June 8, 1937. S. E. LUNDQUIST 2,082,965

FLUOROSCOPIC SHUTTER CONTROL MECHANISM

Filed March 31, 1933 3 Sheets-Sheet 1

Fig. 1.

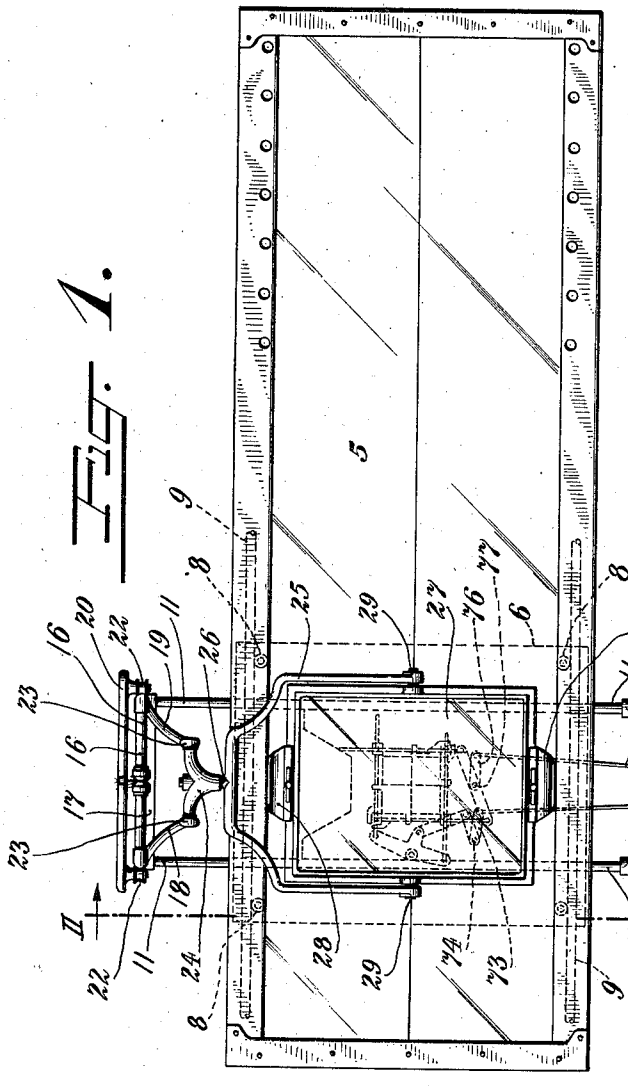


Fig. 6.

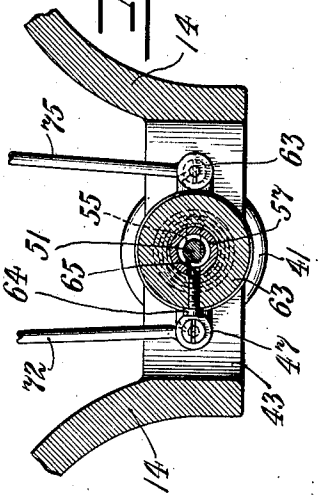
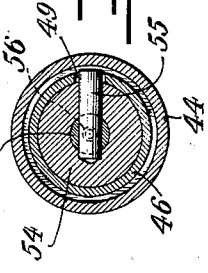


Fig. 8.



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FLUOROSCOPIC SHUTTER CONTROL MECHANISM

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Fig. 2.

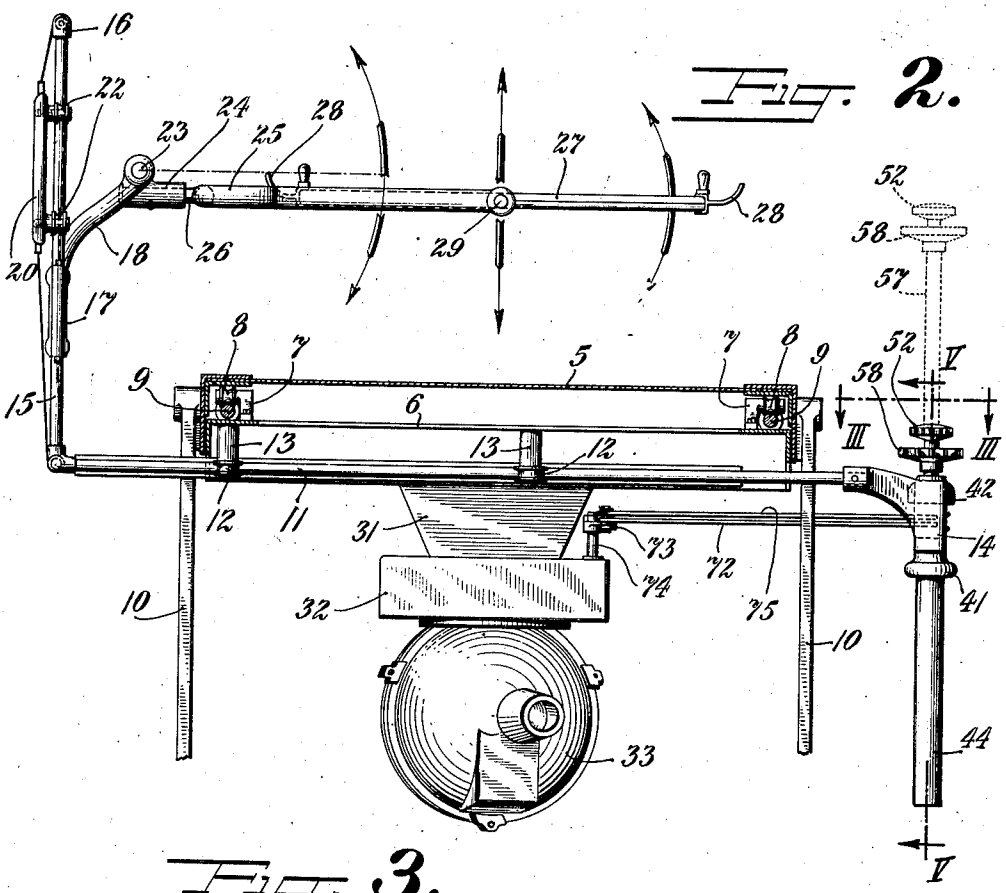
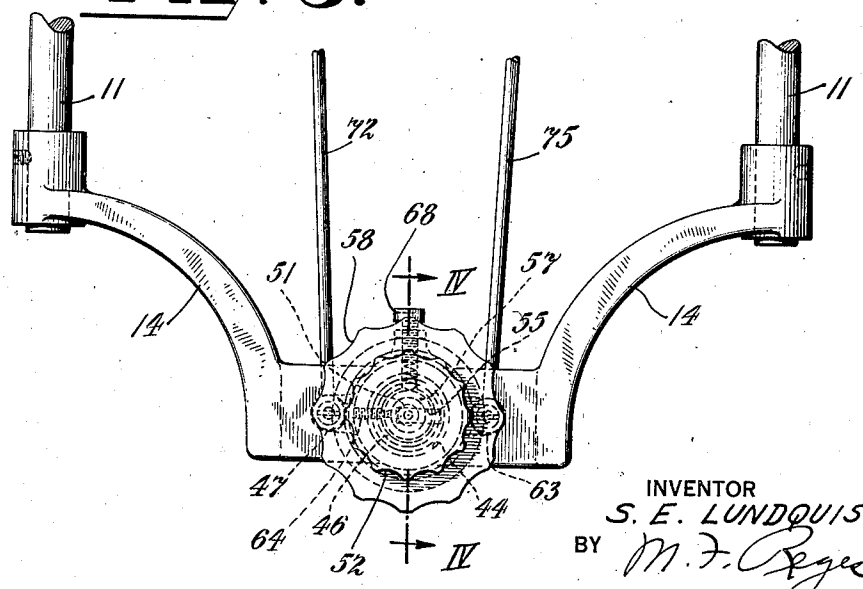


Fig. 3.



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FLUOROSCOPIC SHUTTER CONTROL MECHANISM

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Fig. 4.

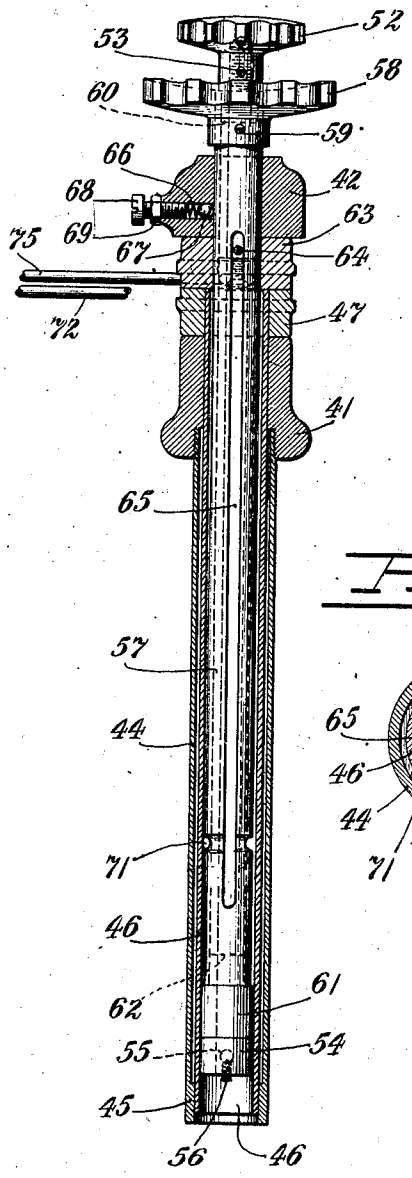

Fig. 5.

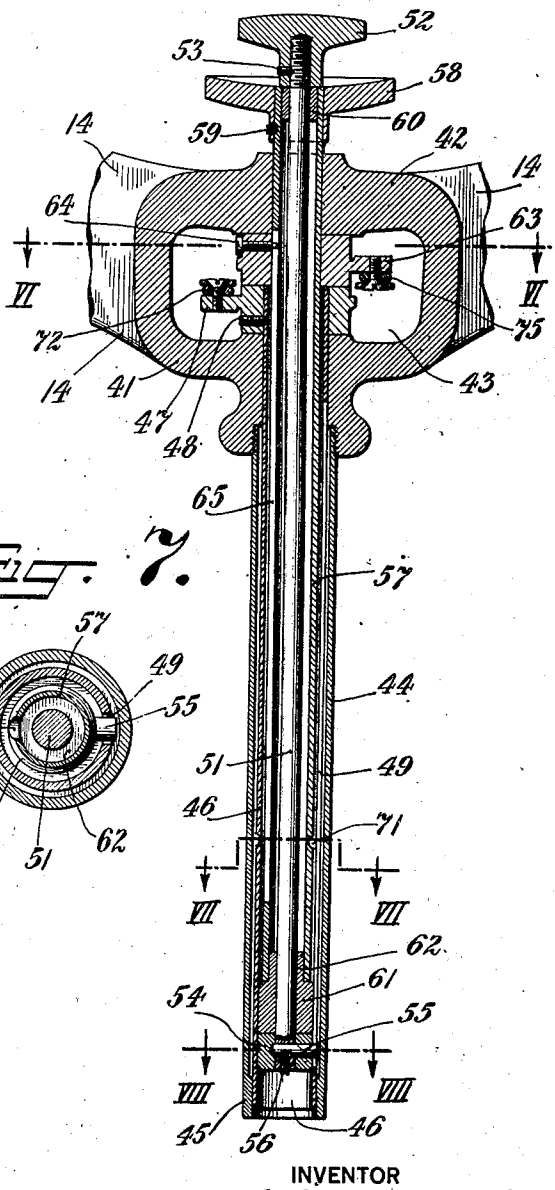

Fig. 7.

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UNITED STATES PATENT OFFICE

2,082,965

FLUOROSCOPIC SHUTTER CONTROL MECHANISM

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Application March 31, 1933, Serial No. 663,720

3 Claims. (Cl. 250—34)

My invention relates to X-ray apparatus and more particularly to control mechanism for the fluoroscopic shutters employed with X-ray tables and vertical fluoroscopes for fluoroscopic examinations and radiographic pictures.

This type of examination is sometimes performed by the roentgenologist with the patient lying prone upon an X-ray table in which the X-ray tube and fluoroscopic shutters are disposed below the table top and the fluorescent screen is above the table top and patient. It occasionally happens, however, that the examination can best be made with the patient in an upright position in which event the table is tilted to a vertical position where it becomes essentially what is known in the art as a vertical fluoroscope. A distinction is nevertheless made in the art between a tilt table and a vertical fluoroscope because the latter can be used only for examinations with the patient in the vertical position while a tilt table, as above stated, is adaptable to both prone and vertical examinations. Although my present invention is applicable to both forms of X-ray apparatus I shall for the sake of simplicity confine the description thereof to tilt tables.

In making diagnostic examinations frequently it is highly desirable that the rays emanating from the X-ray tube be confined to a particular portion of the patient's anatomy and only this desired part be projected upon the fluorescent screen. A set of adjustable shutters which are opaque to X-rays are, therefore, usually provided and are controlled from the table top to alter the size of the aperture through which the rays pass through the patient to the screen.

The fluorescent screen which is disposed above the table top or in front of the same, depending on the position of the table, is adjustable relative thereto in order to permit patients of varying body thickness to be positioned between the table top and screen. As an examination of this character must necessarily be made in the dark and the control knobs for operating the fluoroscopic shutters are affixed to the table top, considerable difficulty is frequently encountered in groping for them. The roentgenologist must face the screen and reach for the controls which is very apt to disturb the patient so that the particular organ under observation may inadvertently become altered causing loss of time and inconvenience.

This difficulty is even more greatly increased should the patient be of stout build which necessitates a considerable spacing between the screen and table top carrying the shutter controls during examinations. In this event the shutter controls may be entirely out of reach of the roentgenologist when in position in front of the fluorescent screen requiring him to leave this position to operate the shutter controls after he has located them in the dark.

In my present invention I obviate the aforementioned objectionable features heretofore inherent in this type of X-ray apparatus by making the fluoroscopic shutter controls telescopically adjustable relative to the table top in order that they may be moved to an extensible position always within easy reach of the operator. These controls being adjustable may be positioned at all times relative to the table top adjacent the adjustable fluorescent screen regardless of the body thickness of a patient thus dispensing with the requirement of groping in the dark for these controls.

A better understanding of my present invention may be had by reference to the accompanying drawings illustrative of one specific form which my invention may take wherein

Figure 1 is a top plan view of a table top or vertical fluoroscope to which my novel shutter control mechanism is attached.

Figure 2 is an elevational view partly in section of a table top and my novel fluoroscopic control mechanism, taken on the line II—II of Figure 1 and looking in the direction indicated by the arrows.

Figure 3 is a plan view in section of a portion of the shutter control knobs taken on the line III—III of Figure 2 and looking in the direction indicated by the arrows;

Figure 4 is a sectional view in elevation of my telescopic shutter control knobs taken on the line IV—IV of Figure 3 looking in the direction indicated by the arrows;

Figure 5 is a sectional view in elevation of my telescope shutter control knobs taken on the line V—V of Figure 2 looking in the direction indicated by the arrows;

Figure 6 is a sectional plan view taken on the line VI—VI of Figure 5 and looking in the direction indicated by the arrows;

Figure 7 is a sectional view taken on the line VII—VII of Figure 5 looking in the direction indicated by the arrows; and

Figure 8 is a sectional view taken on the line VIII—VIII of Figure 5 and looking in the direction indicated by the arrows.

Referring now to the drawings in detail I have shown a patient supporting member, such as a table top 5, carrying a fluoroscopic unit adapted

to move longitudinally the entire length of this table top. This unit includes a carriage 6 which is provided with suitable supporting means, such for example as a plurality of angular lugs or uprights 7 rigidly secured thereto. Rollers 8 are carried by the horizontally extending portion of these lugs 7 and engage a guideway or tracks 9 rigidly affixed to the underside of the table top 5 thus enabling the carriage and parts carried thereby to be moved longitudinally of the table. The table top 5 is supported a suitable distance from the floor by means of standards 10, to which the table is rotatably connected, to allow tilting of the table from horizontal to vertical positions as is well known in the art.

An auxiliary support having side members 11 is carried by the carriage 6 thus forming a part thereof and is adapted to move transversely thereof by means of rollers 12 carried by depending lugs 13 affixed to the carriage. The side members 11 of this auxiliary support are joined at one end by a yoke or bracket 14 while the other end of these side members extend upwardly, as at 15 (Figure 2) and are joined at their upper ends by a cross-tie 16.

A frame member 17, provided with suitable rollers (not shown) and having angularly extending portions 18 and 19, is disposed between the upright portions 15 and is adapted to be moved longitudinally thereof. A counter-weight 20 having rollers 22 is arranged to engage the outer edges of the upright portions 15 and is connected by any suitable means (not shown) to the frame member 17 for the purpose of counterbalancing the weight of the latter and the parts carried thereby.

The free ends of the angularly extending portions 18 and 19 are pivotally connected at 23 by a yoke 24 which in turn has a bifurcated frame member 25 pivotally connected thereto at 26. A fluorescent screen 27 provided with suitable handles 28 is pivotally connected at 29 to the ends of the bifurcated frame member 25 to permit rotation of the screen in a vertical plane about this pivot point 29. Moreover, further rotation of the screen in a vertical plane results from the pivotal connection 26 of the bifurcated frame member 25 to the yoke 24 thus enabling substantial flexibility of the screen during a fluoroscopic examination.

When it is desired to move the fluorescent screen 27 out of the field of radiation of the X-ray tube, as is necessarily the case when taking a radiographic exposure, the screen 27 together with the bifurcated frame member 25 is rotated to a vertical position about the pivotal connection 23 as shown by the arrows in Figure 2. The movement of the frame member 17, which is counter-balanced by the weight 20, longitudinally of the upright portions 15 enables the fluorescent screen 27 to be moved relative to the table top to compensate for patients of various build.

A rectangular ray opaque cone 31 provided with downwardly converging sides is carried by the side members 11 of the transversely movable auxiliary support below the table top, and is centrally disposed relative to the fluorescent screen 27 above the table top in order that they align with each other during transverse movement of this auxiliary support. A housing 32 is secured to this cone and encases adjustable fluoroscopic shutters operable to restrict the aperture in the lower portion of the cone 31.

A ray opaque shield 33 is in turn secured to the housing and is formed in sections to allow the insertion and removal of an X-ray tube (not shown) employed for the purpose of fluoroscopic and radiographic examinations.

The adjustable fluoroscopic shutters encased within the housing 32 and their operation being well known to the art, as shown in Wappler et al. Patent 1,623,567, issued April 5, 1927 and the patent to A. C. Nelson, #1,953,497 issued April 3, 1934, a detailed description thereof is deemed unnecessary. Suffice it to say that upon operation of the shutter control mechanism each pair of shutters are moved toward or away from each other, depending upon the direction of operation of the controls, which restricts or enlarges the aperture at the lower end of the rectangular cone 31 and consequently the area through which the X-rays emanate to the body of a patient and the fluorescent screen.

The yoke 14 connecting one end of the side members 11 of the transversely movable auxiliary support is flared outwardly at its center and forms bearings 41 and 42 with an annular opening 43 therebetween, for supporting my novel shutter control mechanism as can be more readily appreciated by reference to Figures 4 and 5. These bearing portions 41 and 42 have a coaxial opening extending therethrough and a depending hollow cylinder or tube 44 threadedly engages the bearing portion 41 in alignment with the opening therein and is provided at its lower extremity with a portion of reduced diameter which forms a bearing 45. A concentric hollow shaft or tube 46 is disposed within the cylinder 44 and has a slightly less diameter than that of the cylinder 44 so that it may be journaled to rotate about the bearing 45.

This shaft 46 extends through the opening provided in the bearing 41 and projects slightly into the annular opening 43. A lever arm 47 is rigidly secured in a suitable manner, such as by a set screw 48, to the extremity of the shaft 46 so that rotary movement of this shaft causes horizontal movement (as viewed from Figures 2, 4, and 5) of the lever arm 47, and a longitudinal slot 49 (Figure 5) is provided in the hollow shaft 46. A shaft or rod 51 is concentrically disposed within the shaft 46 and extends loosely through the opening provided in the bearings 41 and 42 and slightly above the bearing 42. A control knob 52 is rigidly connected, by suitable means, such as a threaded connection and held by a set screw 53, to the upper extremity of this shaft 51. A collar 54 is secured to the lower extremity of this shaft 51, by means of a laterally extending pin 55 projecting into the slot 49 in the shaft or tube 46, and this pin is rigidly secured in place by suitable means, such as a set screw 56.

A hollow shaft or tube 57 is disposed between the shaft 51 and the shaft 46 and is journaled in the bearing portion 42 and has a control knob 58 rigidly secured by means, such as a set screw 59, to its upper extremity and this control knob 58 is provided with a portion 60 forming a bearing for the shaft 51. A collar 61, having a reduced diameter portion or bearing 62, loosely surrounds the shaft 51 above the collar 54 internally of the shaft 46, and the lower extremity of the shaft 57 is journaled to rotate about the bearing 62 formed by this collar. A lever arm 63 surrounds this shaft 57 in the annular opening 43 between the lever arm 47 and bearing 42. This lever arm 63 is secured to the shaft 57, by

means of a set screw 64, which projects into a longitudinal slot 65 in the shaft 57 in order that rotary movement of the shaft causes movement of the lever arm 63 in a horizontal plane yet permitting longitudinal movement of the shaft 57 as hereinafter described.

The bearing 42 is provided with a lateral opening 66 adapted to encase a spring-pressed ball 67 and an adjustment screw 68 and lock nut 69 holds the spring pressed ball in place as well as enabling the regulation of the tension upon the spring-pressed ball 67. The shaft 57 is provided with a peripheral groove 71 which is adapted to be engaged by the spring-pressed ball 67 thus functioning as a stop preventing longitudinal movement of the shaft 57 beyond fixed limits.

The lever arm 47 has pivotally connected thereto a link bar 72 which extends to a bell crank lever 73 rigidly affixed to a short shaft 74 extending into the housing 32 and connected to the mechanism for operating one pair of the fluoroscopic shutters. A similar link bar 75 is pivotally connected to the lever arm 63 and extends to a bell crank lever 76 also rigidly affixed to a short shaft 77 extending into the housing 32 for operating the remaining pair of fluoroscopic shutters therein encased.

The operation of the fluoroscopic unit shown and described, insofar as it pertains to the longitudinal movement of the carriage relative to the table top and the transverse movement of the auxiliary support, is well known in the art and it is believed unnecessary that it be herein set forth. Moreover, the flexibility of the fluorescent screen due to its movement in various vertical planes and relative to the table top in order to compensate for patients of various builds is fully shown and described in the domestic patents hereinbefore referred to and need not be here repeated.

In the operation of my shutter control mechanism the adjustable shutters are caused to recede or approach each other by the operation of the control knobs 52 and 58. Assuming the operator desires to alter the aperture through which the X-rays are projected from an X-ray tube (not shown) housed within the shield 33, and the mechanism is in the position shown in Figures 2, 4 and 5, he will then rotate the control knob 52. Rotation of this control knob 52 naturally causes like rotation of the shaft 51, to which it is rigidly affixed, and as the pin 55 is secured to this shaft 51 and projects into the slot 49 provided in the hollow shaft 46 this latter shaft rotates in the same direction within the bearings 41 and 45. Consequently the lever arm 47 which is rigidly secured to the shaft 46 is likewise rotated. This rotary movement of the lever arm 47 pulls or pushes on the link bar 72 (depending upon the direction of rotation of the control knob and shaft 46) thus causing like movement of bell crank lever 73 with attendant rotary movement of the short shaft 74. This latter shaft, as before stated, being connected to one pair of the fluoroscopic shutters within the housing 32 causes the movement thereof for the desired alteration of the aperture.

The control knob 58 is then rotated with similar movement of the shaft 57 and as the lever arm 63 is connected to the latter by the set screw 64, the pivoted link bar 75 is pushed or pulled, depending as before stated upon the direction of rotation of the control knob 58, with like movement of the bell crank 76. Rotation of the short shaft 77 also follows with attendant movement of the remaining pair of fluoroscopic shutters within the housing 32.

Although I have described the operation of the control knobs 52 and 58 as being separate operations by the operator it should be understood that they may be both grasped by the operator if desired and simultaneously operated. Alteration, therefore, of the fluoroscopic shutters restricts the radiation emanating from the X-ray tube to a desired area of a patient in position upon, or in front of, the table top and enables this desired area to be projected upon the fluorescent screen 27.

Assuming now the roentgenologist is making a vertical fluoroscopic examination of a patient of comparatively stout build and is in a sitting position facing the screen. The fluorescent screen 27 is accordingly positioned in front of the operator and is a substantial distance from the table top. The shutter control knobs 52 and 58 in their normal position are carried by the table and are usually disposed flush with the top thereof or slightly below the latter in order to facilitate the placing of the patient on the table. In this position with a stout patient under examination, it frequently happens that the shutter control knobs would be out of reach of the operator, but in this event he need merely grasp the control knobs and pull slightly thereon.

The telescopic connection of the control knobs 52 and 58 relative to the support therefor enables them to be extended a substantial distance above the table top where they are always in position adjacent the fluorescent screen. This may be appreciated by reference more particularly to Figures 4 and 5 wherein, as before stated, the shaft 46 is provided with a longitudinal slot 49. The pin 55 extending into this slot and which causes rotation of the shaft 46 is moved longitudinally of the tube upon the control knobs being moved to an extended position.

In a like manner the inner shaft 57 is moved longitudinally and its connection with the lever arm 63 is not destroyed due to the set screw 64 projecting into the slot 65 provided in this shaft 57. This accordingly permits telescopic adjustment of the control knobs relative to the yoke 14 and shafts 44 and 46 without in any way impairing the efficient operation of the entire fluoroscopic mechanism. Moreover, due to the slight frictional engagement of the shaft 57 with the bearing 42 and the spring-pressed ball 67 with this shaft, the control knobs are retained in any desired extensible position. This spring pressed ball 67 further functions as a limit for the maximum extension of the control knobs by engaging the peripheral groove 71 about the shaft 57.

It should be further noted that whichever control knob the operator grasps to move the controls to their extensible position the other one will follow. Thus by pulling on the knob 52 the collar 54 is raised thereby raising the loose collar 61 having the bearing portion 62 for the shaft 57 and consequently causing longitudinal movement of this latter shaft along with the shaft 51. Again should the operator pull on the control knob 58 it naturally follows that, due to the control knob 52 being secured to the shaft 51 above the control knob 58, the former and parts operated thereby will follow.

Accordingly it becomes obvious to those skilled in the art that I have provided fluoroscopic shutter controls which are in telescopic engagement

with the support therefor. This results in a fluoroscopic unit adaptable to tilt tables and vertical fluoroscopes wherein the control may be moved at all times to an extensible position adjacent the fluorescent screen thus substantially obviating the necessity for the operator to grope in the dark therefor. Furthermore, the controls are telescopically adjustable by the operator so that they are always within easy operating distance irrespective of the various body thickness of individual patients.

Although I have shown and described one specific embodiment which my invention may take I do not desire to be limited thereto as various other modifications of the same may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed:

1. A controlling mechanism for a fluoroscopic unit provided with a support, adjustable fluoroscopic shutters, and a fluorescent screen movable vertically to various positions with respect to said support comprising means connected to said adjustable fluoroscopic shutters and to a portion of said support for operating said adjustable fluoroscopic shutters, and means telescopically engaging said support and connected to said first mentioned means and movable to various extended positions independent of the vertical movement of said fluorescent screen to enable said last mentioned means to be moved to various extended positions with respect to said support and the various vertical positions of said screen for causing movement of said first mentioned means with attendant operation of said shutters from any extended position of said last mentioned means.

2. A controlling mechanism for a fluoroscopic unit provided with a support, adjustable fluoroscopic shutters, and a fluorescent screen movable vertically to various positions with respect to said support, comprising mechanism carried by said support for controlling said adjustable fluoroscopic shutters including a hollow cylinder disposed at one side of said support, a hollow shaft concentrically disposed within said cylinder, a pair of concentrically disposed shafts in telescopic engagement with said hollow shaft and cylinder, each of said last named shafts being provided with a control knob for rotating its associated shaft and movable into various extensible positions relative to said cylinder and said support, and connections between at least two of said shafts and said adjustable fluoroscopic shutters to cause operation thereof in response to rotation of said shafts by said control knobs from any extensible position of the latter.

3. A controlling mechanism for a fluoroscopic unit provided with a support, adjustable fluoroscopic shutters, and a fluorescent screen movable vertically to various positions with respect to said support, comprising mechanism carried by said support and connected to said fluoroscopic shutters for actuating said shutters including a hollow cylinder disposed at one end of said support, a hollow shaft concentrically disposed within said cylinder and having a longitudinal slot and being provided with a lever arm secured thereto for rotation with said shaft, a second shaft concentrically disposed relative to said cylinder and having a control knob affixed to one end and a member at its other end engaging the longitudinal slot in said hollow shaft for the purpose of enabling said second shaft to be moved to various extensible positions relative to said hollow shaft and to rotate the latter from any of its extensible positions by actuation of said control knobs, a third shaft concentrically disposed relative to said hollow cylinder having a lever arm secured thereto for rotary movement therewith and provided with a longitudinal slot and a control knob at one end thereof to enable said third shaft to be moved to various extensible positions relative to said cylinder and to cause rotary movement of said lever arm in response to operation of said control knob from any extensible position of said third shaft, and connections from the lever arms affixed to said first and third mentioned shafts to said adjustable fluoroscopic shutters to cause operation thereof in response to the actuation of the control knobs carried by said second and third mentioned shafts.

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