Dec. 21, 1965 N. G. POLYDORIS 3,224,290

DRIVE MECHANISM

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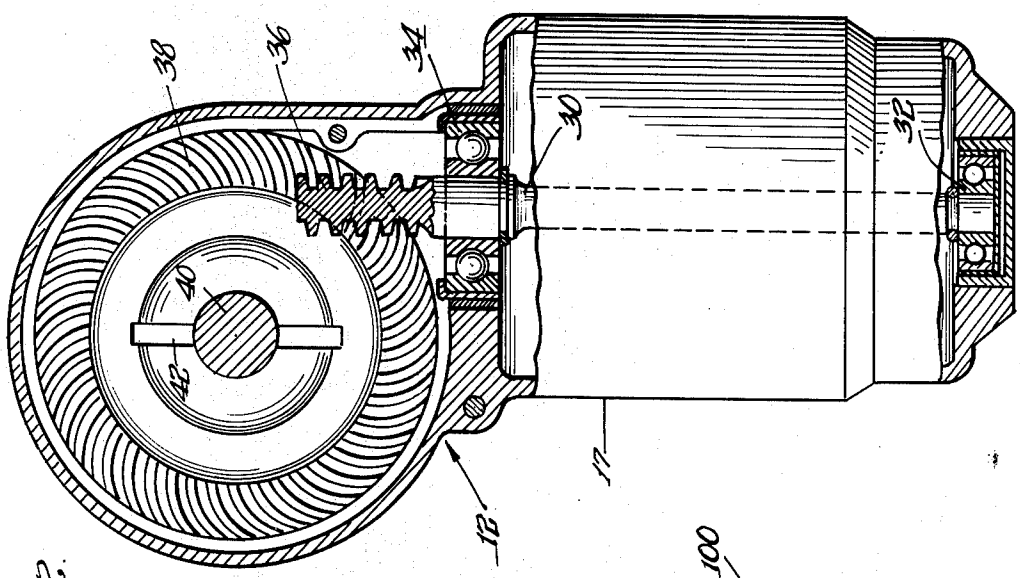


Fig. 2.

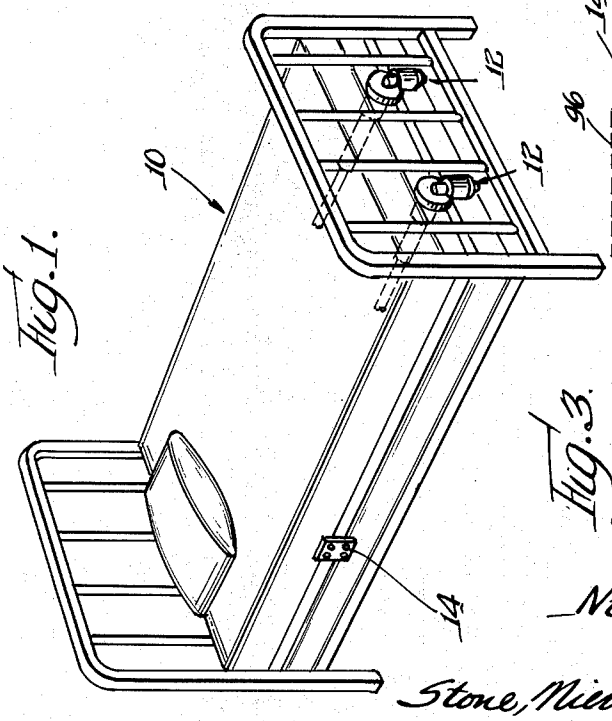


Fig. 1.

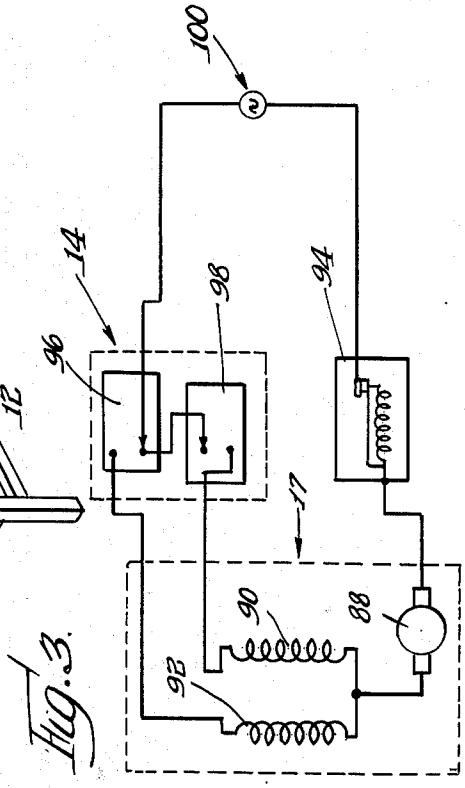


Fig. 3.

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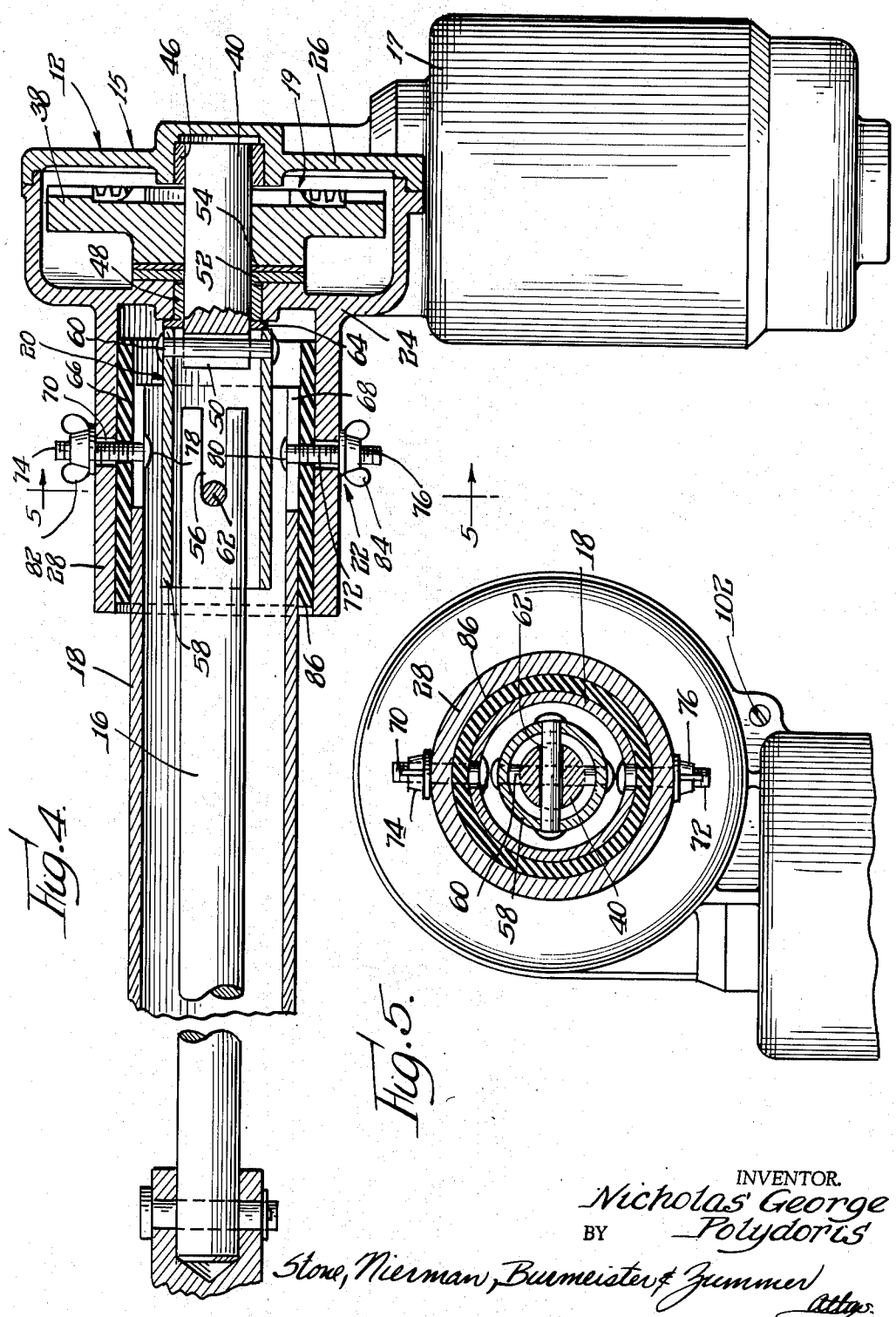


Fig. 4.

Fig. 5.

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DRIVE MECHANISM

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This invention relates to an improved construction of a drive mechanism and more particularly to a drive mechanism for use in operating a bed which bed has a mechanism for raising and lowering portions of the bed.

Beds which have portions which raise and lower are most commonly found in hospitals, and patients using these beds generally desire periodic adjustment of the beds for optimum comfort and rest. Hospital administrators have found that it is particularly desirable for a hospital to have electric motors to operate each adjustable bed which motors may be controlled by the patient so that an attendant need not be summoned by the patient to make each adjustment. Motorized beds are available for hospitals; however, economical hospital administration requires that existing hospital beds be retained and used. Therefore it is desirable that a drive mechanism be provided which may be readily installed in an existing hospital bed. One of the principal problems confronting a hospital administrator in installing a drive mechanism is the limitation of space, i.e., the space which is available to install a drive mechanism in a hospital bed. As is conventional in hospital bed construction, there is normally a plurality of vertical reinforcing bars in a hospital bed foot where the device is to be installed; and in many instances the space between a reinforcing bar and a drive shaft which extends from a drive mechanism which adjusts a portion of the hospital bed is quite small. A further problem which confronts a hospital administrator is that the drive mechanism must be quickly and economically installed without reconstructing the entire bed.

It has been found that many drive mechanisms, which are attached to a hospital bed and are not incorporated in the hospital bed during the initial construction of the bed, have a tendency to create a substantial amount of noise which noise is particularly objectionable to a patient. It is therefore one of the principal objects of the hereindisclosed invention to provide a drive mechanism for attachment to an existing hospital bed which drive mechanism does not cause a substantial amount of noise during the operation of the drive mechanism.

It is another object of the present invention to provide a drive mechanism for a bed which mechanism is compact and may be readily positioned in a small space.

It is a further object of the instant invention to provide a drive mechanism which may be readily attached to an existing bed which device has a high degree of safety in its operation so that it may be used in a hospital or in a home.

It is a still further object of this invention to provide a drive mechanism for attachment to an existing bed to convert it into a motorized bed which device may be manufactured at a low cost.

It is still another object of the hereindisclosed invention to provide a drive mechanism for a bed which drive mechanism may be readily installed in an existing bed.

Other objects and uses of the present invention will become readily apparent to those skilled in the art upon a perusal of the appended specification in light of the accompanying drawings, in which:

FIGURE 1 is a perspective view of a conventional hospital bed with a pair of drive mechanisms attached thereto, each of which drive mechanisms embodies the hereindisclosed invention;

FIGURE 2 is a plan view of one of the drive mechanisms shown in FIGURE 1 with portions of its casing broken away in order to show the construction of the instant invention;

FIGURE 3 is a diagrammatic view of an electric circuit for controlling an electric motor which is a part of the present invention;

FIGURE 4 is a side view of the drive mechanism shown in FIGURE 2 but with portions broken away in order to show the details of construction; and

FIGURE 5 is a cross-sectional view taken on line 5—5 of FIGURE 4.

Referring now to the drawings and especially to FIGURE 1, a conventional hospital bed is generally indicated by numeral **10** which hospital bed has a pair of identical drive mechanisms **12** mounted thereon to raise and lower portions of the hospital bed. The drive mechanisms **12** are electrically connected in a conventional fashion to a switch box **14** which is attached to the hospital bed **10** in a position convenient for a patient so that a patient may readily raise and lower portions of the bed as the patient desires.

Looking now to FIGURE 4, a drive shaft **16** which is a conventional portion of a hospital bed is shown therein. The drive shaft **16** has a conventional tubular guard **18** surrounding a portion of the drive shaft **16** and the guard is fixed to the frame of the bed. Connected to the drive shaft **16** is drive mechanism **12**.

The drive mechanism **12** generally consists of a casing **15** with a split filed series motor **17** connected to the casing. A speed reducer **19** is mounted in the casing and drivingly connected to the electric motor **17**. The speed reducer is connected to the drive shaft **16** by a connector generally indicated by numeral **20** and a torque reactor **22** is connected to the tubular guard to prevent reaction torque from spinning the drive mechanism about the drive shaft.

Considering now the specific construction of the novel drive mechanism **12**, the casing **15** is a molded casing made of a resin, which casing has two mateable portions, namely, a base **24** and a cover **26**. The base has a tube **28** formed integral therewith which constitutes a portion of the torque reactor.

Looking now to FIGURE 2, it may be seen that the electric motor is mounted within the casing **15**. Inasmuch as the instant electric motor is a conventional split field series motor, the details of the entire construction of the motor are not shown herein. The motor has a motor shaft **30** which has one end rotatably mounted in a bearing **32** in the casing and another end rotatably mounted in a bearing **34** adjacent to the speed reducer **18**.

The speed reducer **19** includes a pinion **36** and a gear **38**. The pinion is fixed to the motor shaft. The gear is mounted on a gear shaft **40** and held against rotation relative to the gear staft by a lock pin **42** which engages the gear and extends through an aperture in the gear shaft. It should be noted at this point that the axis of rotation of gear shaft **40** is skewed to the axis of rotation of the motor shaft **30**. The maximum distance between the axis of rotation of the two shafts **30** and **40** is less than the outside radius of the gear **38**. This particular construction allows the drive mechanism to be of a minimum size to be positioned in a confined space, but still achieve a maximum of speed reduction and thereby an increased torque on gear shaft **40**.

The gear shaft **40** is rotatably mounted in the casing **15**. One end of the shaft is rotatably mounted in a sleeve bearing **46** which is positioned in cover **26** of the casing. The other end of the gear shaft is positioned in a sleeve bearing **48** in the base of the casing. The gear shaft has an end slot **50** adjacent to the bearing **48** for

receiving the connector **20** a will be decribed hereinafter. A thrust bearing **52** is positioned within the casing **15** adjacent to the base **24**. A spring washer **54** is positioned between the thrust bearing **52** and the gear **38** to urge the gear into tight engagement with the lock pin **42**.

As was mentioned above the connector **20** drivingly connects the speed reducer with the drive shaft **16**. As is evident in FIGURE 4, the drive shaft **16** contains a drive slot **56** in one end, which end, in this instance, is adjacent to the foot of the bed. The connector **20** includes a drive sleeve **58** which is intercalated between the drive shaft and the tubular guard. The drive sleeve has a connector pin **60** fixed adjacent to one end thereof which connector pin is positioned in slot **50** of the gear shaft. A drive pin **62** is fixed in the drive sleeve and positioned in drive slot **56**. It should be noted that the axis of pin **60** is angularly displaced an amount equal to 90 degrees from the axis of pin **62** as is clearly shown in FIGURE 5 for reasons which will become apparent hereinafter. A bronze washer **64** is positioned between one end of the drive sleeve **58** and the casing **15**.

The torque reactor **22** is connected to the tubular guard **18**. In the conventional construction of most hospital beds, the tubular guard contains a pair of aligned slots **66** and **68**. The instant device utilizes these slots to provide a simple and effective means for holding the casing against rotation. The tube **28** has a pair of apertures **70** and **72** contained therein, and threaded studs **74** and **76** are movably positioned in the respective apertures **70** and **72**. The studs **74** and **76** have heads **78** and **80** respectively formed thereon. The studs **74** and **76** are positioned in respective slots **66** and **68** with the heads within the tube and conventional wing nuts **82** and **84** threadedly engage studs **74** and **76**, respectively to hold the studs in position which hold the tube **28** rotatably fixed to the tubular guard **18**.

Interposed between the tubular guard and the tube **28** is a cylindrical rubber sleeve **86** which acts as a sound deadener by absorbing substantially all of the noise generated by the motor and the interaction of the connector with the drive shaft. Furthermore, the rubber sleeve acts as an insulator between the tubular guard and the tube to eliminate any noise which may be generated by the tube striking the tubular guard.

The electric motor **17** and thus the rotation of the drive shaft is controlled by a novel control means. Looking now to FIGURE 3 which shows the electric circuit of the instant device, the electric motor **17** is shown with its armature **88** separated from its two fields **90** and **92**. The control device **14** is connected to the fields of the electric motor as shown and a thermal circuit breaker **94** is in series with the electric motor. The control device **14** includes a double throw switch **96** and a single throw switch **98**. The single throw switch **98** is connected to the field **90** of the electric motor and to one pole of the double throw switch **96**. The other pole of the double throw switch **96** is electrically connected to field **92** of the electric motor and switch **96** is connected to a conventional source of electrical energy **100**. The electric motor is connected to the source of electrical energy and the thermal circuit breaker is in series with the motor.

The drive mechanism **12** is economical to produce inasmuch as the casing **15** is made of a conventional plastic resin. The base **24** is molded with the tube **28** formed integral therewith. The cover **26** is also molded and the cover is held on to the base by screws **102**. The gear is mounted on the gear shaft **40** in an inexpensive manner, and it may be seen that very little machining is required inasmuch as the bearings **46** and **48** which hold the shaft are simply fitted into the molded casing. The connector with the torque reactor are simplified in order to provide economical production and it may be seen that no special machining is required to mount the drive mechanism on a conventional hospital bed.

As was mentioned above the mounting of the instant drive mechanism on an existing hospital bed is quite simple in that a handle which is used to turn the drive shaft is removed and the device is then simply attached. Should the instant drive mechanism be attached during the initial construction of a bed, the application of the instant device is simplified inasmuch as the conventional handle need not be applied nor removed. When the drive shaft is free of a handle, it is only necessary to slide the connector into the space between the drive shaft and the tubular guard so that the drive pin **62** fits into drive slot **56**. The threaded studs **74** and **76** slip into their respective slots **66** and **68** in the tubular guard, and the respective wing nuts are then tightened to hold the device to the tubular guard and thus the bed. The control device **14** is then conveniently located and the instant drive mechanism is ready for operation.

It is apparent that when the double throw switch **96** is actuated so that the field **92** is connected to the source of electrical energy, energy is supplied to the electric motor to turn the motor shaft and pinion **36** and thus the gear **38**. The gear turns at a lower speed than the pinion **36** and the rotation of the gear turns the gear shaft **40** and and drive shaft **16** are not aligned, there is a tendency for and drive shaft **16** are not aligned, there is a tendency fir the casing to move relative to the bed. By use of the instant connector, small misalgnments of the two shafts are compensated. Since the pins **60** and **62** are spaced 90 degrees apart and the pins are in slots, the connector also acts as a universal joint between the two shafts in addition to being the driving connecting means. When there is a misalignment if the two shafts, the pins ride in and out in their respective slots which riding cooperates with the alignment of the pins to produce the universal joint effect. The bearing **64** between the drive sleeve and base **24** provides a surface upon which the sleeve rides as it tilts relative to the base in order to reduce to a minimum wear on the base by the sleeve. As the drive shaft **16** is rotated, an equal and opposite reaction is transmitted to the casing, but the casing is held in position by the interaction of the tube **28** and the studs **74** and **76** with the tubular guard **18**.

It should be noted that since a series wound motor is used, maximum torque is achieved even at low speeds. The use of a series motor allows motors of smaller horsepower rating to be used with the instant device thereby allowing the device to be made smaller and of course more economically.

When it is desired to rotate the drive shaft **16** in the opposite direction, the switch **96** is released so that field **92** is de-energized, and switch **98** is then activated to connect field **90** with the source of electrical energy through switch **96**. The motor then operates in the opposite direction. It is important to note that the arrangement of the switches **96** and **98** is such that a high degree of safety is achieved. In the event that an operator should engage both switches, i.e., both switches **96** and **98** are activated, the field **92** would be energized but not field **90** inasmuch as the current must flow through switch **96** before it passes through switch **98**. Thus, there is no need for a mechanical interlock between conventional actuating devices for the switches to prevent two actuating devices from closing both switches at the same time. A further important aspect of this invention is that the thermal operative circuit breaker **94** is in line with the armature of the motor so that in the event that the motor stalls or an end position of the drive shaft is reached, the motor will not overheat and burn out but rather the circuit breaker will kick out.

It is readily apparent that any number of the drive devices may be mounted on a particular hospital bed depending upon the number of drive shafts available. It is also apparent that the instant device may be used with beds other than hospital beds.

Although a specific embodiment of the instant invention

has been shown and described herein, it is readily apparent that those skilled in the art may make various modifications and changes without departing from the spirit and scope of the invention. It is to be expressely understood that the instant invention is limited only by the appended claims.

What is claimed is:

1. A drive mechanism for operating a hospital bed, said hospital bed having a drive shaft with a drive slot in one end thereof adjacent to the foot of the bed and a tubular guard surrounding a portion of the drive shaft adjacent to the end if the drive shaft having the drive slot, comprising, in combination, a tube for receiving a portion of the tubular guard and the end of the drive shaft having the drive slot, means connected to said tube for engagement with the tubular guard for holding the tube relative to the tubular guard, a casing fixed to said tube, a connector pivotedly engaging the drive shaft, a sound deadener mounted within the tube for absorbing sound generated by the interaction of the connector and the drive shaft, a first shaft rotatably mounted in said casing and being drivingly connected to said connector, a gear within said casing and being drivingly connected to the first shaft for rotation therewith, a pinion within said casing meshing with the gear in a driving relationship, a motor shaft fixed to the pinion and having its axis of rotation a maximum distance from the axis of rotation of the first-mentioned shaft less than the outside radius of the gear, a reversible electric motor connected to the motor shaft to provide a source of rotational energy to drive said gears, and means for controlling the electric motor to control the operation of the bed.

2. In a device of the character described comprising, a casing, an electric motor mounted in said casing, said electric motor having a first shaft, a first gear connected to said first shaft to be driven by said electric motor through the shaft, a second gear meshing with the first gear, a second shaft connected to said second gear, said second shaft having its axis spaced from the axis of the first shaft a maximum distance less than the outside radius of the second gear, a connector attached to the second shaft for transmitting rotational energy from the second shaft to a drive shaft, a tube connected to said casing surrounding the connector, and a sound deadener within said tube for absorbing noise.

3. A drive mechanism for operating a bed having a portion capable of being raised and lowered, comprising, in combination, a casing, an electric motor connected to said casing, said electric motor having a first shaft, a first gear connected to said first shaft to be driven by said electric motor through the shaft, a second gear meshing with the first gear, a second shaft connected to the second gear, said second shaft having its axis of rotation spaced from the axis of rotation of the first shaft a maximum distance less than the outside radius of the larger of the said gears, a connector attached to the second shaft for transmitting rotational energy from the second shaft to a drive shaft of the bed, and means connected to said casing to hold the casing in a fixed attitude while rotational energy is transmitted by the connector to the drive shaft.

4. A drive mechanism for operating a bed which bed includes a drive shaft to operate a movable section of the bed comprising, in combination, a connector drivingly engageable with the drive shaft, a gear shaft drivingly connected to said connector, a casing rotatably supporting said gear shaft, means connetcing said casing and the bed to prevent rotation of the casing relative to the bed, a sound deadener associated with the casing for absorbing noise and insulating the bed from vibration of the casing, a speed reducer connected to the gear shaft, an electric motor drivingly connected to the speed reducer, and control means connected to the electric motor for controlling the operation of the electric motor.

5. A drive mechanism for operating a bed which bed includes a drive shaft to raise and lower a movable section of the bed comprising, in combination, a casing, an electric motor connected to said casing, a speed reducer mounted in said casing and being drivingly connected to said electric motor, a connector drivingly engageable with a drive shaft of the bed and being drivingly connected to the speed reducer, a tube fixed to said casing, and a rubber sleeve mounted in said tube in engagement therewith and engageable with a portion of the bed to support the casing on the portion of the bed and insulate the bed from vibration of the casing to reduce noise and to reduce vibration of the bed.

6. A drive mechanism for operating a bed which bed includes a drive shaft to raise and lower a movable portion of the bed comprising, in combination, a connector drivingly engageable with the drive shaft, a speed reducer drivingly connected to the connector, a casing rotatably supporting said speed reducer, an electric motor drivingly connected to the speed reducer and being connected to said casing, control means connected to the electric motor for controlling the operation of the electric motor, and a vibration insulator positioned between a portion of the bed supporting the casing and the casing to absorb vibration of the casing to reduce noise and vibration of the bed.

7. In a drive mechanism for operating a bed which bed has a drive shaft adjacent to one end of the bed, the combination of, a connector engageable with the drive shaft to turn the drive shaft, a gear shaft drivingly connected to the connector, a casing rotatably supporting the gear shaft, means connected to said casing to hold the casing with respect to the bed in a fixed attitude, a gear rotatably mounted in said casing and being drivingly connected to the gear shaft, a pinion meshing with said gear, a reversible electric motor connected to said casing and being drivingly connected to the pinion to rotate the pinion in a selected direction, a first electric switch electrically connected to the electric motor for controlling the rotation of the electric motor in one direction, a second switch being electrically connected to the electric motor to control the electric motor in the other direction and being electrically connected in series with the first switch, whereby the first switch must be open with respect to the electric motor in order to allow the second switch to control rotation of the electric motor.

8. A drive mechanism for operating a bed which bed has a drive shaft having a drive slot in one end and a tubular guard surrounding a portion of the drive shaft adjacent to the end of the drive shaft having the drive slot, comprising, in combination, a tube for receiving a portion of the tubular guard and the end of the drive shaft having the drive slot, a stud in said tube engageable with the tubular guard to hold the tube relative to the tubular guard, a casing fixed to said tube, a connector pivotedly mounted in the drive slot of the drive shaft, a first shaft pivotedly connected to the connector, a first gear mounted in said casing and being drivingly connected to said first shaft, a second gear meshing with the first gear, a second shaft drivingly connected to the second gear and having a maximum distance between the axis of the second shaft and the axis of the first shaft of less than the outside radius of the first gear, and an electric motor mounted in the casing and being connected to the second gear through the second shaft to provide a source of rotational energy.

9. A drive mechanism for operating a hospital bed which bed has a drive shaft having a drive slot in one end and a tubular guard surrounding a portion of the drive shaft adjacent to the end of the drive shaft having the drive slot, comprising, in combination, a casing, a reversible electric motor connected to said casing, control means connected to said motor for selecting the direction of rotation of said motor and controlling the rotation of the motor, said electric motor having a motor shaft, a pinion drivingly connected to said motor shaft

and said pinion being mounted within said casing, a gear rotatably mounted within said casing and meshing with said pinion, a gear shaft drivingly connected to said gear, a connector drivingly connected to said gear shaft and being intercalated between the drive shaft and the tubular guard, said connector having a drive pin positioned in the slot of the drive shaft to pivotally engage the drive shaft and rotate the drive shaft, a tube fixed to said casing and surrounding the connector, means connected to said tube and engageable with the tubular guard to hold the tube and casing against reaction torque, and a sound deadener within said tube for absorbing noise within said tube.

10. A drive mechanism for operating a bed which bed has a drive shaft having a drive slot in one end adjacent to one end of the bed and a tubular guard surrounding a portion of the drive shaft adjacent to the end of the drive shaft having the drive slot, comprising, in combination, a casing, a reversible electric motor connected to said casing, a double throw switch having one pole electrically connected to said electric motor to control the rotation of the electric motor in one direction, a second switch connected in series to the electric motor to control the rotation of the electric motor in the opposite direction and connected to the other pole of the double throw switch to be controlled by the double throw switch, an overload device connected in series with the electric motor to open the circuit to the electric motor upon overloading of the motor, said reversible electric motor having a motor shaft, a pinion drivingly connected to the motor shaft, a gear rotatably mounted within said

casing and meshing with said pinion, a gear shaft drivingly connected to the gear, the axis of rotation of said gear shaft having a maximum distance to the axis of rotation of the motor shaft less than the outside radius of the gear, a connector drivingly connected to the gear shaft and being intercalated between the drive shaft and the tubular guard, said connector having a drive pin pivotedly mounted in the slot of said drive shaft for turning the drive shaft, a tube fixed to said casing and surrounding the connector and a portion of the tubular guard, and means connecting the tube to the tubular guard to hold the casing relative to the tubular guard against reaction torque.

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