as at 23 in Fig. 2, and with a work piece 24 positioned on the film. The radiation directed downwardly through the work piece and onto the film will then produce an image on the film indicating the internal condition of the work piece. The relatively large area within cabinet 10 allows for the photographing of very large parts in the cabinet. In order to prevent the discharge of any of the radiation to the outside of cabinet 10, all of the walls 13, 14, 15 and 16, as well as doors 17 and upper housing 19, are formed of lead or other similar high density material which is capable of functioning as a shield for preventing the passage of radiation there-through.

The present invention is particularly concerned with the provision in cabinet 10 of a fluoroscopic assembly 25 for supporting a work piece 24a in a position in which it can be viewed fluoroscopically from the exterior of the cabinet. This assembly 25 is retractable from the Fig. 1 position of use to the Fig. 4 retracted position adjacent sidewall 15 of cabinet 10. In this Fig. 4 position, the fluoroscopic assembly number 25 leaves the entire interior of cabinet 10 unobstructed, to allow for the X-ray photographing of any desired size of work piece within the cabinet. When assembly 25 is in the Fig. 1 position, the work piece 24a is fluoroscopically viewed through a window 26 formed in the lower portion of

side wall 15, which window may be rectangular as seen in Fig. 3. Across the window or aperture 26, there is provided a window pane 27, formed of a substance which is transparent to light rays but is essentially opaque to the passage of X-rays and similar radiation there-through. For instance, this pane 27 may be formed of glass having lead contained therein in a manner resisting the passage of X-rays through the pane. This type of glass is of course well known in the art, and therefore need not be described any more specifically.

The fluoroscopic support assembly 25 includes a platform 28, which projects horizontally from side wall 15 to the center of cabinet 10 in the active work supporting position of assembly 25 (Figs. 1, 2 and 3). Platform 28 includes a planar sheet of lead 29 forming the horizontal portion of the platform, and having angle irons rigidly attached to its periphery in a manner forming two depending parallel vertical flanges 30 extending along opposite sides of platform 28, and a third transverse depending flange 31 extending across the outer end of the platform. Toward its outer end, and at a location positioned directly beneath radiation head 11 when assembly 25 is in its active position, the tray 28 contains an opening 32, typically of rectangular configuration, and within which there is rigidly carried a correspondingly rectangular fluorescent screen 33. As seen in Fig. 2, the work piece 24a is placed on fluorescent screen 33, so that radiation may pass downwardly through the work piece and cause a fluorescent image on screen 33. Beneath this screen, there is provided a windowpane 34 formed of lead-containing glass or other material such as that utilized for pane 27, to prevent any of the radiation from passing downwardly through pane 34. At the same time, this pane is transparent to the passage of visible light therethrough.

Beneath screen 33 and pane 34, platform 28 carries a typically rectangular mirror 35, which is mounted by a piano hinge 36 to the underside of an angle iron 37 by which elements 33 and 34 are supported in the platform. The mirror 35 is mounted by these hinges 36 to swing relative to the rest of the platform between the full line downwardly inclined active position of Fig. 2 and the upper broken line retracted position of that figure. In this broken line retracted position, mirror 35 extends parallel to the horizontal lead plate 29 of the platform, and is thus so positioned as to be easily foldable with the platform to the Fig. 4 retracted position. In its lowered active position, mirror 35 is suspended at the proper Fig. 2 inclination by a pair of chains 38 attached at their upper ends to flanges 30 of the platform, and at their lower ends to the opposite sides of the mirror. In the upper retracted position 35a of the mirror, this part is supported in fixed relation to the platform by a latch or holding element 39 (see Fig. 5), which is pivoted at 40 to one of the flanges 30 and which has a portion 41 adapted to support an edge of the mirror. To allow movement of the mirror to and from its retracted position 35a of Fig. 2, element 39 can pivot about its hinge pin 40 to the broken line position represented in Fig. 2, in which position the flange 41 is located out of the path of swinging movement of mirror 35. The inclination or angularity of mirror 35 in its Fig. 2 full line position is desirably 45° relative to both the vertical and horizontal, to reflect the light from fluorescent screen 33 along a generally horizontal line represented at 42 in Fig. 2, so that the light passes through window 26 for viewing from the outside of that window.

The assembly 25 is retractably mounted to the inner side of wall 15 by a pair of vertically extending spaced rigid channels 43, which are of U-shaped horizontal section, and which have their open sides facing toward one another. These channels 43 are rigidly secured to the inner side of wall 15, and are located on opposite sides of window 26.

When the platform 28 is in its Fig. 1 horizontal posi-

tion, it is supported in that position by means of a pair of angular or inclined spaced parallel braces 44, which may extend at approximately a 45° angle to both the vertical and horizontal. These two braces are positioned at opposite sides of the platform, and are pivoted at their upper ends to depending side flanges 30 of the platform, at 45. The lower ends of flanges 44 are pivotally connected at 46 to a pair of vertical rigid elements 47 which extend vertically along the inner sides of channel members 43 respectively. Members 47 are rigidly interconnected toward their lower ends by a rigid horizontal frame member 48. Each of the elements 47 is guided for only vertical movement within the housing, by means of a pair of rollers 49, which are rotatably mounted to the upper and lower ends of member 47 for rotation about a pair of vertically spaced horizontal axes 50. These rollers 49 have a diameter corresponding approximately to the width 51 of channels 43, to be received within those channels and guided thereby for the desired vertical movement. The rollers 49 at one side of the platform may be mounted for rotation about the same axes 50 as are the rollers positioned at the opposite side of the platform. As will be apparent, the entire structure 47—48—49 moves as a unit vertically within the cabinet, as guided by the two channel members. For retaining the structure in any of different positions within the cabinet, the member 48 carries a spring-pressed latch element 52, which is adapted to engage a toothed member 53 rigidly attached to the inner side of wall 15, so that the portion 54 of latch element 52 can rest on any of the different teeth of element 53 to support the entire tray structure at a desired elevation.

The inner edge portion of tray 28 (the portion closest to wall 15) may be curved downwardly at 54, as seen best in Fig. 2. More specifically, both the top lead plate 29 and the opposite side flanges 30 of the tray may curve downwardly at this point. Directly opposite channels 43, the depending flanges 30 of the platform may project slightly beyond top lead plate 29 of the platform, to provide lugs to which a pair of rollers 55 are mounted for rotation relative to the tray structure about a horizontal axis 56 extending parallel to the previously mentioned horizontal axes 50. These rollers 55 may be dimensioned the same as rollers 49, and are received and guided within channels 43, to thus guide the inner edge portion of the platform for vertical movement along the channels. Such vertical movement of rollers 55 within the channels moves these rollers toward and away from the lower rollers 49, to thereby move the platform structure between its active and retracted positions. More specifically, as rollers 55 are moved upwardly from their Fig. 2 positions to their Fig. 4 positions, the braces 44 swing toward wall 15, and the platform swings inwardly and downwardly toward wall 15, until the entire structure is in the Fig. 4 position. The platform when retracted may have a vertical dimension corresponding substantially to the internal height of the cabinet, and the positioning of the parts may be such as to require some upward movement of the structure 47—48—49 from the Fig. 2 position in order to accommodate the platform structure in its Fig. 4 retracted position. Also, there may be provided on outer flange 31 of the platform a pair of ball casters or other anti-friction elements 57 which are engageable with the bottom wall 14 of the cabinet as the platform structure swings toward its Fig. 4 position, to limit downward movement of the platform structure, and thus cause an upward movement of braces 44 and the attached parts 47 and 48 as the platform is retracted. The platform is releasably retained in its Fig. 2 active position by means of a pair of latch elements 58, which are pivoted at 59 to the two depending flanges 30 of the platform, and which have holding notches 60 adapted to engage and hold a pair of pins 61 projecting inwardly from elements 47 along the upper of the two axes 50. Elements 58 may have lugs 62 for facilitating the manual

actuation into and out of active positions, and the notches 60 of elements 58 may have a slightly inclined or angular configuration such as to effectively retain pins 61 within these notches as a result of the upward force exerted against latch parts 58 when the platform is in active condition. This upward force exerted on elements 58 is of course caused by the gravitational pull exerted against the outer and heavier portions of the platform, including the fluorescent screen 33 and associated parts.

To now describe the manner of use of the apparatus, assume first of all that it is desired to make an X-ray photograph within cabinet 10. As previously mentioned, this is effected by positioning the platform structure 25 in its Fig. 4 retracted position adjacent wall 15, and then locating the film 23 and work piece 24 on bottom wall 14 within the cabinet (Fig. 1). The X-ray tube or other radiation head 11 is then energized or placed in a condition to emit radiation downwardly along axis 22, to make the desired X-ray photograph.

When it is desired to fluoroscopically view a work piece 24a, for example a metal casting, within the cabinet 10, the first step is to open doors 17, and to swing the platform structure 25 to its active position of Figs. 1, 2 and 3. This is effected by merely pulling the lower portion of the retracted platform of Fig. 4 in a direction away from wall 15, to cause rollers 55 to move downwardly along channels 43, and to thereby swing braces 44 toward their active Fig. 2 positions. When the tray is in its horizontal Fig. 2 position, latch elements 58 are moved to their holding positions of Fig. 2, to retain the platform in that condition. The latch element 52 is then actuated manually against the force of its associated spring 63 to a position in which portion 54 of element 52 can move downwardly past some of the teeth of element 53, and into engagement with a proper one of the teeth for accurately locating the platform assembly at a desired location opposite window 26. Part 39 is swung to its broken line position of Fig. 2, to release mirror 35 for downward movement to its inclined Fig. 2 active position, and the apparatus is then ready for use as a fluoroscopic device. The work piece is placed on the platform, above fluorescent screen 33, and doors 17 are closed, following which radiation head 11 is energized to direct a beam of X-rays or light downwardly, centered about axis 22. This beam passes through work piece 24a in Fig. 2 and causes a fluorescent image on screen 33 representing the work piece. This image is reflected by mirror 35 in a manner such that a viewer at a location 64 at the outside of the housing can view the fluoroscopic image of the work piece. When it is desired to again retract the fluoroscopic apparatus, the mirror 35 is first swung to and held in its retracted position, and the platform is moved to its Fig. 4 position as previously discussed. In the Fig. 2 active condition of the fluoroscopic assembly, it is noted that the lead plate 29 provides a shield within the interior of the cabinet between the radiation source and window 26, for preventing the direct passage of any of the radiation to that window.

I claim:

1. The combination comprising a closed radiation chamber having side walls and a window in one of the side walls through which the interior of the chamber is visible from the outside thereof, means for directing onto a work piece in said chamber a radiation beam capable of passing through opaque solid substances, a platform for supporting a work piece in said chamber and including a fluorescent screen onto which the radiation falls after passing through said work piece to form a visible image of the work piece, means mounting said platform, and its fluorescent screen for movement between an active generally horizontal work supporting position and a retracted generally vertical position adjacent a wall of said chamber, and a mirror in a position to reflect said image

of the work piece on said screen in a line of vision through said window of the chamber.

2. The combination as recited in claim 1, including means mounting said mirror to said platform for movement therewith between said active and retracted positions.

3. The combination as recited in claim 1, including hinge means mounting said mirror to said platform for swinging movement relative thereto between a first position generally parallel to said platform and a viewing position disposed angularly with respect to the platform, said mirror being movable with the platform as the latter moves between said active and retracted positions.

4. The combination as recited in claim 1, in which said window is formed in a vertical side wall of the chamber, and said mounting means movably attaches the platform to the chamber adjacent the window-containing side wall thereof, said platform projecting generally horizontally from said side wall above a mirror-viewing line of vision through the window in said active position, and extending essentially vertically adjacent said window-containing side wall in said retracted position.

5. The combination as recited in claim 1, in which said mounting means include a pair of vertical guide members adjacent to window-containing side of the chamber and at opposite sides of the window, and means supporting the platform and mounted by side guide members for vertical movement and acting to horizontally project and retract the platform by such movement.

6. The combination as recited in claim 1, in which said platform comprises a lead sheet the area of which contains said screen, there being a transparent window pane at the location of said fluorescent screen adapted to pass light therethrough but preventing the passage of said radiation therethrough.

7. The combination comprising a radiation chamber having a side wall containing a window through which the interior of the chamber is visible from the outside thereof, means for directing downwardly within said chamber radiation capable of passing through opaque solid substances, a platform for supporting a work piece in said chamber and including a fluorescent screen onto which the radiation falls after passing through said work piece to form a visible image of the work piece, a mirror carried by said platform, means mounting said platform and its fluorescent screen and mirror adjacent to said window-containing side wall for movement between an active position projecting generally horizontally within said chamber at an elevation above an area of the window through which the mirror is visible and a retracted position extending generally vertically at a side of the chamber directly opposite said window, and hinge means attaching said mirror to the platform for swinging movement relative thereto between a position generally parallel to the platform and a relative position in which the mirror is inclined downwardly and below the platform and will reflect said image of the work piece through said window when the platform is in its active position.

8. The combination as recited in claim 7, in which said mounting means include a pair of elongated braces pivotally mounted at first ends to swing relative to the chamber between retracted vertical positions adjacent a side of the chamber and active positions projecting at an inclination upwardly and away from said side of the chamber to support the platform in its active position, means pivoting second ends of said braces to the platform at points which are spaced from the side of the chamber in the active position of the platform, and means guiding an edge portion of the platform for vertical movement to open and retract the platform.

9. For use in a radiation chamber having a window through which the interior of the chamber is visible and within which there is emitted a radiation beam capable of passing through an opaque solid substance; a platform for supporting a work piece in said chamber and including a

fluorescent screen onto which the radiation may fall after passing through said work piece to form a visible image of the work piece, means including spaced vertical guides and travelers therein for mounting said platform and its fluorescent screen for movement between an active generally horizontal work supporting position and a retracted generally vertical position adjacent a wall of said chamber, and a mirror carried by said platform for reflecting said image of the work piece on said screen in a direction to be viewed through said window of the chamber.

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10. The combination of claim 9, including also means mounting the mirror in an inclined position beneath the platform from which the mirror is movable substantially into parallelism with the platform.

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