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RECIPROCATOR FOR X-RAY APPARATUS

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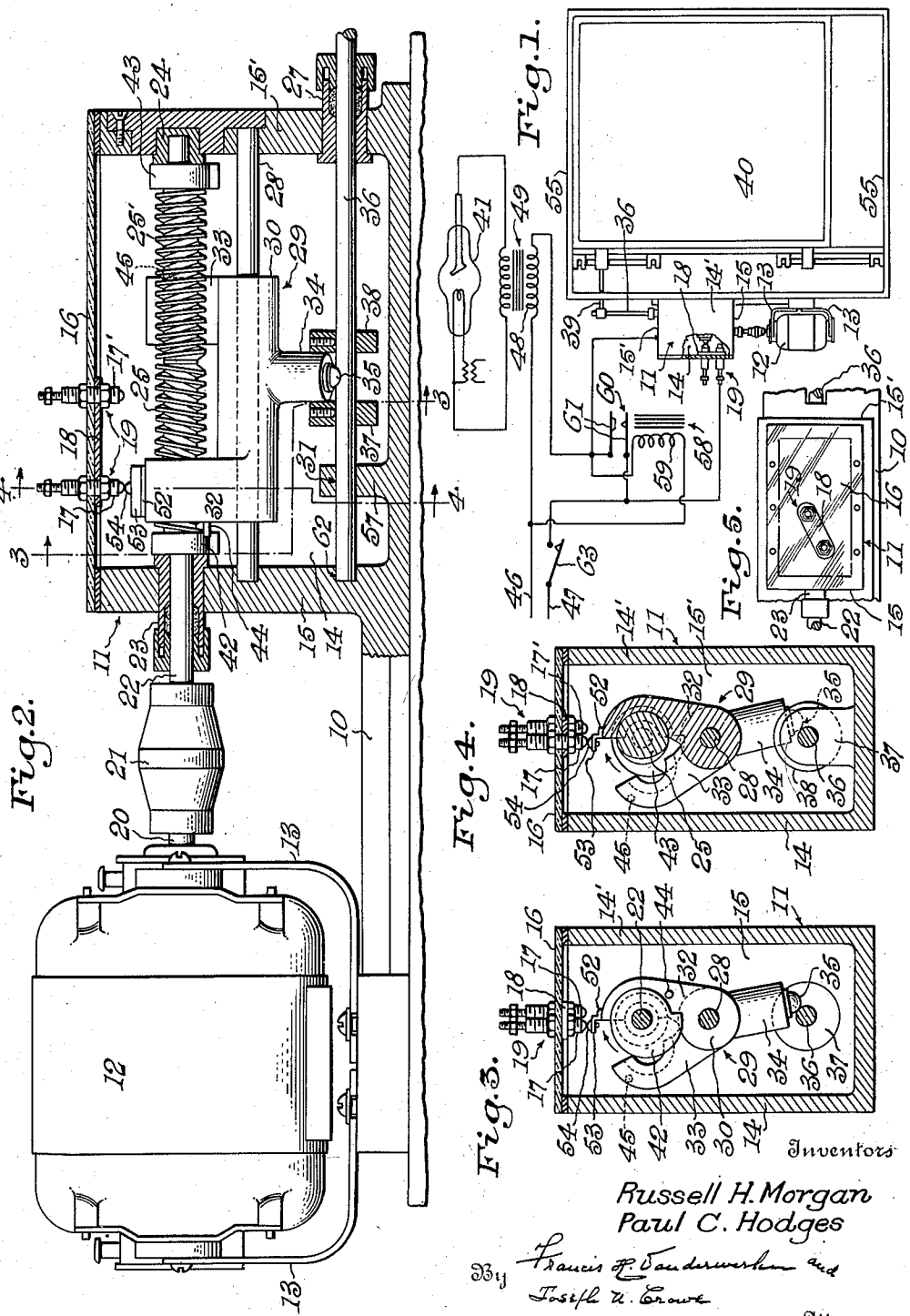


Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Inventors

Russell H. Morgan

Paul C. Hodges

By Francis H. Vandenburgh and Joseph A. Crowe

Attorneys

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RECIPROCATOR FOR X-RAY APPARATUS

Russell H. Morgan and Paul C. Hodges, Chicago, Ill., assignors to the United States of America as represented by the Secretary of War

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3 Claims. (Cl. 250—62)

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This invention relates generally to a reciprocating apparatus for X-ray grids but more particularly to an apparatus of this type which automatically starts the energization of the X-ray tube corresponding to a predetermined location of the grid in its reciprocatory path.

One object of the invention is to provide combined means for reciprocating a grid and starting the exposure of the X-ray film immediately after reversal in direction of the reciprocating grid.

Another object of the invention is to provide a reciprocating apparatus for X-ray grids combined with automatic means for commencing the excitation of the X-ray tube when the grid is in a position to travel the longest possible distance without reversal of direction.

These and other objects will be apparent from the following detailed description of the preferred embodiment of the invention taken in connection with the accompanying drawings in which:

Figure 1 is a diagrammatic view showing the grid, the reciprocating mechanism therefor, and the electrical circuit from the latter to the X-ray tube;

Figure 2 is a partially sectionized elevational view showing the reciprocating mechanism;

Figure 3 is a sectional view taken on the line 3—3 of Figure 2;

Figure 4 is a sectional view taken on the line 4—4 of Figure 2; and

Figure 5 is a top plan view of the reciprocator housing.

Like reference characters are used to designate similar parts in the description and in the drawings.

Briefly stated, this invention comprises a mechanism for reciprocating an X-ray grid and for controlling the energization of the X-ray tube at predetermined locations in the movement of said grid.

The portion of the apparatus for reciprocating the grid is similar to that described in copending application Serial No. 495,690, filed July 22, 1943, now Patent #2,467,592. To this device has been added contact switches which are operated by the reciprocating mechanism, the switches being electrically connected to a relay for controlling the operation of the X-ray tube.

Referring to Figures 1 and 2, the numeral 10 indicates a base which forms a support for a reciprocator housing 11 and an electric driving motor 12. The motor 12 is supported by a resilient mounting 13 which is attached to a base 10. The base 10 forms the bottom of the housing 11 which

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includes side walls 14, 14', end walls 15, 15', and a Lucite cover plate 16 in which are mounted two ball catches 17 and 17' connected by a metal strap 18. These ball catches function as contacts of the grid switch 19, as will be further described.

The resilient mounting 13 which supports the motor 12 is attached to the base 1. The driving shaft 20 of the motor 12 is connected through a flexible coupling 21 to the operating shaft 22 of the reciprocating mechanism, said operating shaft being rotatably mounted within bearings 23 and 24 in the end walls 15, 15' of the housing 11. The operating shaft 22 of the reciprocator is provided with left-hand and right-hand threaded portions 25 and 25'. Thus a portion 25 of the shaft 22 is threaded in one direction while a similar portion 25' is threaded in the opposite direction. The end walls 15 and 15' of the housing 11 are drilled for the reception of a parallel guide rod 28 on which a forked member 29 reciprocates and oscillates. This member 29 comprises a forked body 30 drilled axially to receive the rod 28, on which it is slidably mounted, the forked body 30 being formed to provide two arms 32 and 33 which extend toward the cover plate 16, one on either side of the rotating shaft 22, as illustrated in Figure 2. The outer side portions of the arms 32 and 33 are threaded so that they may removably engage the screw threaded portions 25 and 25' of the shaft 22, and are set at such an angle, relative to each other, that one of the arms may engage the threaded portion 25 or 25' at a given time. At the extremity of arm 32 is mounted a switch member or trigger 52 formed of an angle support 53 which is attached to the arm 32 and is provided with a contact member 54. Extending outwardly from the body 30 of the forked member 29 is a third arm 34, in the end of which is a spring pressed detent 35 adapted to ride smoothly over the rod 36 which is slidably mounted in a bearing opening 31 within the bracket 57 and the bushing 27 located in the end wall 15'. Located in abutting relation on either side of the arm 34 and secured to the rod 36 are the collars 37 and 38. It will thus be seen that longitudinal motion of the forked member 29 imparts corresponding longitudinal motion to the rod 36. The rod 36 is mounted for sliding movement within the bearing opening 31 located in bracket 57 and within the bushing 27 located in the end of the housing 11. The inner end of the rod slidably projects into the drilled opening 62 in the end wall 15 and the unconfined end of the rod projects outside of the housing and is connected to an arm 39 (Figure 1), securely fastened to the

Potter-Bucky grid 40 which is reciprocated within a frame 55 beneath the X-ray tube 41.

The angles at which the arms 32, 33 and 34 project from the body 30 of the forked member 29 are such that when the detent 35 lies on one side of the rod 36 the threaded portion of the arm 32 engages the threaded portion 25 of the shaft 22; and when detent 35 lies on the other side of the rod 36 the threaded portion of the arm 33 engages the threaded portion 25' of the shaft 22 as shown in Figure 2. Longitudinal motion is imparted to the forked member 29 by virtue of the threaded engagement of either of the arms 32 or 33 with the rotating shaft 22; the detent 35 imparting a counterforce preventing the arm from disengaging itself from the rotating shaft 22.

On either end of the rotating shaft 22 are the disc cams 42 and 43. The peripheral surface of each of the said cams is circular except for one lobe as shown in Figure 2.

Two cam followers 44 and 45 are located in such a position on arms 32 and 33, respectively, that when the forked member 29, advancing toward the cam 42 or the cam 43 by virtue of the rotation of the shaft 22, reaches either one of the cams, the cam engages its respective cam follower, quickly disengages one threaded arm from the shaft 22, snaps the detent 35 across the rod 36, and engages with the other threaded arm that was previously disengaged.

Thus, the reciprocating mechanism may be seen to operate as follows:

The motor 12 rotates the double-threaded shaft 22 at a constant speed. When the threaded portion of the arm 32 is engaged with the threaded portion 25 of the shaft 22, forked member 29 is caused to travel in a longitudinal direction toward the cam 42. In so traveling the forked member slides over the rod 28 and by virtue of its connection to the rod 36, through the arm 34 and the collars 37 and 38, causes the rod 36 to travel in a like direction. The rod 36 through its connection with the arm 39, which is in turn connected with a Bucky grid or diaphragm 40, causes a longitudinal motion of the said grid which is slidably mounted within the frame 55. When the arm 32 reaches the cam 42, the said cam engages the cam follower 44 and instantaneously disengages the arm 32 from the threaded portion 25 of the shaft 22, snaps the detent 35 to the opposite side of rod 36 and in turn engages the threaded portion of the arm 33 with the threaded portion 25' of the shaft 22. The last-mentioned engagement produces almost instantaneous reversal of the motion of the forked member 29 and causes the said member to travel in a longitudinal direction toward the cam 43.

This reversal occurs in less than one-fourth of one per cent of the time needed for one complete grid cycle. The forked member 29, through its connection with the rod 36 and the arm 33, causes a similar reversal of travel of the Bucky diaphragm 40. When the arm 33 of the forked member 29 reaches the cam 43 the follower 45 is engaged by the cam 43 which causes disengagement of the arm 33 from the threaded portion 25' and reengagement of the arm 32 with the threaded portion 25 of the shaft 22. This produces another reversal in travel and causes the forked member 29 to travel in its original direction. Thus, the forked member 29 and thereby the Potter-Bucky grid 40 to which it is attached travel uniformly in a to-and-fro direction, reversal of travel being effected by the disengagement of one of the arms 32 or 33 through

the engagement of the respective cams 42 or 43 with the respective cam followers 44 or 45 and the subsequent engagement of the opposite arm.

As the grid reverses and starts to move inwardly from its position shown in Figure 1, the metal contact 54 of trigger 52 attached to the left-hand thread half-nut, momentarily strikes the outer ball catch 17' but passes the inner catch 17 without touching it. On the outward trip the metal contact 54 of trigger 52 strikes the inner ball catch 17 but passes the outer one 17'. By means of the grid switch 19 which includes the ball catches 17, 17' and trigger 52, and a self-holding relay 58 (Figure 1), exposures shorter than 0.6 second may be made without grid reversal, whereas longer exposures continue through one or several reversals of the grid. The relay is connected so that one side of its coil 59 which is grounded to housing 11 receives ground from the grid switch 19 and the other side receives 110 volt A. C. when the exposure switch 63 is closed. After the exposure switch has been closed there is a momentary delay until the grid begins to travel in a new direction and a pulse of ground comes from the grid switch. A pair of normally open relay contacts 61 provides a self-holding circuit so that once the relay has closed it remains closed as long as the exposure switch 60 is held down as there is a continuous flow of current through the coil 59 of the relay 58.

From a consideration of the embodiment of this invention, it will be appreciated that a simple and effective means has been provided for reciprocating a Potter-Bucky grid or diaphragm at the speed required to avoid shadows thereof appearing on the radiograph. Positive drive in both directions and reversal well within the limited permissible time are insured by the cam means employed to reverse the travel in either direction, and automatic energization of the X-ray tube is effected after a reversal of the grid to avoid beginning an exposure period when the grid is either in a position where it is motionless at the end of a reciprocatory movement, or approaching such a position.

It will be apparent to those skilled in the art that various changes and modifications can be made in the apparatus of the disclosed invention without departing from the spirit and scope thereof as defined in the appended claims.

Having thus described our invention, what we claim as new and wish to secure by Letters Patent is:

1. A mechanism for reciprocating a Bucky grid of an X-ray apparatus including an X-ray tube and circuit means for energizing the tube, the combination which comprises mounting means for a screw, a rotatable screw mounted in the mounting means, the screw having oppositely directed threads along successive portions of its length, an actuating member mounted on the screw and having a pair of arms disposed on opposite sides of the screw, one of the said arms being in engagement with the screw for effecting lineal movement of the actuating member in one direction, means operating on the actuating member at the end of travel of the actuating member in one direction for effecting a tilting motion of the member for disengaging the said arm of the actuating member from the screw and engaging the other arm of the member with the oppositely directed threads of the screw for effecting reverse travel of the actuating member, means for continuously rotating

the screw, reciprocatory means connected to the grid and the actuating member for reciprocating the grid responsively to reciprocation of the actuating member, and means engageable by each arm of the actuating member at the end of each reciprocation and within said X-ray tube circuit constituting a grid switch, said circuit also including a manually operated exposure switch, and a relay switch adapted to control the energization circuit effecting the operation of the X-ray tube, said relay switch being adapted to effect initial energization of the X-ray tube through the operation of the grid switch after reversal of the reciprocating mechanism and to effect the uninterrupted energization of the X-ray tube regardless of the operation of the grid switch with the movement of said arms, until the termination of the energization, by the operation of the exposure switch, at the conclusion of the exposure.

2. A mechanism for reciprocating a Bucky grid of an X-ray apparatus including an X-ray tube and circuit means for energizing the tube, the combination which comprises mounting means for a screw, a rotatable screw mounted in the mounting means, the screw having oppositely directed threads along successive portions of its length, an actuating member mounted on the screw and having a pair of arms disposed on opposite sides of the screw, one of the said arms being in engagement with the screw, rotation of the screw effective lineal movement of the actuating member first in one direction and then in reverse direction through the oppositely directed threads, means operating on the member acting at the end of travel of the actuating member for effecting a tilting motion of the member for disengaging the said arm of the actuating member from the screw and engaging the other arm of the member with the oppositely directed threads of the screw for effecting reverse travel of the actuating member, means for continuously rotating the screw, reciprocatory means connected to the grid and the actuating member for reciprocating the grid responsively to reciprocation of the actuating member, and means within said X-ray tube circuit including a grid switch operated by the movement of said arms, a manually operated exposure switch and a relay switch adapted to control the energization circuit effecting the operation of the X-ray tube, said relay switch being adapted to effect initial energization of the X-ray tube through the operation of the grid switch after reversal of the reciprocating mechanism and to effect the uninterrupted energization of the X-ray tube regardless of the operation of the grid switch with the movement of said arms, until the termination of the energization by the operation of the exposure switch at the conclusion of the exposure.

3. An apparatus for reciprocating a Bucky grid of an X-ray apparatus including an X-ray tube and circuit means provided with an exposure switch and a relay switch, and adapted for energizing the tube, the combination which comprises a housing mounting means for a screw within said housing, a rotatable screw mounted in the mounting means, the screw having oppositely directed threads along successive portions of its length, an actuating member mounted on the screw and having a pair of arms disposed on opposite sides of the screw, the said arms being threaded oppositely to each other to correspond to the opposite threads on the screw, one of said arms being in engagement with the screw for effecting lineal movement of the actuating member in one direction, cam members mounted on the screw and rotatable therewith adapted to be engaged by the actuating means after a predetermined distance of travel thereof along the screw for tilting the actuating member and thereby disengaging the said arm of the actuating member from the screw and engaging the other arm of the member with the oppositely directed threads of the screw for effecting reverse travel of the actuating member, means for continuously rotating the screw, and reciprocating means connected to the grid and the actuating member for reciprocating the grid responsively to reciprocation of the actuating member, a pair of spaced contacts in the housing adapted to energize the circuit means, and a contact on the first mentioned arm of the actuating member adapted to clear one of the spaced contacts in the housing on outward movement of the actuating member along the screw and to engage momentarily the other of the spaced contact members responsively to the actuating member reaching its end of outward travel along the screw and responsively to tilting motion of the actuating member by the cam means, the contact member in the housing missed by the contact on the said arm on the outward movement of the actuating member being engaged by the contact on the arm as the arm of the actuating member is tilted by the cam means for initiation of the outward movement of the actuating member, whereby the X-ray tube included in said circuit means is energized immediately after a reversal of said grid in its reciprocating paths and the energizing circuit kept closed by the relay switch until the exposure switch is opened.

RUSSELL H. MORGAN.
PAUL C. HODGES.

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