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(54) **Tilttable operating table**

(57) The present invention generally finds application in the art of medical apparatus and particularly relates to an adjustable surgical table comprising a load-bearing column (2) having an upper head (3) with a patient-supporting tabletop (4) mounted thereto, guide means (5) for guiding the tabletop (4) along a longitudinal plane of symmetry (π), wherein the guide means (5) comprise a curvilinear guide (6) to be associated with the column (2) and a slide (7) adapted to move on the guide (6), first actuator means (8) operating on the slide (7) to cause motion thereof along the curvilinear guide (6). The curvilinear guide (6) is adapted to be fixed to the head (3), and the slide (7) is rigidly connected to the tabletop (4), with no freedom of relative rotation, the first actuator means (8) being mounted to the head (3) to cause motion of the slide (7) relative to the guide (6).

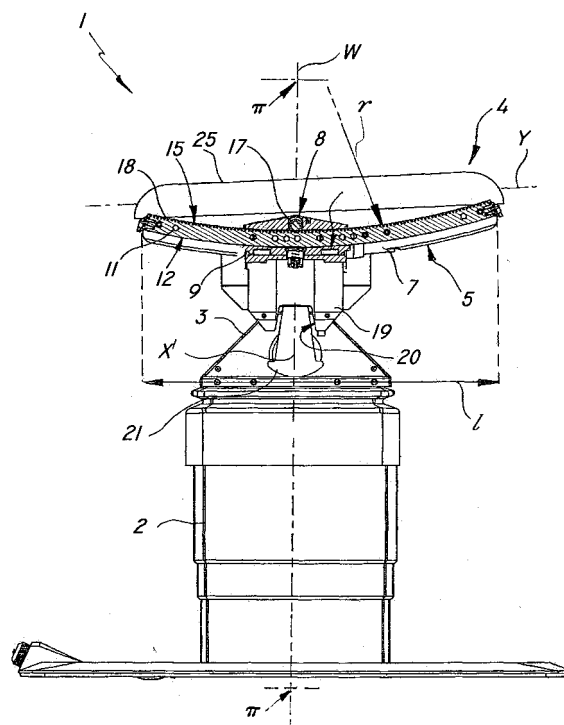


FIG. 1

Description

Field of the invention

[0001] The present invention generally finds application in the art of medical apparatus and particularly relates to a surgical table that is adjustable to adapt the position of a patient lying thereon to the required surgery procedure or diagnostic analysis.

Background of the invention

[0002] Surgical tables for use in surgery or diagnostics are known to be essentially composed of a base column standing on the floor, and supporting a tabletop designed to receive a patient in lying, supine, sitting or even complex positions, depending on the specific type of examination.

[0003] Once the patient has been placed on the tabletop, the latter is driven for the patient to take the position that is most appropriate with respect to the particular type of surgery or analysis, and most comfortable for the surgeon or operator.

[0004] For this purpose, surgical tables shall be able to translate along one or more axes, i.e. for adjusting the height of the tabletop to the height of the surgeon, and to rotate about one or more axes for positioning the patient body, or a part thereof, possibly in oblique directions.

[0005] WO02/111618 discloses a surgical table comprising a horizontal tabletop mounted to a load-bearing column and adapted to slide in the direction of its length by means of a carriage movable along a pair of straight rails, one of which is associated with the tabletop and the other with the column.

[0006] DE10253878 discloses a surgical table that is removably mounted to a load-bearing column so that it can be rotated relative thereto to the desired position.

[0007] A similar solution is also known from EP1032350, by the Applicant hereof, in which both the height and tilt of the surgical table are adjusted using suitable actuators located within the column.

[0008] While these known surgical table solutions, like those commonly used for surgery and diagnostics in general, provide some flexibility of use, they cannot reach extreme tilt and longitudinal extension positions, but are generally limited by the particular geometry of the column and the tabletop, thereby affording not more than 45° rotation of the tabletop relative to the vertical.

[0009] In certain cases, a greater tilt may particularly be needed when the patient has to be moved to the so-called "Trendelenburg position", which is useful during certain radiological imaging procedures, such as for diagnosis of reflux esophagitis or hiatal hernia, in which the patient is laid in a supine position on a tilted tabletop, with the head lower than the knees and pelvis, or to the reverse Trendelenburg position, with the head higher than the knees and pelvis, which is useful for procedures on obese patients.

[0010] On the other hand, horizontal translation is needed and advantageous when the tabletop has to be moved close to an X-ray diagnostic apparatus, such as the one disclosed in US5790996, to provide as large and blind spot-free a range as possible for X rays.

[0011] Another critical aspect is the possibility of placing the tabletop at a minimum height from the floor to adapt the tabletop height to the height of the surgeon, for improved operating comfort.

[0012] US6070281 discloses an adjustable surgical table connected to a base via a movable C-arm which causes combined translation thereof in space in the longitudinal and vertical directions. The table is articulated at one end of the arm for further rotation and, in combination with the motion of the C-arm, this provides large tilts of the tabletop, possibly reaching the totally vertical position.

[0013] US5790996 discloses a similar solution in which the movable C-arm is articulated to the base and the tabletop is slideably mounted thereto.

[0014] Nevertheless, while these solutions allow extreme tabletop positioning, they still suffer from the drawback that the coupling points, particularly between the tabletop and the arm or the arm and the floor, are subjected to considerable stresses, which make the table unsuitable for large weight support, unless these components have a sturdier, and hence more costly and complex construction.

[0015] Other prior art solutions allow tabletop adjustment by separate operation of a plurality of hydraulic, mechanical or electric actuators, each controlling translation along respective axes, so that each particular combination of axial movements corresponds to a specific orientation of the tabletop in space.

[0016] Nonetheless, handling of such surgical tables is rather complex and not always provides adequate results in terms of patient positioning flexibility.

Summary of the invention

[0017] The object of the present invention is to overcome the above drawbacks, by providing an adjustable surgical table that is highly efficient and relatively cost-effective.

[0018] A particular object is to provide an adjustable surgical table that allows for large tabletop tilts relative to a median vertical plane, particularly when the patient has to be moved to the Trendelenburg or reverse Trendelenburg position.

[0019] A further object is to provide an adjustable surgical table that allows tabletop translation along its length to eliminate blind spots for X-ray diagnostic apparatus.

[0020] Yet another object is to provide a surgical table that can be placed at a minimum height from the floor for the patient position to be as comfortable as possible for the surgeon or operator, and adapted to different heights.

[0021] A further object is to provide an adjustable surgical table that affords high positioning flexibility as well

as sturdy and reliable construction, to allow even arrangement of the loads supported by the surgical table.

[0022] Another important object is to provide a surgical table that can be adjusted in space in a relatively simple manner, while remaining comfortable for the patient, by perfectly synchronous movements of its parts.

[0023] These and other objects, as better explained hereinafter, are fulfilled by a tiltable surgical table as defined in claim 1, comprising a floor-standing load-bearing column, having a substantially conical upper head which defines a substantially vertical axis of symmetry, a tabletop mounted to said head, guide means for guiding said tabletop along a longitudinal plane of symmetry passing through said vertical axis, wherein said guide means comprise a curved guide associated with said column and at least one slide adapted to move on the guide, first actuator means operating on said at least one slide to cause motion thereof along said at least one curved guide.

[0024] The table is characterized in that the curved guide is adapted to be fixed to the head and the slide is rigidly connected to the tabletop, locked against rotation relative thereto and in that the first actuator means are removably mounted to the head to cause motion of the slide relative to the guide.

[0025] This particular configuration of the invention allows for extreme tabletop positioning, with considerably greater tilts to the vertical as compared with usual values obtained using standard surgical tables guided along straight guides.

[0026] Advantageously, the curved guide may include a pair of supports having a substantially cylindrical upwardly concave top surface, which are disposed symmetrically about the longitudinal plane of symmetry.

[0027] Preferably, the slide may include a pair of arched elements whose bottom surface is complementary in shape to the top surface of the supports.

[0028] Thus, the rotary and translational motion of the surgical table caused by the slides, as well as the rotation provided by the column, will allow the tabletop to be positioned at a smaller minimum height than the minimal height typically reached by common surgical tables, which generally depends on the column height.

Brief description of the drawings

[0029] Further characteristics and advantages of the invention will be more apparent from the detailed description of a preferred, non-exclusive embodiment of an adjustable surgical table according to the invention, which is described as a non-limiting example with the help of the annexed drawings, in which:

FIG. 1 is a side sectional view of an adjustable surgical table of the invention;

FIG. 2 is a perspective view of a detail of the surgical table of FIG. 1;

FIG. 3 is a top view of the detail of FIG. 1;

FIG. 4 is a perspective view of the load-bearing column of a surgical table of the invention, which is partially open to provide an inside view thereof;

FIGS. 5a, b, c are side views of a surgical table of the invention in three different operating conditions, with the tabletop in the horizontal position;

FIGS. 6 a, b, c are side views of a surgical table of the invention in two more operating conditions, with the tabletop in a tilted position.

Detailed description of a preferred embodiment

[0030] Referring to the above figures, the surgical table of the invention, generally designated by numeral 1, may be used to adapt the position of a patient to a given surgical procedure or diagnostic examination.

[0031] In the latter case, the table 1 may be used in combination with suitable diagnostic apparatus, e.g. for X-ray imaging, not shown because they are known per se.

[0032] According to the invention, the surgical table, as shown in FIG. 1, comprises a floor-standing load-bearing column 2 having a substantially conical upper head 3 that defines a substantially vertical axis of symmetry W, a tabletop 4 mounted to the head 3, guide means 5 for guiding the tabletop 4 along a longitudinal plane of symmetry π passing through the vertical axis W.

[0033] The guide means 5 include a curved guide 6 associated with the column 2 when the tabletop 4 is mounted thereon, and a slide 7 movable on the guide 6. First actuator means 8 are provided, which operate on the slide 7 to cause motion thereof along the curved guide 6.

[0034] According to a peculiar feature of the invention, the curved guide 6 is designed for attachment to the head 3 and the slide 7 is rigidly connected to the tabletop 4 and locked against rotation relative thereto. The first actuator means 8 are in turn removably mounted to the head 3 to cause the slide 7 to move relative to the guide 6.

[0035] The guide 6 may be fixedly or movably attached to the head 3 of the column 2.

[0036] As shown in FIG. 2 and FIG. 3, the guide may include a pair of lateral supports 9, 9' each having a substantially cylindrical upwardly concave top surface 10, which are disposed symmetrically about the longitudinal plane of symmetry π .

[0037] Preferably, the slide 7 may include a pair of arched elements 11, 11', each having a bottom surface 12, 12' complementary in shape to the top surface 10 of the corresponding support 9, 9', for causing rotation of the tabletop 4 at the same time as the arched elements 11, 11' slide within the lateral supports 9, 9' of the guide 6.

[0038] Also, the first actuator means 8 may include one or more kinematic pairs 13 located at the ends of a first motorized drive shaft 14, having a first transverse axis X, which is rotatably mounted to the guide 6. The shaft 14 may be rotated by a motor 16, which is coupled to the shaft through a gearmotor, not shown.

[0039] According to the preferred non exclusive configuration of the invention as shown in the figures, the kinematic pairs 13 may be each formed of a pair of gear wheels 17, 17' integral with the shaft 14, and located at its transverse ends, for meshing with corresponding curved racks 18, 18' formed on each of the top surfaces 15, 15' of the arched elements 11, 11'.

[0040] Nonetheless, the kinematic pairs 13 may have other configurations, not shown, and may be each formed, for instance, of a pair of substantially smooth rolling surfaces respectively associated with the shaft 14 and the arched elements 11, 11', without departure from the scope of the present invention.

[0041] Advantageously, the surgical table 1 of the invention may have a modular construction, with the tabletop 4 being composed of a central module for supporting one part of the patient body, such as the pelvis, and end modules, not shown, articulated to the longitudinal ends, and designed to support the rest of the body, such as the torso and the legs.

[0042] Furthermore, the relative tilt of each of the end modules relative to the central module may be independently adjusted to cause the tabletop 4, and hence the patient body, to assume the most appropriate configuration for any type of surgery or examination.

[0043] According to the invention, the slide 7 is rigidly connected to the central module, which corresponds to the whole tabletop 4 in the figures, and its arched elements 11, 11' have substantially the same longitudinal extension ℓ as the latter.

[0044] Furthermore, the guide 6 may be coupled, preferably in a one-piece construction, to a pair of downwardly-directed interface elements 19, 19', which are located at each arched element 11, 11', symmetrically about the longitudinal plane π .

[0045] Each interface element 19, 19' has a specially shaped concave surface 20, 20' which is designed to be removably engaged by a corresponding lateral projection 21, 21', complementary in shape to the head 3, so that the guide 6 can be integrally joined to the lateral projections 21, 21' of the head 3, and the central module of the tabletop 4 is allowed to fit the motion of the latter.

[0046] For this purpose, the lateral projections 21, 21' may be hinged to the column 2 and the head 3 about a second transverse axis X' substantially parallel to the first axis X.

[0047] The particular connection between the guide 6 and the column 2 allows for easy removal of the assembly composed of the guide 6, the slide 7 and the tabletop 4 from the column 2, thereby allowing the tabletop 4 to be transported from one department to the other, e.g. on carriages, not shown because of commonly known fabrication.

[0048] Furthermore, the guide means 5 may be removably associated with the column 2 while being integral with the tabletop 4, thereby allowing the use of standard columns 2 adapted for connection to tabletops of different construction.

[0049] Also, second actuator means 22 may be provided, which are kinematically connected to the head 3 for adjusting the tilt of the tabletop 4 relative to a longitudinal axis Y substantially perpendicular to the vertical axis W, with the tabletop 4 in the horizontal position.

[0050] Third actuator means may be also provided, which are not visible because they are located in the head 3, for causing translation of the head 3 in a substantially vertical direction defined by the vertical axis W, to cause height adjustment of the tabletop 4.

[0051] The second 22 and third actuator means may be as disclosed in patent EP1032350, by the applicant hereof. For example, the second actuator means 22 may include a pair of substantially vertical telescopic jacks 24, 24', arranged symmetrically about the longitudinal plane π , as shown in FIG. 4.

[0052] Thus, by separately driving the jacks 24, 24' using suitable mechanisms of commonly known fabrication, the tilt of the head 3 and hence of the tabletop 4 may be adjusted relative to the longitudinal plane of symmetry π .

[0053] On the other hand, oscillation of the lateral projections 21, 21' of the head 2, for tilting the tabletop 4 relative to the horizontal plane defined thereby, is obtained using a special linkage located within the head 3, which is also not shown because it is known per se.

[0054] Controlled and coordinated motion of the first 8, second 22 and third actuator means, for driving the table 1 and positioning the tabletop 4 into the various operating modes may be obtained using special control means, not shown, which include a microprocessor unit, with an appropriate computer program installed therein for actuator motion interpolation.

[0055] This allows for simultaneous control of the angular and longitudinal positions of the central module 4 relative to the column 2. Particularly, by coordinating the rotation of the second axis X' and the sliding motion of the slide 7 along the curved guide 6, the tabletop 4 may be caused to translate in both longitudinal and vertical directions, while maintaining the horizontal position of the central module 4 and without ever inclining the patient.

[0056] This operating condition is shown in FIG. 5, in which the tabletop 4 is shown at three different heights from the floor, i.e. h_1 , h_{MIN} , h_2 .

[0057] Particularly, FIG. 5a shows the table 1 with the tabletop 4 in its horizontal, substantially centered position, with the projections 21, 21' of the head 3 having zero tilt α relative to the floor.

[0058] FIG. 5b shows the table 1 with the tabletop 4 still in its horizontal position but translated to the right into the maximum longitudinal translation position, and with the patient support surface 25 at a minimum height h_{MIN} from the floor.

[0059] In this case, the rotation of the central module 4 in the longitudinal plane of symmetry π , caused by the motion of the arched slide 7 along the curved guide 6 was compensated for by the coordinate rotation of the

lateral projections 21, 21' about the second axis X'.

[0060] The particular configuration of the guide means 6 allows the minimum height h_{MIN} of the support surface 25 of the tabletop 4 from the floor to be smaller than standard values obtained in surgical tables with straight guides. The difference between such minimum values will be determined by the radius of curvature r of the slide 7 and the guide 6.

[0061] A further advantage will be obtained in terms of a longer longitudinal translation of the tabletop 4, also depending on the curvature r of the guide means 5, which eliminates any blind spots for X-ray diagnostic apparatus or the like.

[0062] The microprocessor control means cause the rotary and translational motion of the tabletop 4 and the rotational motion of the axis X' to be simultaneous and coordinated.

[0063] The synchronism of such motions further allows the support surface 25 of the tabletop 4 to be maintained at a constant tilt α , e.g. always horizontal, thereby making the table 1 as comfortable as possible for the patient.

[0064] FIGS. 6a and 6b show two operating positions of the table 1 with the tabletop 4 adapted to move the patient into the Trendelenburg or reverse Trendelenburg position, with the tilt α of the support surface 25 relative to the transverse plane of symmetry π' being provided in the former case by the oscillation of the lateral projections 21, 21' of the head 3 only and in the latter case by the coordinated motion of the guide means 5 and the lateral projections 21, 21'.

[0065] The displacement of the slide 7 along the guide 6 is found to increase the tilt α of the tabletop 4 relative to the horizontal position, thereby forming an angle in a range from about 45° in the case of FIG. 6a to about 55° or more in the case of FIG. 6b. Higher values can be reached by increasing the longitudinal extension ℓ or decreasing the radius of curvature r of the slide 7.

[0066] The above disclosure clearly shows that the invention fulfills the intended objects and particularly meets the requirement of providing an adjustable surgical table allowing for greater longitudinal and vertical translation and rotation than surgical tables with straight guides.

[0067] Thanks to the particular configuration of the guide means 5 and their connection with the support tabletop 4, the table 1 will provide considerable sturdiness and allow even distribution of the patient's weight, which will make it suitable for supporting patients of very large size without affecting reliability.

[0068] The surgical table of this invention is susceptible of a number of changes and variants, all falling within the inventive scope disclosed in the appended claims. All the details thereof may be replaced by other technically equivalent parts, and the materials may vary depending on different needs, without departure from the scope of the invention.

[0069] While the surgical table has been described with particular reference to the accompanying figures, the numerals referred to in the disclosure and claims are

only used for the sake of a better intelligibility of the invention and shall not be intended to limit the claimed scope in any manner.

Claims

1. An adjustable surgical table, comprising:

- a floor-standing load-bearing column (2) having an upper head (3) that defines a substantially vertical axis of symmetry (W);
- a tabletop (4) mounted to said head (3) for patient positioning;
- guide means (5) for guiding said tabletop (4) along a longitudinal plane of symmetry (π) passing through said vertical axis (W), wherein said guide means (5) comprise a curved guide (6) designed to be associated with said column (2) and a slide (7) adapted to move on said guide (6);
- first actuator means (8), operating on said slide (7) to cause motion thereof along said curved guide (6);

characterized in that said curvilinear guide (6) is adapted to be fixed to said head (3), and said slide (7) is rigidly connected to said tabletop (4), locked against rotation relative thereto, said first actuator means (8) being mounted to said head (3) to cause motion of said slide (7) relative to said curved guide (6).

2. Surgical table as claimed in claim 1, **characterized in that** said curved guide (6) includes a pair of lateral supports (9, 9') having substantially cylindrical upwardly concave top surfaces (10), which are disposed symmetrically about said longitudinal plane of symmetry (π).

3. Surgical table as claimed in claim 2, **characterized in that** said slide (7) includes a pair of arched elements (11, 11'), having bottom surfaces (12, 12') complementary in shape to said top surfaces (10) of the corresponding lateral supports (9, 9').

4. Surgical table as claimed in claim 3, **characterized in that** said first actuator means (8) include at least one kinematic pair (13) located at one end of a motorized shaft (14), having a first transverse axis (X), which is rotatably mounted to said curved guide (6).

5. Surgical table as claimed in claim 4, **characterized in that** said at least one kinematic pair (13) comprises at least one gear wheel (17) integral with the shaft (14), for meshing with a corresponding rack (18) formed on a corresponding top surface (15) of one of said arched elements (11, 11').

6. Surgical table as claimed in claim 1, **characterized in that** said tabletop (4) comprises at least one central module for supporting the pelvis of the patient, end modules being articulated to its longitudinal ends, for supporting the torso and the legs of the patient respectively. 5

7. Surgical table as claimed in claim 6, **characterized in that** said slide (7) is rigidly connected to said central module (4), said arched elements (11, 11') having substantially the same longitudinal extension (ℓ) as the latter. 10

8. Surgical table as claimed in any one of the preceding claims, **characterized in that** said curved guide (6) is coupled to a pair of interface elements (19, 19') each having a specially shaped concave surface (20, 20') which is designed to be removably engaged by corresponding lateral projections (21, 21'), complementary in shape to said head (3), so that said guide (6) can be integrally joined to said head (3). 15
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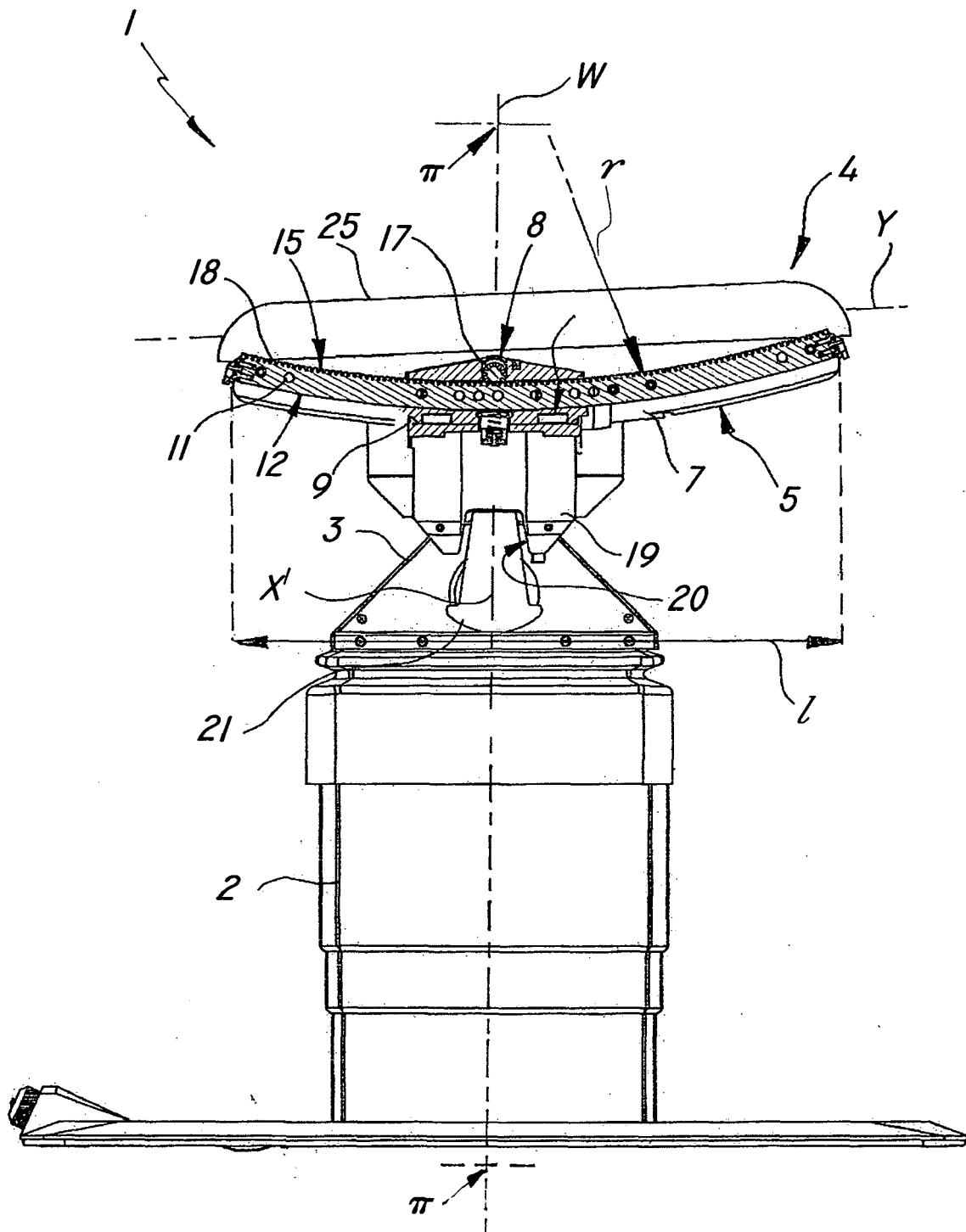
9. Surgical table as claimed in any one of the preceding claims, **characterized in that** said lateral projections (21, 21') are hinged to said column (2) about a second transverse axis (X') substantially parallel to the first axis (X). 25

10. Surgical table as claimed in any one of the preceding claims, **characterized in that** it further comprises second actuator means (22) kinematically linked to said lateral projections (21, 21') of said head (3) for adjusting the tilt (α) of said tabletop 4 relative to the floor. 30
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11. Surgical table as claimed in any one of the preceding claims, **characterized in that** it further comprises third actuator means for causing translation of said head (3) in a substantially vertical direction, for height adjustment of the tabletop (4). 40

12. Surgical table as claimed in any one of the preceding claims, **characterized in that** it further comprises means for coordinated control of said first (8), second (22) and third actuator means for simultaneous control of the angular and longitudinal positions of said central module (4) relative to the column (2). 45

13. Surgical table as claimed in claim 12, **characterized in that** said control means comprise a microprocessor unit with a suitable computer program installed therein. 50
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**FIG. 1**

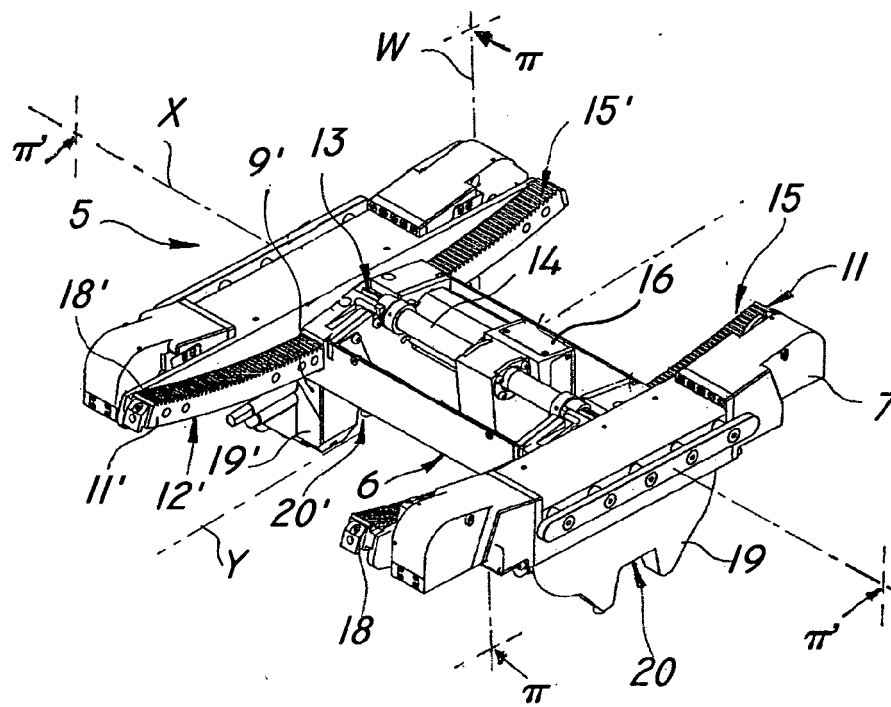


FIG. 2

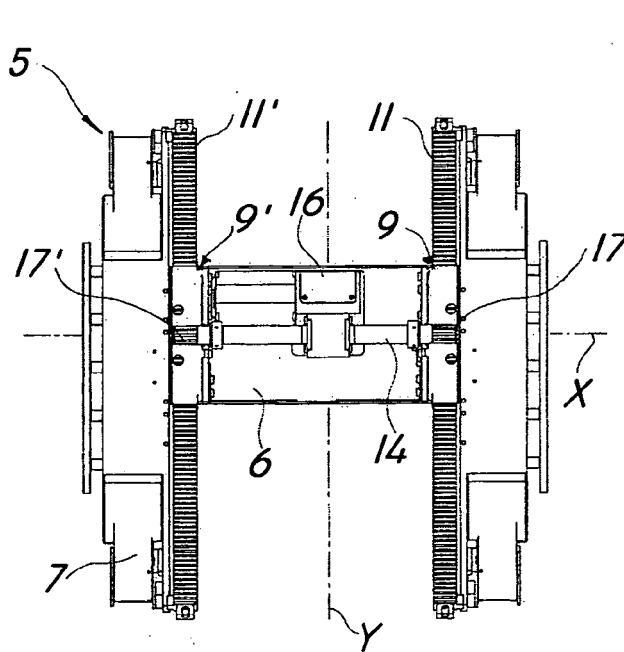


FIG. 3

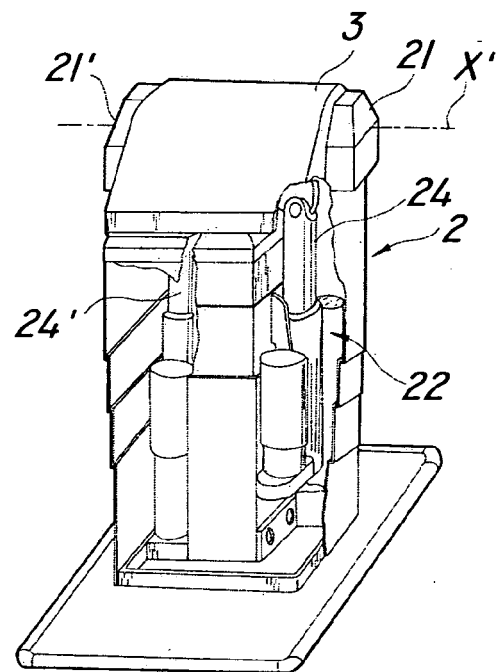


FIG. 4

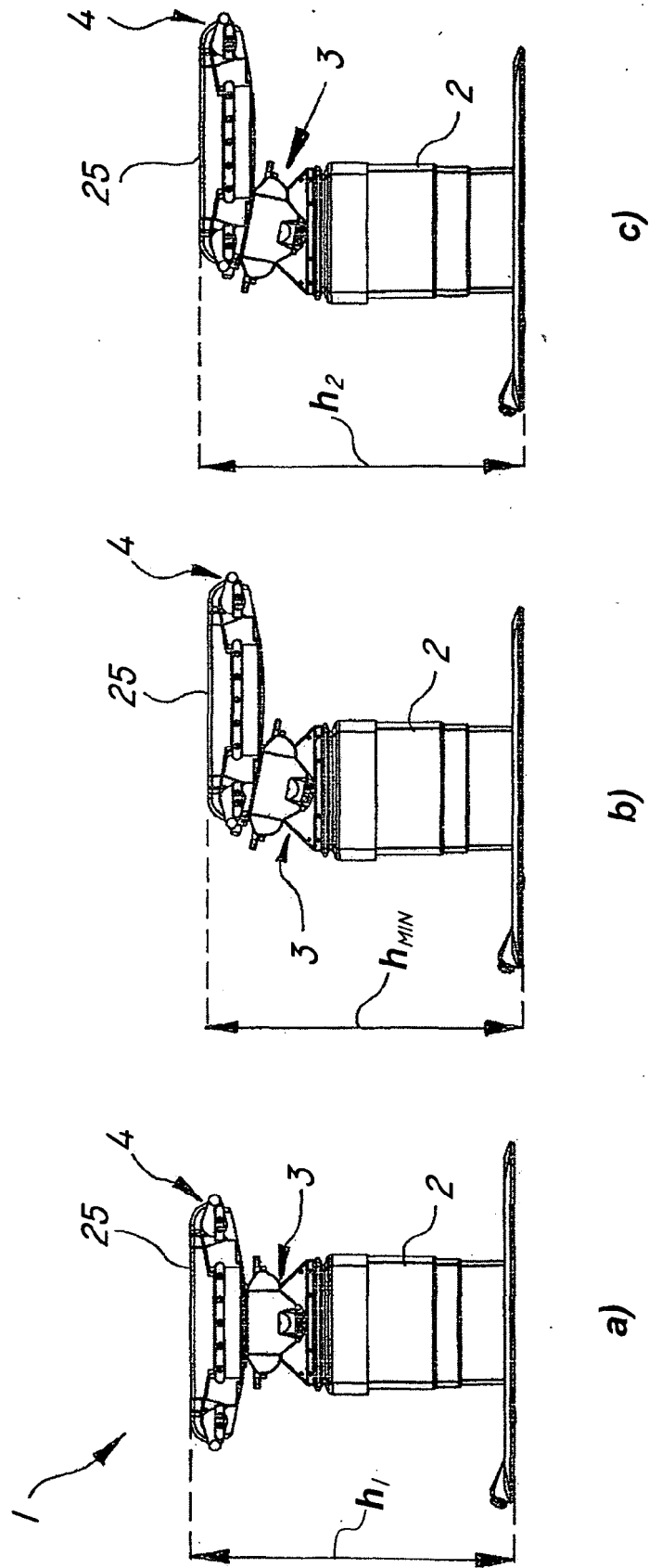
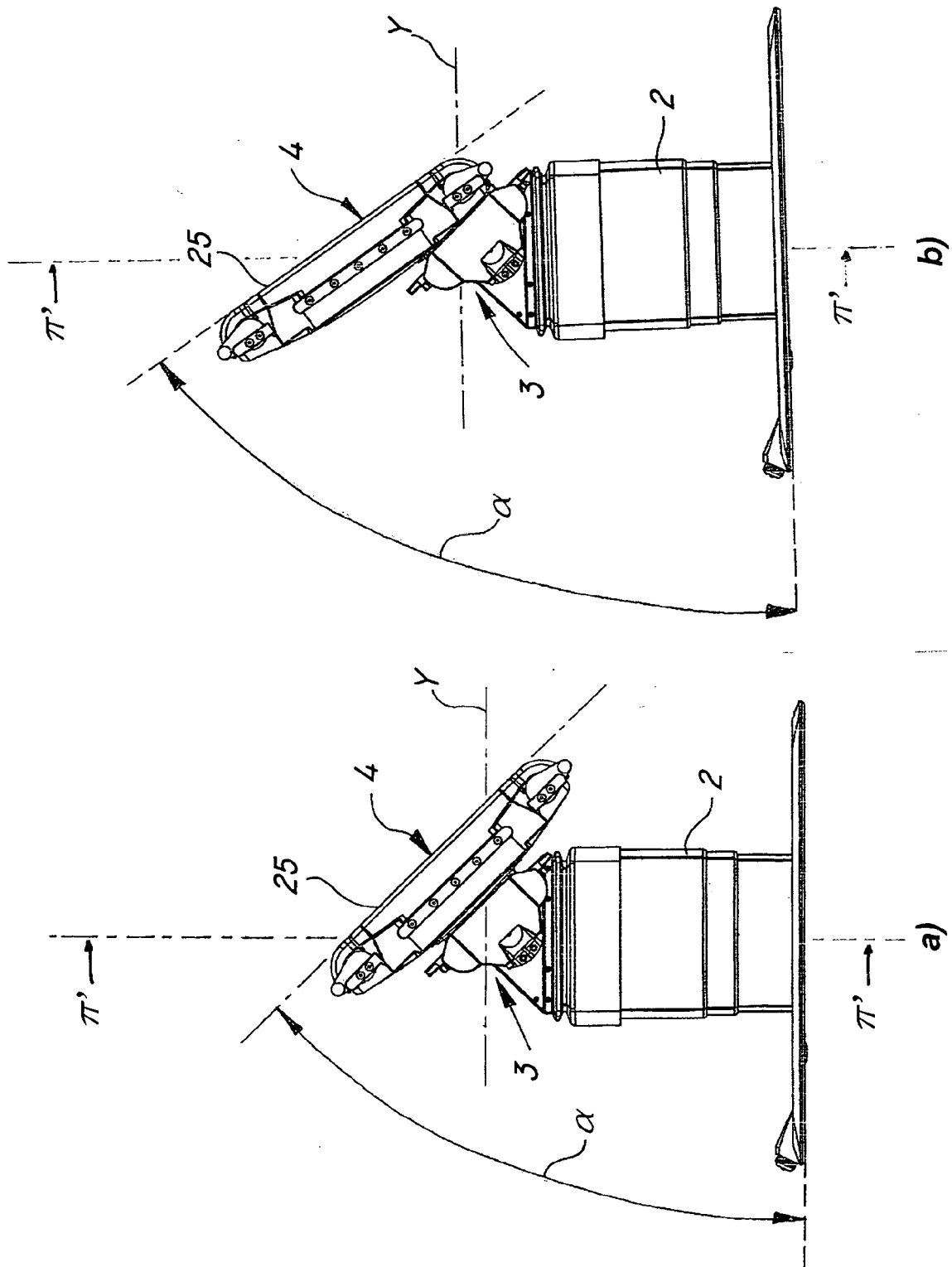


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 02111618 A [0005]
- DE 10253878 [0006]
- EP 1032350 A [0007] [0051]
- US 5790996 A [0010] [0013]
- US 6070281 A [0012]