

BED CONSTRUCTION

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This invention relates to hospital beds and in particular to beds of the kind which incorporate a mechanism for altering the height and inclination of the bed frame.

It has become a common requirement that hospital beds should be capable of being tilted and preferably also raised and lowered, in order to facilitate nursing and medical examinations. The more sophisticated beds are powered, e.g. by electric motors driving a mechanical linkage or which incorporate a hydraulic or pneumatic power pack. Additional refinements sometimes include means for contouring the sections of the patient-support mattress as described, for example, in our U.K. Patent No. 1,474,018.

Conventionally, electric motor- or hand-driven linear screw jacks have been used to effect the tilting of the bed. Additional motor-driven screw jacks operating via scissor linkages or other lever arrangements have been used to raise and lower the bed frame. Such arrangements have tended to clutter the underside of the bed frame, with a plethora of linkages, jacks, motors and hydraulic pipes. Not only does this restrict space for locating other useful equipment, (such as the blower apparatus for inflating the mattress cushions in our above-mentioned patent specification), but it provides a multiplicity of crevices in which dirt can lodge and makes it very

difficult to sterilise the bed thoroughly.

The invention is therefore directed to a solution of the problem of providing powered-actuation of a bed in such a way as to minimise the space occupied by the actuating mechanism, and to facilitate cleaning and operating of the bed.

According to one aspect of the present invention, there is provided a bed comprising:-

(a) a ground-engaging frame

(b) a bed frame supported from the ground-engaging frame and having actuating means for raising the bed frame and tilting the bed frame about an axis generally at right angles to the length of the bed

(c) said actuating means comprising two shafts mounted transversely of the ground-engaging frame, each shaft being linked via associated actuating arms to the bed frame and being independently drivably connected to an electric motor, whereby rotation of the shaft is translated by said actuating arms to raising or tilting of the adjacent bed frame.

The motors may be drivably connected directly by gearing to the transverse shaft. In this case, the motor is arranged to drive the shaft via a planetary gear system. Alternatively, the motor may be drivably connected by a linkage such as a lead screw and lever. Although this is less compact than the first-mentioned arrangement, it is a simpler and cheaper arrangement.

Preferably, a pair of motors and associated gearing or linkages and actuating arms are provided, one at or

close to each end of the bed in order to maximise available space in the central area beneath the bed frame. With this construction, operation of the motors together in one relative direction at the same speed will cause the bed frame to be raised (or lowered), with the bed frame generally horizontal. Reversal of the direction of rotation of one of the motors (or stopping of one motor) will cause the frame to tilt. Suitable electrical control circuiting is provided to stop the motors and reverse their direction of rotation, when the bed reaches its desired height and/or orientation, or it is desired to alter the height or inclination of the bed.

Gearing will be required between the motor or motors and the trasverse shaft which provides a substantial speed reduction in order to link the normal motor shaft speed to the few inches per second raising/lowering movement required for the bed frame. The gearing preferably also includes one or more worm/worm wheel assemblies since such assemblies have the advantage not only of achieving a large gear ratio reduction in a small space, but also have the advantage that they are self-locking when the motor drive stops.

One embodiment of a bed in accordance with the invention will now be described with reference to the accompanying drawings in which:-

Figure 1 is a plan view of the bed with the mattress section removed,

Figure 1a is a plan view similar to Figure 1, but

with a different drive connection between the motor and the transverse shaft.

Figure 2 is a side elevation of the bed shown in Figure 1,

Figure 2a is a side elevation of the bed shown in Figure 1a, and

Figure 3 is a schematic view of the motor and gearbox.

Referring to Figures 1 and 2, the bed has a ground-engaging frame 1, which is desirably fitted with castors 2, and supports a bed frame 3. Extending transversely between longitudinal side members 4 of the ground-engaging frame 1, are a pair of transverse shafts 5 and 6. Shafts 5 and 6 are mounted in bearings 7 secured to one side member and in a gearbox 8, secured to the other side member. Each gearbox 8 is driven by an electric motor 9 connected to its respective gearbox.

Rotational movement of each shaft 5 or 6 is translated into raising or lowering movement of the bed frame 3 by actuating arms 10 and 11, which are pivotably connected at pivots 12. At one end of the bed (in the example illustrated, the foot end 3), the upper end of actuating arms 11 is fixed to the underside of the bed frame 3. The upper end of corresponding arm 11 at the head is connected to the bed frame 3 via a pivot connection 14 to enable the swinging movement of the actuating arms to be accommodated.

Figure 2 shows in schematic form, a mattress base

formed by three relatively hinged sections 15, 16 and 17. As shown, the centre section 16 may be secured to the bed frame 3 and the other two raisable sections, raised and lowered by actuating links 18 and 19 (e.g. motor driven lead screws), or by other suitable means, such as the pneumatic bellows illustrated in our U.K. Patent No. 1,474,018.

Figure 3 is a schematic view of the gearbox 8. Motor 9 is connected by a series of pinion gears 31, 32 and 33 to a shaft 34 on which a worm 35 is mounted. Worm 35 drives a worm wheel 36 which is mounted for rotation on transverse shaft 11. Integrally formed with worm wheel 36 is the sun wheel of an epicyclic gear train of which the planet carrier is secured to the shaft 11.

Figures 1a and 2a show a bed which is similar to that shown in Figures 1 and 2 except that the arrangement for driving the transverse shafts 8 is different. In Figures 1a and 2a, the same reference numerals are used to designate the parts which have equivalents in Figures 1 and 2.

In Figures 1a and 2a, motors 9 are each connected to a gearbox 20 and the motor/gearbox assembly is secured to the ground-engaging frame 1. Gearboxes 20 incorporate conventional reduction gears and the final drive is connected to a lead screw 21 which is attached at the end remote from the gearbox to a lever 22. Levers 22 are secured to a hub or trunnion on transverse shafts 5 or 6. The arrangement is such that operation of motors 9 will

cause lead screws 21 to extend or retract (depending on the direction of motion of their associated drive motor). This will be translated into rotational movement of the shafts 5 or 6, thus causing the actuating arms 10 & 11 to open out or fold up. Limit switches (not shown) may be provided on the frame 1 which are actuated by stops on the lever 22 or associated hub so that when the actuating arms reach their fully extended and folded up conditions, the appropriate motor will be switched off and the tilting or raising or lowering movement automatically arrested.

**CLAIMS:-**

1. A bed comprising:
 - (a) a ground engaging-frame
 - (b) a bed frame supported from the ground-engaging frame and having actuating means for raising the bed frame and tilting the bed frame about an axis generally at right angles to the length of the bed,
 - (c) said actuating means comprising two shafts mounted transversely of the ground-engaging frame, each shaft being linked via associated actuating arms to the bed frame and being independently drivably connected to an electric motor, whereby rotation of the shafts is translated by said actuating arms to raising or tilting of the adjacent bed frame.
2. A bed according to claim 1 in which a motor is drivably connected via gearing to each shaft.
3. A bed according to claim 1 in which a motor is drivably connected via a lead screw and a lever to each shaft.
4. A bed according to any one of the preceding claims in which each shaft is independently drivably connected to an associated motor and the arrangement includes means for independently selecting the direction of rotation of said motors so that the bed frame can be selectively raised or tilted.
5. A bed according to any one of the preceding claims in which the bed frame is arranged to support at least three relatively hinged sections and the bed



includes means for raising and lowering at least one section.

6. A bed according to any one of the preceding claims in which the actuating arms associated with one of said transverse shafts are fixed to the bed frame while the actuating arms associated with the other of said transverse shafts are pivotably connected to the bed frame.
