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J. AGEL

3,222,518

MOVABLE X-RAY TABLE WITH MEANS TO TAKE X-RAY PICTURES OF
SUCCESSIVE PORTIONS OF THE OBJECT AND MEANS TO
ALTERNATIVELY INSERT PHOTOGRAPHIC MEANS AND
IMAGE AMPLIFIER MEANS

Filed June 24, 1963

2 Sheets-Sheet 1

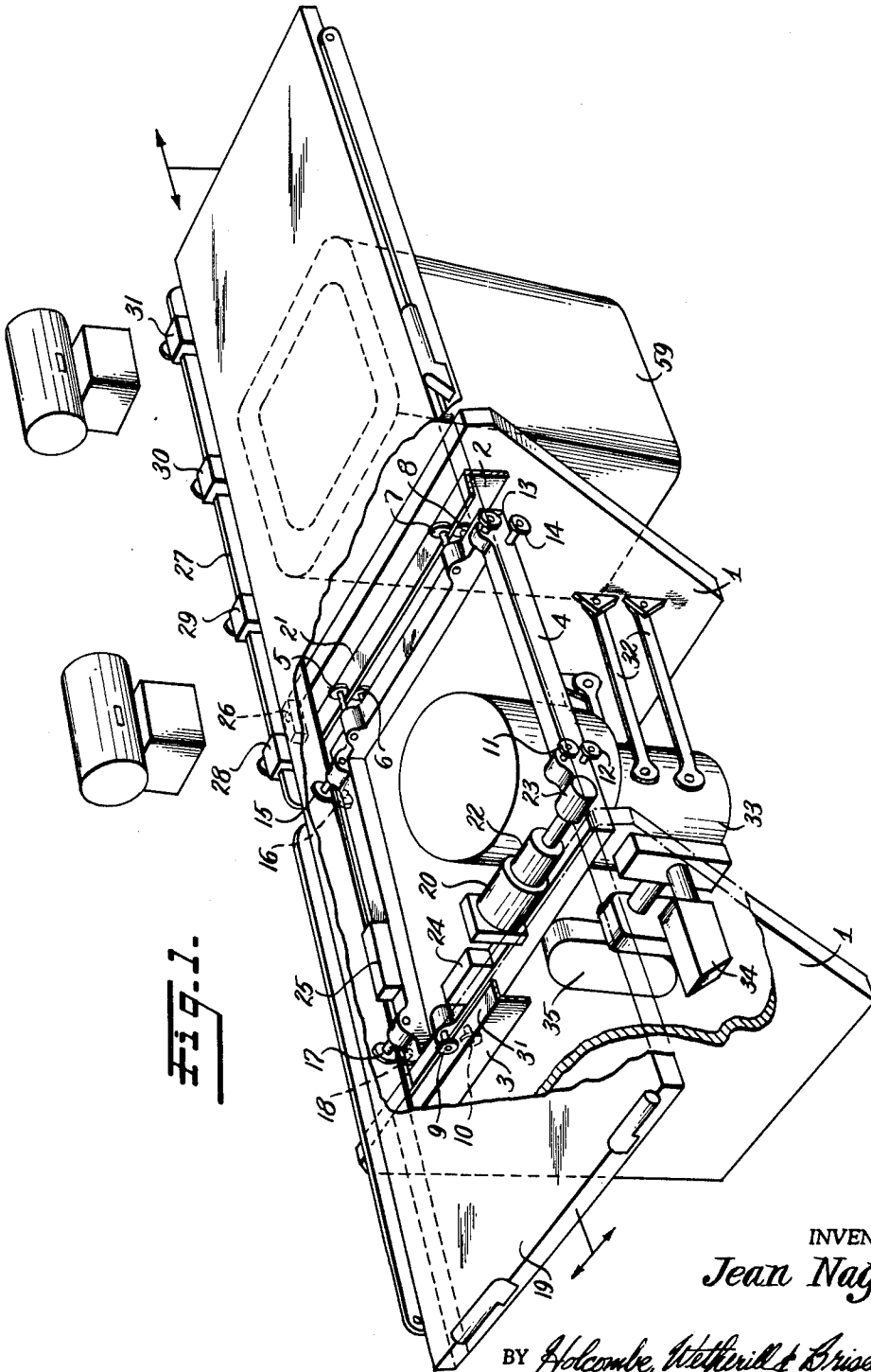


Fig. 1.

INVENTOR
Jean Nagel

BY *Holcombe, Wetherill & Brudnis*
ATTORNEYS

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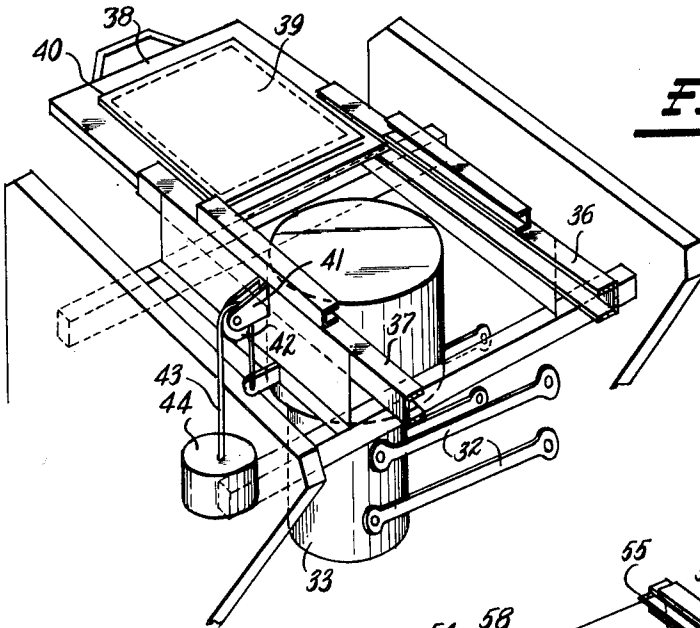


Fig. 2.

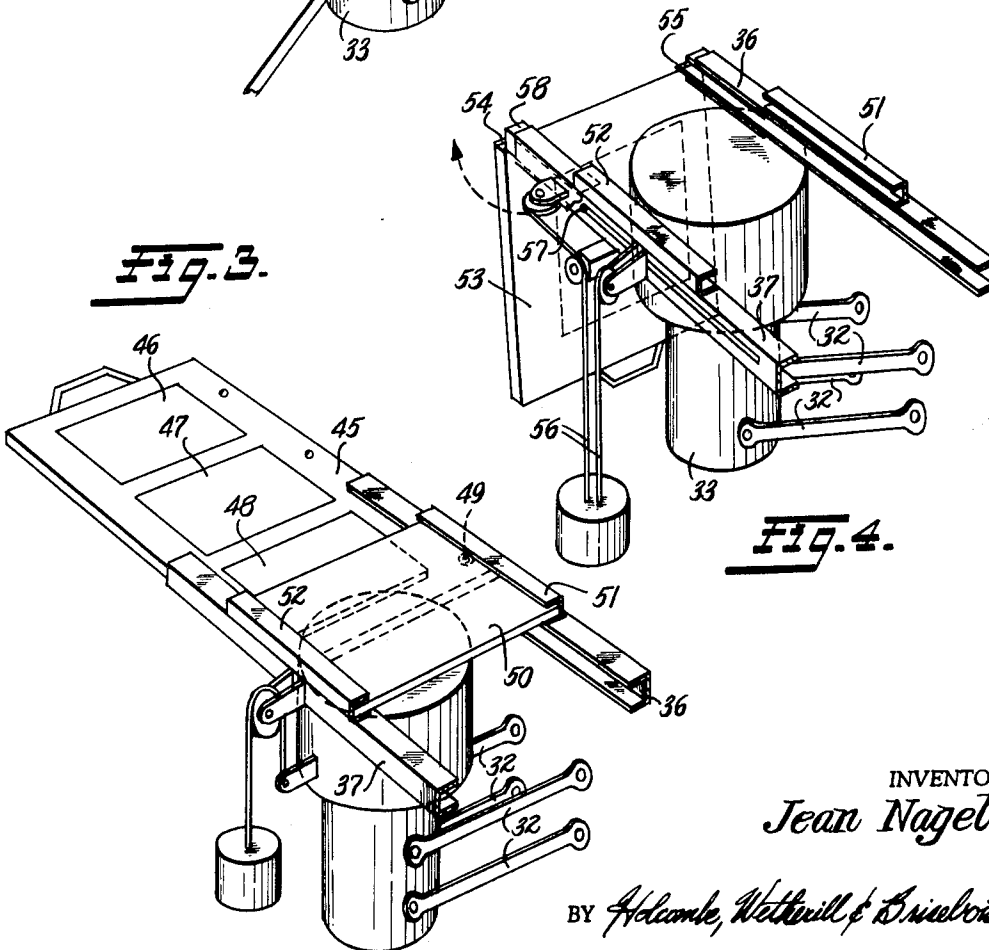


Fig. 3.

Fig. 4.

INVENTOR
Jean Nagel

BY *Holcombe, Wetzel & Briscoe*

ATTORNEYS

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MOVABLE X-RAY TABLE WITH MEANS TO TAKE X-RAY PICTURES OF SUCCESSIVE PORTIONS OF THE OBJECT AND MEANS TO ALTERNATIVELY INSERT PHOTOGRAPHIC MEANS AND IMAGE AMPLIFIER MEANS**Jean Nagel, Vanves, France, assignor to Compagnie Generale de Radiologie, Paris, France, a corporation of France**

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Claims priority, application France, June 28, 1962,

902,284, Patent 1,335,544

5 Claims. (Cl. 250—58)

This invention relates to medical X-ray systems of the type comprising a flat table adapted to receive a subject to be X-rayed recumbent on its top and means for accurately displacing the table in a horizontal plane both longitudinally and transversely for positioning a selected part of the subject's body in the path of a vertical X-ray beam for examination, photography and/or treatment.

Various X-ray table systems of this kind have been proposed, wherein the positioning of the table is effected manually and/or by power. It is an object of this invention to provide an improved X-ray table system having provision for automatically displacing the table bearing a subject thereon in accordance with a predetermined positional sequence; another object is to provide in such a table system for the possibility of fully synchronising the table displacements with the operation of automatic camera means, whereby to position sequentially various selected areas of the subject's body in the path of the X-ray beam, and photograph each of said areas while thus positioned, all in accordance with a prescribed sequence or programme.

One important medical application of the invention is in the diagnosis and treatment of vascular diseases, where the blood circulation along the vessels e.g. of the subject's lower limbs is investigated by first injecting into the vessel at one point, a substance opaque to X-rays. The invention then permits rapidly and automatically radiographing successive portions of the vessel as they are progressively opacified by the substance carried along with the bloodstream. In view of the high rate of arterial blood flow, about four metres per second, such operations have heretofore presented serious problems. It is a specific object of this invention to provide improved X-ray apparatus for the above and related applications.

Another object is to provide an X-ray system having improved facilities for accurate substitution of a photographic plate-carrier for a brightness amplifier, whereby a selected part of the subject's body can first be X-ray viewed, and then the same part can be X-ray photographed immediately without having to reposition the table carrying the patient.

A broad object is to provide a medical X-ray system having greatly improved features of operating facility, accuracy, and versatility, and also one that will be especially well-suited for remote viewing and motion-picture recording by television.

An exemplary embodiment of the invention will now be described by way of illustration but not of limitation with reference to the accompanying schematic drawings, wherein:

FIGURE 1 is a perspective view of an improved X-ray table system according to the invention and associated equipment;

FIGURE 2 is a partial perspective view showing more clearly the movement and counterweight means for brightness intensifier (or luminance amplifier) unit and the means for inserting a plate-carrier frame in vertically centered relation therewith;

FIGURE 3 is generally similar to FIGURE 2 but shows the insertion of a multiple plate-carrier frame; and

FIGURE 4 is a view similar to FIGURE 2 but relating to a modification.

Generally speaking, the apparatus of the invention as shown in FIGURE 1 includes a supporting frame structure 1 and a flat rectangular table 19 which is displaceable in its plane both longitudinally and transversely above the frame structure.

More specifically, the supporting frame 1 is shown as carrying a pair of longitudinally spaced transverse angles or channels 2 and 3 providing rails or guideways. A rectangular frame 4 is provided with pairs of rollers engaging the upper and lower surfaces of the horizontal flanges 2' and 3' of the angles 2 and 3 for displacement, transversely to the supporting frame structure 1. Thus frame 4 carries the upper and lower rollers 5-7 and 6-8 engaging the flange 2', and the upper and lower rollers 9 and 10, respectively, engaging the flange 3'.

The frame 4 further carries pairs of upper and lower rollers on each of its remaining two sides, to wit the upper rollers 11 and 13 and lower rollers 12 and 14 on one side, and the upper rollers 15 and 17 and lower rollers 16 and 18 on the opposite side. These four pairs of rollers are engaged by the upper and lower surfaces of suitable side flanges, not shown, provided along the longitudinal sides of the flat rectangular table member 19.

It will thus be seen that the frame 4 is displaceable transversely across the supporting structure 1, while table 19 is displaceable longitudinally relative to the frame 4, thus providing the table 19 with two-dimensional freedom of movement relative to the frame structure 1 in a horizontal plane.

In the illustrated embodiment, provision is made for manually displacing table 19 with frame 4 transversely across the supporting structure 1, and for mechanically displacing the table 19 in the longitudinal direction with respect to frame 4 and structure 1. For this latter purpose there is shown an electric motor 20 suitably mounted on the frame 4 and driving by way of an electrically actuated clutch 22 a driver roller 23 frictionally engageable with a cooperating longitudinal surface of the table 19. Instead of the friction drive shown, a rack and gear drive may be used. Motor 20 is further shown as being provided with an electrically actuated brake 21, of a suitable conventional type capable of bringing the motor promptly to a stop on disengagement of the clutch 22.

Electrically actuated braking means 25 and 24 are further provided for blocking the table 19 in any position on its longitudinal and transverse paths of displacement respectively.

Extending parallel to a longitudinal side of the table 19 and supported therefrom is a rail 27 having switch-actuator cams 28, 29, 30, 31 mounted thereon at adjustable longitudinal settings by means of set screws. Obviously the number of cams used may differ from the four shown. The cams are engageable with a switch contact member 26 mounted on a side of frame 4 in a suitable position to be engaged by the cams in succession as the table 19 moves longitudinally with respect to the frame 4.

An automatic film- or plate-changing camera unit 59, of generally conventional character, is shown as positioned underneath the table 19 in fixed relation to the supporting frame structure 1, and in vertical alignment with an X-ray beam issuing from a conventional X-ray generating unit shown above the table.

In the preferred use of the apparatus as so far described, assuming for example it is desired to take successive radiographs of selected parts of one leg of a subject lying upon the table 19, the cams 28-31 may first be preset to positions along the rail 17 corresponding to

said selected parts, and the table 19 with frame 4 shifted manually in a transverse direction until the said leg of the patient is positioned in the vertical plane of the X-ray beam. Then electric power is applied so that motor 20 rotates to move the table 19 longitudinally with respect to frame 4 and supporting structure 1. As a first cam, say cam 28, strikes the switch 26, this acts through conventional circuitry not shown, to disengage clutch 22 and apply the electrically actuated brakes 21 and 25. The table is thus blocked at a position in which the first of the areas to be radiographed is presented to the X-ray beam. The X-ray camera 59 is now operated, manually or preferably automatically, to expose a film and to remove the exposed film or plate and insert a fresh one in its place. The brakes 25 and 21 are released and clutch 22 reengaged to cause the table 19 to start on a new lap of its longitudinal travel, until the next of the preset cams engages switch 26, when the above process is repeated.

It will be readily understood that the process thus described can be made fully automatic, and the circuitry required for this purpose is of a relatively simple type which will be easily designed by anyone skilled in the art of electrical control, so that it has not been illustrated herein. When all the requisite radiographs of the subject's one leg have thus been taken, the table 19 may be shifted manually in a transverse direction to place the other leg in position, should this be necessary, and the above sequential process repeated, with either the same or different settings of the cams 28-31.

According to a feature of the invention, a brightness (or luminance) amplifier unit 33 is supported from the structure 1 generally beneath the frame 4. The unit 33 is supported for vertical, up-and-down parallel movement relative to structure 1 by means of a parallel linkage system comprising two pairs of arms 32 having opposite ends pivoted to structure 1 and to suitable points of the casing of unit 33 as shown. The unit 33 is further shown as having attached to it a television camera 34 and a motion-picture camera 35, though the provision of each of these attachments is of course optional.

Referring more especially to FIGURE 2, a pair of longitudinally spaced slideways 36 and 37 shown as a pair of channels facing each other, are supported from the frame structure between the frame 4 and table 19. A slider 38 carrying a plate- or film-carrier 39 and an overlying anti-diffusion screen 40 is slidably insertable into the guideways 36 and 37 from a side of the apparatus. From the outer side of slideway 37 a pulley 42 is rotatably supported by means of a yoke 41. A rope 43 trained over the pulley has one end attached to the casing of unit 33 and its other end suspends a weight 44 serving to counterbalance the weight of unit 33 and any attachments thereto.

With the arrangement just described, it will be evident that with the plate-carrier slide 38 removed, the brightness intensifier unit 33 can be lifted to its uppermost operative position to effect an X-ray viewing. Thereafter, the unit 33 can easily and quickly be pushed down and out of the way and the slider 38 inserted, so as to take a radiograph of the organ previously viewed.

FIGURE 3 illustrates an arrangement using a plate-carrying slider 45 provided with a plurality of, herein three, plate cases 46, 47 and 48, whereby a sequence of radiographs can be taken in rapid succession by simply displacing the slider 45. A detent latch 49 is provided for latching the slider 45 in each of its correct positions at which the plates are centered with respect to the field previously viewed by means of the brightness amplifier unit 33. In this case screen 50 is shown positioned in separate slideways 51 and 52 provided above the ways 36 and 37.

In FIGURE 4 is shown a modification wherein the ways 36 and 37 are of telescopic construction, and the plate-carrier 53 is provided with hinge means 54 and 55.

The arrangement is such that after the slider 53 has been pulled out it can be shifted from a horizontal to a vertical position so as to be conveniently out of the way.

As further shown in FIGURE 4, a rope 56 has one end attached to counterweight 44 and its other end passed around a pulley and attached to a pin 57 projecting from the lower telescopic slideway 58. With this arrangement the movement imparted to slider 53 in shifting it to horizontal position and inserting it into its ways, acts by way of rope 56 to push the unit 33 to its lower, idle position. The rope 56 acts to relieve the counterweight 44 so that the unit 33 is lowered automatically to its idle position where it does not interfere with the insertion of the plate-carrier 53.

It will be appreciated that the invention as described provides important improvements in medical X-ray apparatus. While the two main features of the invention, namely the means for positioning table 19 in relation to the camera 59, and the means for substituting the brightness amplifier unit 33 and sliding plate-carrier, may be used separately with advantageous results, it is preferred according to the invention that the two arrangements be combined since this will lead to especially interesting results particularly (though not exclusively) in connection with the vascular X-ray investigations previously referred to. The injection of opaque substance, previously described, can then be effected under televised monitoring using the brightness-amplifier unit 33, and the rate of flow of the bloodstream as well as other diagnostic features can then be studied by operating the table and automatic camera 59 as described earlier herein.

Various changes and modifications, other than those expressly mentioned above, can of course be introduced without exceeding the scope of the invention claimed.

I claim:

1. An X-ray system comprising in combination means producing an X-ray beam; a table adapted to support the body of a subject thereon in a plane generally normal to the beam, said table comprising a movable part including a top and a fixed part including a supporting frame therefor; means mounting the table top on the supporting frame for displacement in said plane longitudinally of the subject's body so as to position any selected part of the subject's body in the beam; X-ray camera means positioned on the opposite side of said table top from said beam producing means for radiographing said selected part positioned in the beam, said camera means being mounted to be stationary while said selected part is being radiographed; motor operated drive means mounted on said supporting frame for displacing the table top; switch means, a plurality of switch operating means separately positionable relative to the table in a direction parallel to table top displacement, said switch means being carried by one of said table parts while said switch operating means are mounted on the other in a cooperating position such that said switch means is actuated on displacement of the table top to each of a corresponding plurality of positions; said switch means being connected to said motor operated drive means for operating and disabling the latter in a controllable sequence on actuation of the switch means, whereby to displace the table top in a stepped sequence to each of said plurality of positions, means for operating said camera while the table top is at each position; means producing a second X-ray beam parallel to said first beam and intersecting the plane of said table top at a point longitudinally spaced from said first beam; a brightness amplifier unit including television camera and cine-camera means immovably connectable therewith; parallel linkage means on said supporting frame supporting said unit under the table top for parallel displacement in a direction generally parallel to the optical axis thereof towards the table top to an operative position in centered relation with said second beam and away from the table to an idle position; photographic plate carrier means

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mounted under the table top for sliding movement generally in the plane of said table top transversely thereto between an operative position in centered relation with said second beam and a withdrawn idle position; and means for alternatively moving said unit to its operative position and said carrier means to its idle position, and moving said unit to its idle position and said carrier means to its operative position.

2. The system as claimed in claim 1, further including means mounted on said supporting frame for selectively displacing the table top in a second direction transverse to said longitudinal direction of displacement.

3. The system claimed in claim 1, wherein said switch means are connected to the camera means for automatically operating the camera while the table is at each said position.

4. The system claimed in claim 1, including counterweight means attached to said amplifier unit for counteracting the force of gravity during displacement of said unit between its two positions.

5. The system claimed in claim 1, including means

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connected to said amplifier unit and to said plate carrier means for causing downward movement of said unit to its idle position on displacement of the carrier means to operative position and upward movement of said unit to its operative position on displacement of the carrier means to its idle position.

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20 RALPH G. NILSON, *Primary Examiner*.