

April 21, 1964

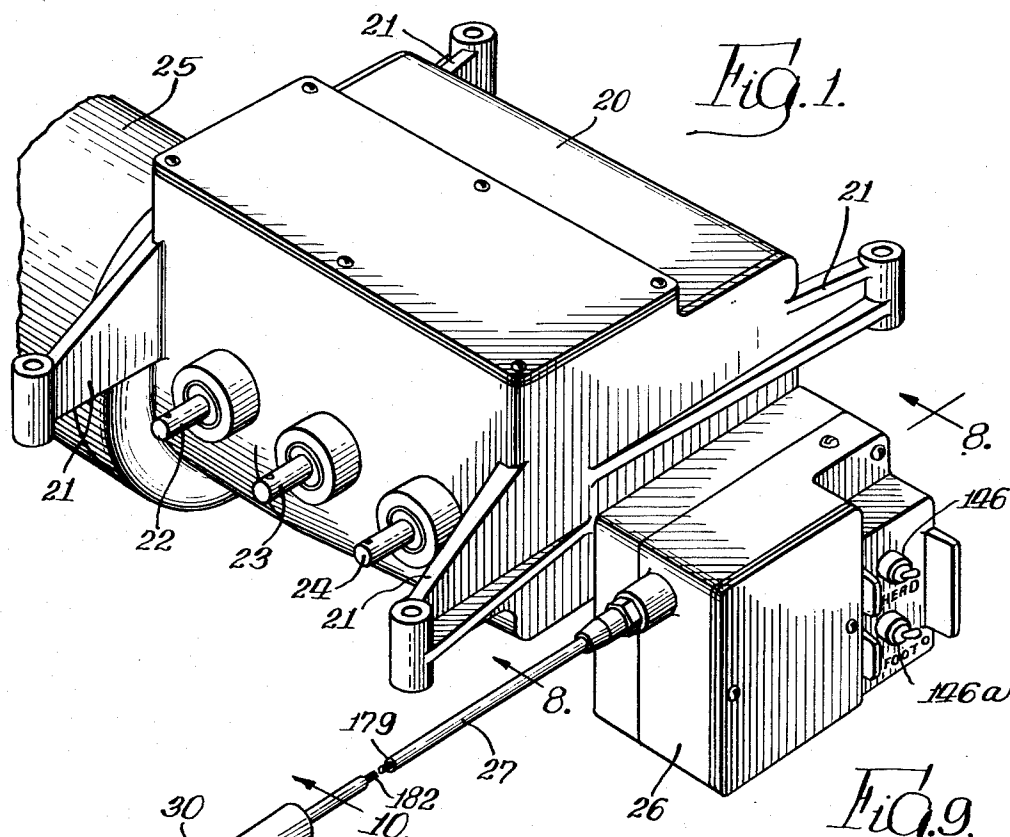
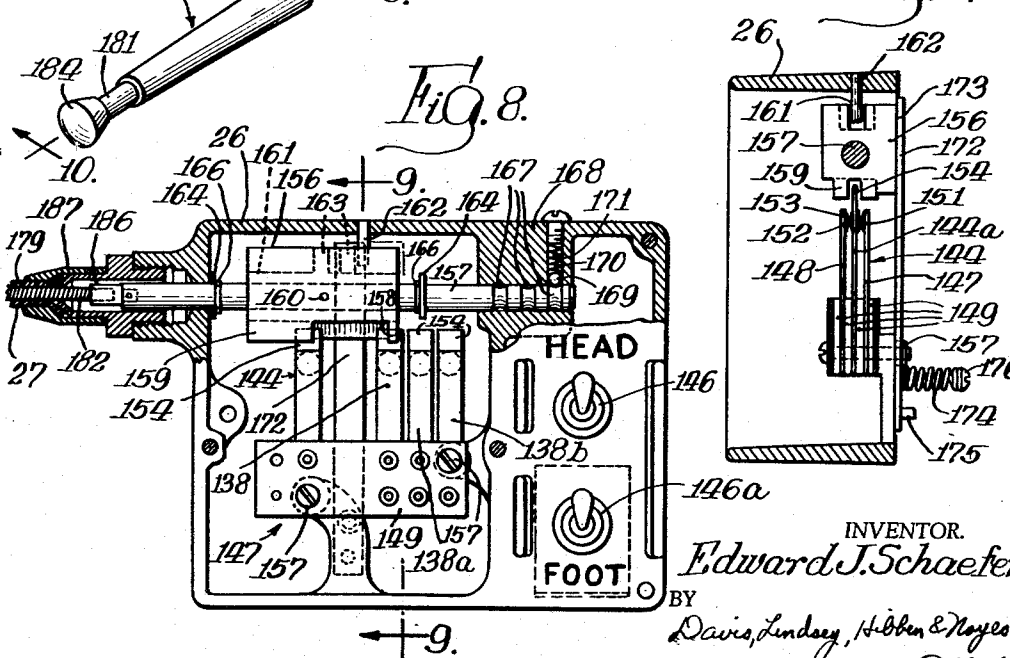
E. J. SCHAEFER

3,129,607

DRIVE UNIT AND CONTROL

Filed July 5, 1960

4 Sheets-Sheet 1



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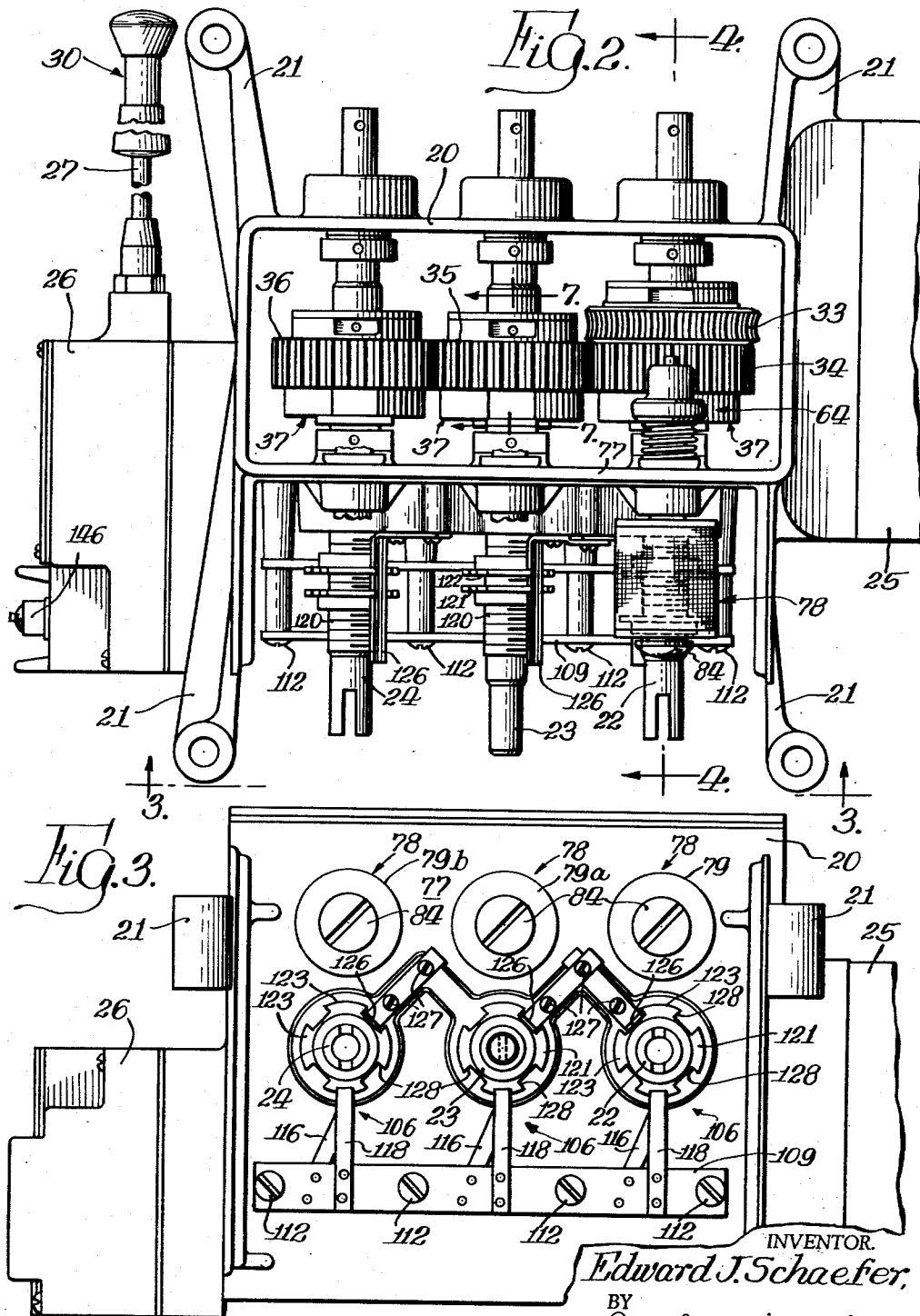
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DRIVE UNIT AND CONTROL

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4 Sheets-Sheet 2



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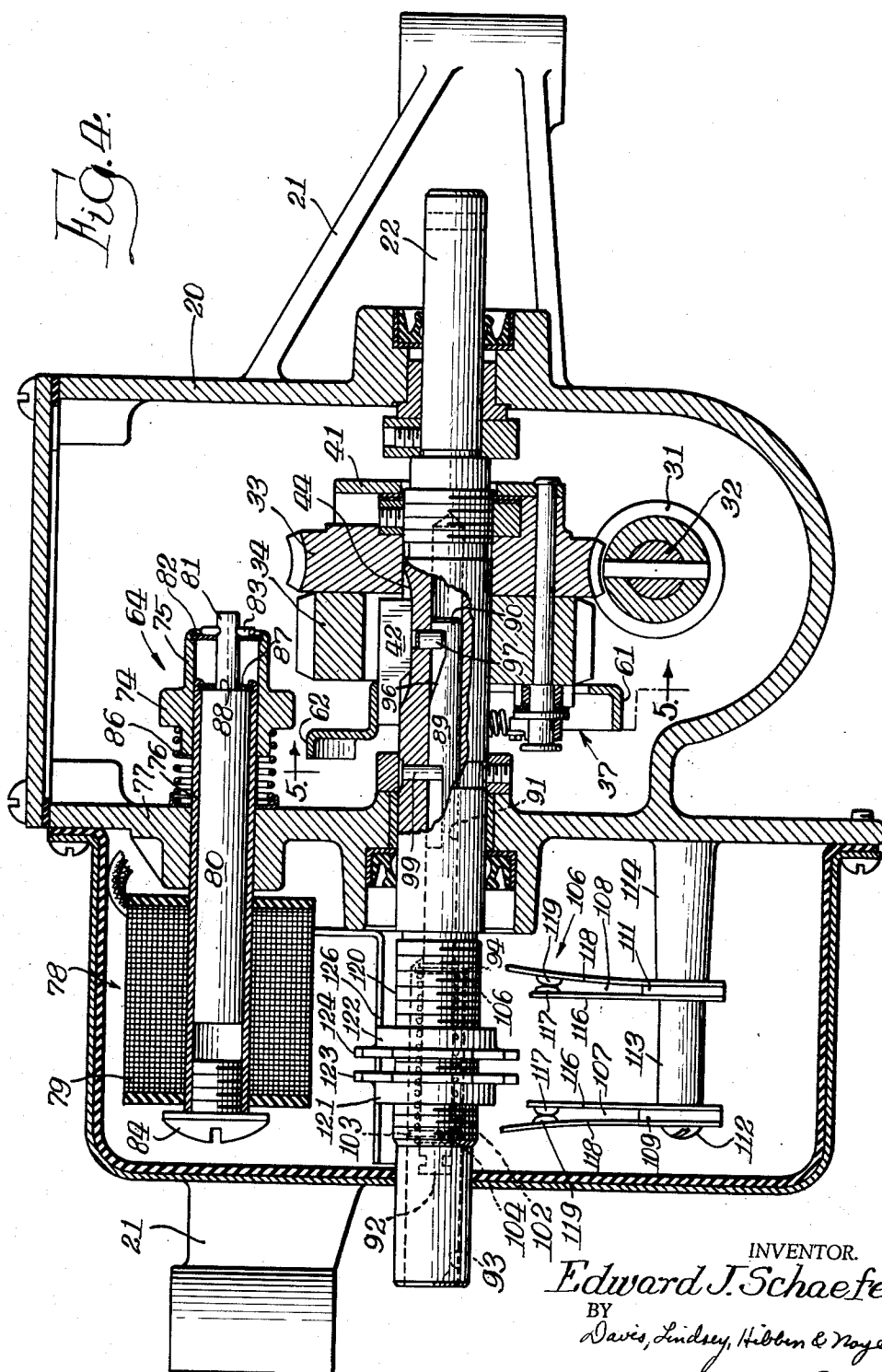
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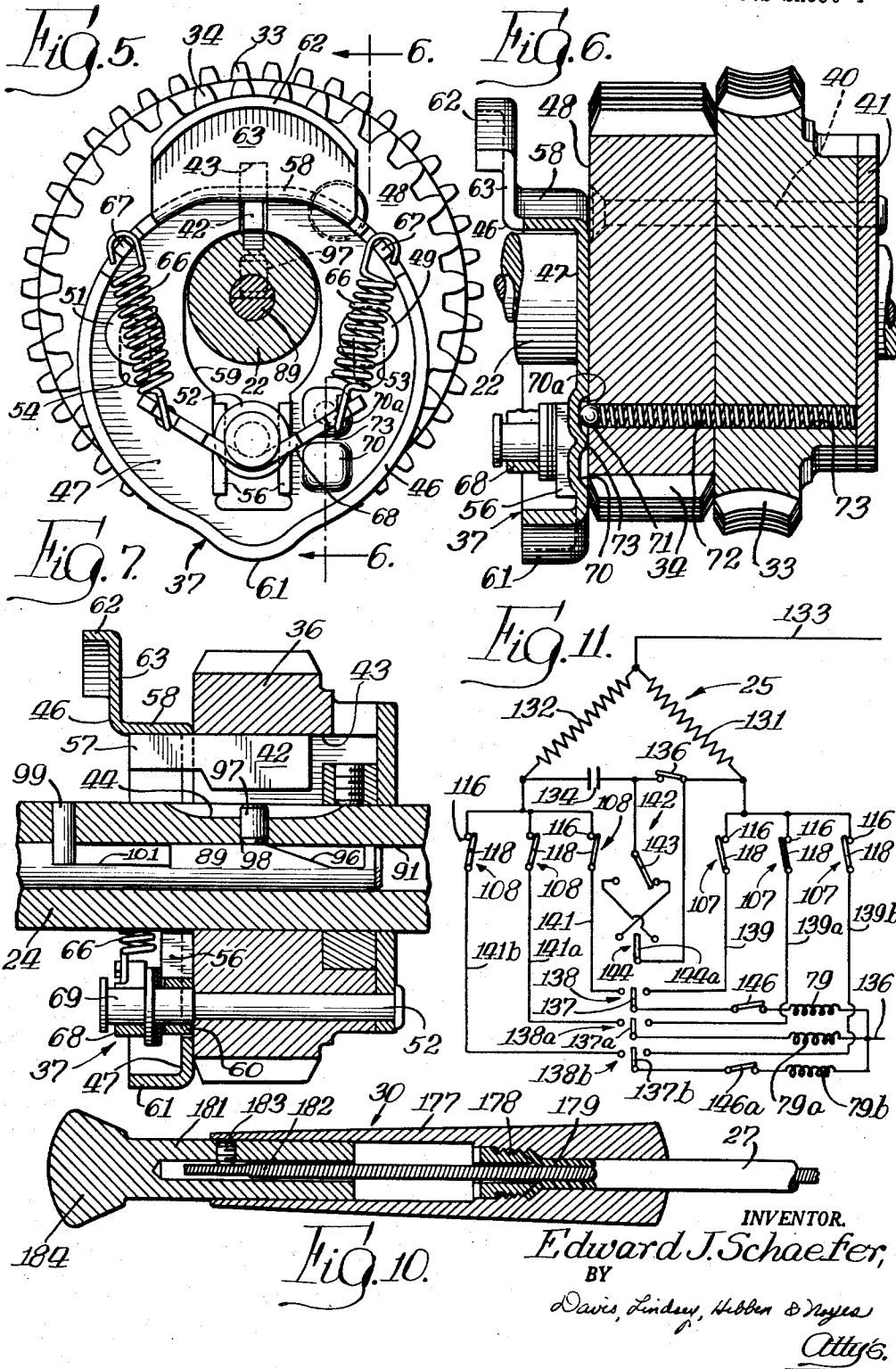
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3,129,607

DRIVE UNIT AND CONTROL

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Filed July 5, 1960, Ser. No. 40,959
35 Claims. (Cl. 74-665)

This application is a continuation-in-part of my co-pending application, Serial No. 796,160, filed February 27, 1959, now abandoned.

This invention relates to electrically powered drive units and control therefor.

In order to save time and labor and to improve safety, it has become commonplace to provide motor power drives for many types of equipment. Such drives may perform the functions that normally require motor power as well as functions that have been performed by hand. In some types of equipment it is desirable to provide power drives for performing several related but distinct functions. It is also desirable that control of such drives be as simple as possible so that little or no skill is required by an operator.

By way of example, a modern hospital bed usually is adjustable in various ways for the increased comfort of the patient or for medical reasons. Some hospital beds are provided with a mechanism for raising and lowering the head section of the bed, another mechanism for raising and lowering the foot section of the bed, and still another mechanism for raising and lowering the level of the bed. Older beds used individual hand cranks for performing these functions. More modern beds are equipped with one or more power drives for performing the functions. One form of drive unit embodying the present invention is adapted for use in connection with hospital beds in order to provide power for the three independent functions outlined above. It is to be understood, however, that the drive unit herein disclosed is not limited to use with a hospital bed but may have other uses.

It is a primary object of this invention to provide a novel drive unit and control therefor which is compact, dependable, safe, and easily controlled.

It is another object of this invention to provide a novel drive unit powered by an electric motor, the unit being adapted to selectively drive any one of a plurality of mechanisms in either direction of operation.

Another object of the invention is to provide a drive unit including novel clutch means which is engaged and disengaged by force supplied by rotation of the parts.

Yet another object of the invention is to provide a drive unit having a novel clutch means which is engaged and disengaged by force supplied by the unit's drive motor and which is electrically controlled.

A further object of the invention is to provide a novel drive unit which automatically confines its operation to pre-established limits in both directions of operation.

Another object of the invention is to provide a novel multiple shaft drive unit which has a control system that is simple to operate and which enables an operator to select and control the operation of any one of the mechanisms connected to it by the manual manipulation of one simple control member.

Still another object of the invention is to provide a novel drive unit which can be manually manipulated in the event of a power failure.

A further object of the invention is to provide a novel multiple shaft drive unit, including controls therefor, which is adapted for use in a hospital bed, the controls being accessible to, and manipulatable by, a patient while lying in bed.

A further object of the invention is to provide a novel,

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easily operated control system for a multiple shaft drive unit.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a drive unit embodying the features of the present invention;

FIG. 2 is a top plan view of the unit in FIG. 1, showing some of the internal structure of the unit;

FIG. 3 is a view of the structure as viewed from the line 3-3 of FIG. 2;

FIG. 4 is a sectional view taken along the line 4-4 in FIG. 2;

FIG. 5 is an enlarged sectional view taken along line 5-5 in FIG. 4;

FIG. 6 is a sectional view taken along line 6-6 of FIG. 5;

FIG. 7 is an enlarged sectional view taken along the line 7-7 of FIG. 2;

FIG. 8 is an enlarged sectional view taken along the line 8-8 of FIG. 1;

FIG. 9 is a sectional view taken along the line 9-9 of FIG. 8;

FIG. 10 is an enlarged sectional view taken along the line 10-10 of FIG. 1; and

FIG. 11 is a diagrammatic view showing the electrical circuit for the unit of FIG. 1.

A drive unit embodying features of the invention is adapted to selectively drive in opposite directions any one of a plurality of shafts from a single electric motor under the control of a single manually operable control device. While the drive unit is particularly adapted for driving various movable parts of a hospital bed and is disclosed in a form for such use, it of course may be used as the drive of other forms of equipment or devices.

The drive unit comprises generally a housing 20 which, when used as a drive for a hospital bed, is provided with a plurality of arms 21 by which the housing may be suspended under the frame of the bed, preferably near the foot. The housing 20 has a plurality of driven shafts which are journaled in the housing and project at each end from the housing. In the present instance, three such driven shafts are shown and are indicated as 22, 23, and 24. The shafts 22, 23, and 24 are adapted to be selectively driven by an electric motor 25 (see FIGS. 1 and 2) rigidly mounted on one side of the housing 20.

Control of the motor and the respective shafts is obtained by switch mechanism contained in a switch box 26 (see FIGS. 1, 2, 3, 8 and 9) mounted on the side of the housing 20 opposite to that on which the motor 25 is mounted. Extending from the switch box 26 is a manually operable control means in the form of a Bowden wire 27 (see FIGS. 1, 2, 8 and 10) having at its opposite end a manually operable control device indicated generally at 30. The Bowden wire 27 permits the manually operable control device 30 to be placed in a position convenient to the patient in the hospital bed, so that the patient himself can manipulate either the head or foot sections or change the level of the bed as a whole. For this purpose it will be understood that the shafts 22, 23 and 24, when driven, respectively actuate mechanisms (not shown) for manipulating the head, the foot and the level of the bed as a whole.

For driving the respective shafts 22, 23 and 24 from the motor 25, the latter is provided with a worm 31 (see FIG. 4) rigidly secured to the motor shaft 32 and meshing with a worm wheel 33 rotatably mounted on one of the driven shafts, in this instance the shaft 22. Also rotatably mounted on the shaft 22 and rigidly secured to the worm wheel 33 is a gear 34 (see FIGS. 2, 4 and 6) which meshes with a gear 35 rotatably mounted on the shaft 23, the gear 35 in turn meshing with a gear 36

rotatably mounted on the shaft 24. Each of the gears 34, 35 and 36 are adapted to be connected to their associated shafts through a clutch mechanism indicated generally at 37. The gear 34 is secured to the worm wheel 33 by a rivet 40 extending through the gear 34, the worm wheel 33 and a clamping plate 41 mounted on the opposite side of the wheel 33 from the gear 34.

The three clutch mechanisms 37 for the shafts 22, 23 and 24 are alike and each interconnects its associated shaft and gear by a key 42, movably mounted in a slot or keyway 43 in its associated gear. A cooperating keyway 44 (see FIG. 7) is provided in the associated shaft. Rotation of the gears aligns the keyways 43 and 44 once every revolution, and the key 42 is movable from a neutral or retracted position in the keyway 43 to a projected or drive position in which it also engages the associated shaft in its keyway 44. The key 42 shown in FIG. 7 is in its neutral position while the key 42 shown in FIG. 5 is in its drive position.

Movement of the key 42 from either one of its positions to the other is accomplished by the shifting of a cup-shaped member 46 (see FIGS. 5, 6 and 7) to which the key 42 is rigidly secured. The cup-shaped member 46 has a generally flat end wall 47 shiftably but non-rotatably mounted on the end face 48 of its associated gear.

Each of the members 46 and its associated gear is held in assembled relation by three eccentrically positioned rivets 49, 51 and 52 which are provided with enlarged heads. The rivet 52 is positioned on the diameter of the member 46 extending in the direction in which the member shifts. The shanks of the rivets 49 and 51 project through elongated slots 53 and 54, respectively, provided in the end wall 47 of the member 46 and extending parallel to the direction in which the member shifts. Thus, the rivets act to guide the member 46 during shifting and also cause rotation of the member 46 with its associated gear.

The rivet 52, in addition to helping hold the member 46 and its associated gear in assembled relation, also is a guidepost and coacts with the member 46 to guide the member 46 during shifting. The rivet 52 projects outwardly through a slot in the member 46, the metal from the slot being bent to provide a pair of spaced ribs 56. A roller 60 is mounted on the rivet 52 to roll against the ribs 56.

A portion 57 of the key 42 also projects through the end wall 47 of the cup-shaped member 46 and is rigidly fastened, as by welding, to the inner surface of the side wall 58 of the member 46. Likewise, the associated shaft projects through an opening 59 in the end wall 47, the opening being elongated to provide clearance between the shaft and the member 46 for the shifting of the latter.

Shifting of the cup-shaped member 46 to effect movement of the key 42 from either of its positions to the other is accomplished by using force supplied by rotation of the member 46. To this end, the cup-shaped member 46 is provided with a pair of outwardly facing axially offset peripheral cam surfaces on diametrically opposite sides of the key 42. One cam surface, indicated at 61, is formed in the side wall 58 by bulging the side wall outwardly as shown in FIG. 5. The opposite cam surface 62 is formed on a lip 63 extending outwardly from the outer edge of the side wall 58, the cam surface 62 being axially offset with respect to the cam surface 61 as is shown in FIGS. 6 and 7. The cam surfaces 61 and 62 are engageable by a shiftable actuator or cam follower, shown generally at 64 in FIG. 4, and described more fully hereinafter, for effecting the shifting. From FIG. 4 of the drawings it is apparent, however, that, when the cam follower 64 is positioned to be engaged by the cam surface 61 during the rotation of the clutch mechanism 37, the cup-shaped member 46, together with the key 42, will be forced toward the neutral position. Likewise, when the cam follower 64 is shifted to be engaged by the

cam surface 62, the cup-shaped member will be forced toward the drive position.

It should be recognized that alignment of the keyways 43 and 44 will not ordinarily occur at precisely the instant that the cam follower 64 engages the high point on the cam surface 62. To prevent jamming in this circumstance, the cam surface 62 is formed so that engagement with the cam follower 64 will only shift the member 46 part way toward the drive position with the key 42 close to the periphery of the shaft 22. The member 46 is shifted the remainder of the way to the drive position by spring means. In the present instance, a pair of tension springs 66 provide the force required to complete the shifting of the cup-shaped member when the keyways 43 and 44 are aligned. As shown in FIG. 5, the side wall of the cup-shaped member 46 is notched to provide a pair of lugs 67 on opposite sides of the lip 63, and one end of each of the springs is hooked on a lug 67. The opposite ends of the springs are anchored to the rivet 52 by a yoke 68, said opposite ends of the springs being respectively secured to the arms of the yoke 68 corresponding to the lugs 67. The rivet 52, in this instance, has a guidepost portion 69 and the yoke element 68 straddles the portion 69 to keep the springs in tension. Thus, after the member 46 has been moved part way toward the drive position, the springs 66 will pull the member 46 the remainder of the way as soon as the key 42 is aligned with the keyway 44.

It should be further noted that the springs 66 exert a continuous force on the member 46. Thus, when the cam follower 64 is in the neutral position (the position to engage the cam surface 61) and the surface 61 is rotated out of engagement with the cam follower 64, the springs 66 could normally cause the key 42 to ride on the surface of the shaft 24 and click against, or partially engage the slot 44 upon each rotation. To prevent such click or partial engagement each gear assembly is provided with means for holding the key 42 out of contact with the associated shaft (such as 22) when the cam follower 64 is in the neutral position and the key 42 is out of the slot. In the present instance, the holding means comprises a spring pressed detent 71 (see FIG. 6) in the form of a ball which contacts with the member 46. The detent 71, together with a spring 72, is mounted in a bore 73 extending through the gear parallel to the axis of rotation of the gear, the spring bearing at one end against the detent 71 and at its other end against the plate 41. The end wall 47 is formed, adjacent the detent, to provide a pair of pockets 70 and 70a for receiving the detent. The pockets 70 and 70a are aligned parallel to the direction of movement of the member 46 and are separated by a transverse wall or shoulder 73. The pockets 70 and 70a and the shoulder 73 are located so that when the clutch is in neutral the detent 71 is engaged in the pocket 70 and coacts with the shoulder 73 to hold the key spaced outwardly from the surface of the shaft 22. To effect engagement of the clutch the member 46 is shifted to the full extent provided by the cam surface 62 and the detent 71 rides over the shoulder 73 into the pocket 70a. When the springs 66 have completed the shifting of the member 46 to the drive position, the detent 71 occupies the position shown in FIG. 6. Thus, in effect, the detent 71 jumps back and forth across the shoulder 73 as the member 46 is shifted back and forth between neutral and drive positions by the cams 61 and 62, and the detent 71, coacting with the opposite sides of the shoulder 73, holds the member 46 in the position determined by the last cam to engage the cam follower 64.

One of the actuators or cam follower 64, mentioned briefly above, is shown in FIGS. 2 and 4. In the present instance, the actuator 64 comprises a cam wheel 74 rotatably and shiftably mounted on the end of a tubular spindle 76. The spindle 76 is mounted in and projects through a boss 77 formed on a wall of the casing 20, the spindle 76 being parallel to the shaft 22, which the actuator 64 serves. The cam wheel 74 is positioned on the

spindle 76 adjacent the periphery of the cup-shaped member 46. The wheel 74 is axially shiftable between a first or neutral position for engagement with the cam surface 61 and a second or drive position for engagement with the cam surface 62. FIG. 4 shows the wheel 74 in the first or neutral position. Shifting of wheel from the first to the second position is, in this instance, accomplished by a solenoid shown generally at 78. The solenoid 78 comprises a winding or coil 79 mounted on the outer end of spindle 76 beyond the boss 77, and an elongated armature or plunger 80 slidably disposed in the bore of the spindle 76. Coils of the solenoids for the other clutch means are indicated as 79a and 79b (see FIGS. 3 and 11).

One end 81 of the armature 80 is connected to the wheel 74 by a washer 82 mounted in the outer end of the hub 75 of the roller and abutting against a crosspin 83 through the end 81 of the armature, as shown in FIG. 4. The opposite end of the armature 80 projects part way into the winding 79 so that, upon energization of the winding, the armature 80 will be pulled further into the winding, thus shifting the wheel 74 toward the winding. Movement toward the winding is stopped, when the cam wheel 74 reaches the second position for engagement with the cam surface 62, by a stop screw 84 threaded into the outer end of the spindle 76. It should be noted that the hub 75 of the roller 74 is elongated to provide clearance for the end of the spindle 76.

Upon deenergization of the solenoid 78, the wheel 74 is returned to its first position, carrying with it the armature 80. In this instance the return is effected by a compression spring 86 mounted on the spindle 76 and coacting between the boss 77 and the wheel 74. The return movement of the wheel and armature is limited by a washer 87 rigidly mounted in the end of the tubular spindle 76. The end portion 81 of the armature is of reduced diameter to provide a circumferential shoulder 88 which abuts against the washer 87 when the wheel is at the first or neutral position, the end portion 81 projecting through the washer 87.

From the foregoing description of the mounting of the cam wheel 74, it is apparent that the cam wheel is free to rotate on the spindle 76. Such rotation occurs when either of the cam surfaces 61 or 62 engages the cam wheel and permits the cam wheel to rotate with the rotation of the cam surface to reduce friction therebetween.

When the drive unit is used in a hospital bed, it is important that at least some of the bed adjusting mechanisms be operable by hand in the event of a power failure. For example, the head and foot adjusting mechanism should be manually adjustable. Therefore the shafts 22 and 24 are each provided with means for manually disengaging their respective clutch mechanisms on engagement of the hand crank. The structure for accomplishing these ends is shown in FIGS. 4, 5 and 7 and comprises an elongated plunger 89 mounted in an axial bore 91 provided in each of the shafts 22 and 24. The bore 91 extends from one end of its shaft to a point beyond the position of the key 42. The plunger 89 has an end 92 located near the one end of the shaft and adapted to be engaged by a hand crank (not shown). The opposite end 90 of the plunger is located opposite the key 42. The one end of each of the shafts is counterbored as at 93 to provide clearance around the end 92 of the plunger for accommodating the hand crank and to provide an outwardly facing shoulder 94 located inwardly from the end 92 of the plunger.

To disengage the clutch, the end 90 of the plunger 89 is provided with an inclined cam surface 96 for forcing a pin 97 radially against the key 42 upon axial movement of the plunger 89, thereby pushing the key 42 out of engagement with its associated shaft. The pin 97 is mounted in a radial bore 98 interconnecting the keyway 44 and the bore 91. A driving connection between the plunger 89 and its associated shaft is provided by a radially extending drive pin 99 mounted in the shaft and engaging

the plunger 89 in a longitudinally extending slot 101 therein. The pin 99 also acts as a stop for limiting the axial movement of the plunger.

In order to release the pin 97 after manual manipulation of the mechanism is accomplished, the plunger 89 is provided with a compression spring 102 mounted on the plunger in the counterbore 93. One end of the spring 102 engages a washer 103 held in position on the end 92 of the plunger by a retaining ring 104. The opposite end of the spring engages another washer 106 which is slidably mounted on the plunger and engages the shoulder 94 in the bore. Thus axial inward movement of the plunger 89 compresses the spring 102, and upon release of the plunger, the spring 102 will return the plunger outwardly to its original position, freeing the pin 97. The pin 97 of course will be forced inwardly the next time that the key 42 enters the keyway 44.

The present drive unit is also provided with limit switch means for confining the operation of its shafts to pre-established limits of rotation in either direction, which switch means is an important safety feature of the invention. Each of the drive shafts 22, 23 and 24 is provided with a limit switch device, indicated generally at 106 in FIGS. 2, 3 and 4, for limiting the operation of its associated shaft. Each switch device 106 includes a pair of normally closed switches 107 and 108 mounted adjacent the associated shaft and in spaced relation longitudinally of the shaft. As is shown by FIGS. 2, 3 and 4, each of the switches 107 and 108 comprises a fixed arm 116 having a contact 117 at one end and a spring arm 118 having a contact 119 near its corresponding end, the fixed arms 116 of the two switches being on the inner sides thereof and the spring arms 118 being on the outer sides. The three switches 107 are secured to a mounting strip 109 in spaced relation corresponding to the spacing between the shafts 22, 23 and 24, while the three switches 108 are similarly secured to another mounting strip 111. In both instances the spring arms are all on one side of the mounting strip and the fixed arms are on the other side of the mounting strip. Also, the spring arms 118 extend farther from the mounting strips than do the fixed arms 116. The mounting strips 109 and 111 are fastened to the wall 77 of the casing 20 by a plurality of elongated screws 112 and are held in predetermined spaced relation longitudinally of the shafts by spacer sleeves 113 and 114 mounted on the screws 112 between the strip 109 and the strip 111 and between the strip 111 and the wall 77, respectively.

On rotation of each of the shafts 22, 23 or 24 to a pre-established limit in either direction, the corresponding one of the switches 107 and 108 associated with the shaft is opened. This is accomplished by a pair of nuts 121 and 122 threaded on the associated shaft between the switches 107 and 108, each shaft being threaded, as at 120, along a portion of its length to receive the nuts. The nuts 121 and 122 are provided with radially extending flanges 123 and 124, respectively, for engagement with the spring arms 118 of the respective switches 107 and 108.

During operation of the drive unit, the nuts 121 and 122 are prevented from rotating with their associated shafts. Thus, the nuts move in unison in one direction or the other along their shaft, depending on the direction of the shaft's rotation. The nuts are held against rotation by fixed bars 126, each bar being L-shaped with one leg secured to the wall 77 of the casing 20 as by screws 127. The other leg of each of the bars 126 extends parallel to its associated shaft and engages the nuts in notches 128 formed in the flanges 123 and 124. Hence, rotation of the shaft 22 will cause the nuts 121 and 122 to move along the shaft. When the shaft has rotated the pre-established amount in one direction, the flange 124 of nut 122 will engage the end of spring arm 118 and open switch 108. Likewise, rotation of the shaft 22 to its limit in the opposite direction will cause the nuts 121 and 122 to move to the right and the flange 123 of nut 121 will similarly open switch 107.

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Although the bars 126 are fixed, they are sufficiently flexible for removal from engagement in a notch 128 of either the nut 121 or 122 so that the nuts can be individually rotated for adjustment purposes. By individually adjusting the position of the nuts with respect to their shaft, the rotative limits of the shaft in either direction of rotation are adjusted.

The limit switches above described are connected in circuit with the motor 25 and with the solenoids 78 so that operation stops when a limit switch opens. The specific mode of connection will be described more fully hereinafter.

Inasmuch as the motor 25 is electric and the clutches are electrically actuated, the instant drive unit is controlled by switch means. FIG. 11 diagrammatically shows a preferred control circuit for the drive unit when used in conjunction with a hospital bed. Thus, FIG. 11 shows the motor 25 as a conventional instantly reversing single phase motor having a pair of field windings 131 and 132. One end of each of the windings 131 and 132 is connected to one conductor 133 of a line. A capacitor 134 and a centrifugal switch 136 are connected in series between the opposite ends of the windings 131 and 132. The coils 79, 79a and 79b of the three solenoids 78 are connected in parallel to the other conductor 136 of the line and are respectively connected to movable contacts 137, 137a and 137b of three single throw double pole switches, 138, 138a and 138b. The switches 138, 138a and 138b are individually selectively connectable to the winding 131, through parallel leads 139, 139a and 139b, respectively, and to the winding 132 through leads 141, 141a and 141b, respectively. Upon closure of any one of the switches 138, 138a and 138b in either direction, the motor 25 and also one of the coils 79, 79a or 79b corresponding to the closed switch, are connected across the conductors 133—136 for energization. The motor will operate, of course, in one direction or the other depending on which of the field windings 131 and 132 is connected directly across the conductors as a running winding.

The three normally closed limit switches 107 are connected respectively in the leads 139, 139a and 139b between the switches 138, 138a and 138b and the winding 131, and the three normally closed limit switches 108 are connected respectively in the leads 141, 141a and 141b between the switches 138, 138a and 138b and the winding 132. Thus, the limit switches are connected to deenergize the motor and the associated solenoid when a limit of operation is reached.

The circuit also includes a device 142 for instantly reversing the motor from one direction of operation to the other. The device 142 includes a rotation sensing switch 143 mounted in the motor and a manual single pole double throw reversing switch 144 connected to bypass the centrifugal switch 136 in the event it is desirable to reverse motor operation after the centrifugal switch has opened. This reversing device is fully discussed in my United States Patent No. 2,847,629. It should be noted, however, that, in the present instance, in order to effect reversal of the motor, both the switch 144 must be appropriately closed to provide a connection around the open centrifugal switch and, also, one of the switches 138, 138a and 138b must be closed to connect the opposite winding as a running winding. Switch structure for simplifying this operation is an important feature of this invention and will be discussed hereinafter.

Finally, the circuit is provided with a pair of manually operable switches 146 and 146a connected in series with coils 79, 79b, respectively, which may be opened to prevent energization of the solenoids 78 and 78b.

The controls for the drive unit have been simplified to the extent that an inexperienced operator can manipulate the unit without difficulty. FIGS. 1, 8 and 9 show a preferred form of the controls. The switch box 26, previously mentioned contains the controls comprising

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the switches 138, 138a, 138b, 144, 146 and 146a. The latter two switches are individually manually operated and are mounted in one end of the switch box 26. The switch 146 is designated, in this instance, as "head" and the switch 146a is designated as "foot," since it is contemplated that the shafts 22 and 24 will be connected to the mechanisms for operating the head and foot sections of the bed, respectively. These switches are located out of the normal reach of the patient and may be selectively opened for preventing the patient from inadvertently operating those parts of the bed. For this reason the switch box 26 is mounted on the side of the housing 20 underneath the bed.

The switches 138, 138a, 138b and 144 are combined in a unitary assembly 147 mounted in the end of the switch box 26 opposite the end containing switches 146 and 146a. The four switches are arranged in longitudinally spaced relation in the assembly with the reversing switch 144 located at one end of the assembly and the switches 138, 138a and 138b located at the other end.

Each of the four switches comprises a pair of laterally spaced parallel fixed arms 147 and 148 and a movable arm, such as 144a, positioned between the arms 147 and 148 (see FIG. 9). The arms are clamped in assembled relation between adjacent pairs of four elongated spacer strips 149. At their free ends, the arms 147 and 148 are provided with contacts 151 and 152, respectively, and the movable arms, such as 144a, are each provided with an intermediate contact 153. The spacer strips hold the arms so that the intermediate contact 153 of each switch does not normally engage either of its associated fixed contacts 151 and 152. The movable arms, such as 144a, are of equal length and each is longer than its associated fixed arm, each movable arm having a portion 154 extending outwardly from its contact 153 for engagement by an actuating member to be described hereinafter. The switch assembly 147 is fastened in fixed position in the switch box 26 by bolts 157. The various switch elements are connected in circuit with the motor and the solenoids as shown in FIG. 11.

The movable switch arms, such as 144a, are manipulated by the above mentioned actuating member, which, in this instance, is a rectilinear block 156. The block 156 is rigidly secured to a shaft 157 by a pin 160 adjacent the switches 138, 138a, 138b and 144. The shaft 157, in turn, is journaled at each end in transverse walls of the switch box for rotation in either direction and also for axial movement.

As shown in FIGS. 8 and 9 the block 156 is provided with a pair of lugs 158 at the end of the block adjacent the switches 138, 138a and 138b. The lugs 158 are laterally spaced to normally straddle the portions 154 on the movable arms. Axial movement of the block 156 selectively positions the lugs 158 for engagement with one of the movable arms of the switches 138, 138a and 138b. Upon rotation of the block in either direction, the movable arm, such as the arm 137, is moved to close the contact thereon with one of the fixed contacts 151 or 152.

The block 156 is also provided with a pair of laterally spaced longitudinally extending ribs 159. The ribs 159, like the lugs 158, normally straddle the portion 154 of the movable arm 144a. However, the ribs 159 are long enough for engagement with the movable arm 144a at every longitudinal position of the block 156, and are longitudinally spaced from the lugs 158 to provide clearance therebetween to avoid engagement by the ribs 159 with the movable arm of the switch 138 when the block is moved to the position where the lugs 158 engage the movable arm of switch 138b. Thus, on rotation of the block 156 in either direction to close one of the switches 138, 138a and 138b, the reversing switch arm 144a will close on one of the fixed contacts of the reversing switch 144.

Although the block 156 is rotatable in both directions

and is also axially movable, axial movement of the block when in a rotated position might cause one of the lugs 158 to jam against the edge of one of the movable arms. To avoid this possibility, the top of the block 156 is provided with a longitudinally extending slot 161. A pin 162, rigidly mounted in the top of the switch box 26, projects downwardly into the slot 161, as shown in FIG. 9. The slot 161 has narrow places at two spaced points 163 corresponding to the spaces between the three switches 138, 138a and 138b. The narrow places 163 in the slot 161 act as stops, preventing longitudinal movement when the block 156 is in a rotated position and preventing rotation of the block when the lugs 158 are between adjacent switches.

The block 156 is spring biased to occupy a non-rotated position in order that the intermediate contacts 153 will normally be disengaged from their fixed contacts and that the block may be longitudinally shifted without difficulty. To this end, an elongated return arm 172 is positioned with one end bearing against a flat side 173 of the block 156. At its opposite end, the return arm 172 is mounted on a pin 175 on the switch box 26 and, in this instance, is urged toward the block 156 by a compression spring 174. The spring is held against the return arm 172 by a screw 176 threaded into the switch box 26 through the return arm. The force exerted by the spring on the return arm 172 is adjustable by rotation of the screw 176. Because of the flat side 173, rotation of the block 156 in either direction forces the end of the return arm outward against the force of the spring 174 which, in turn, tends to return the block to its non-rotated position.

To simplify the longitudinal positioning of the block 156 relative to the switches 138, 138a and 138b, one end of the shaft is provided with three circumferential grooves 167, the grooves 167 being longitudinally spaced to correspond to the spacing of the switches 138, 138a and 138b. The grooved end of the shaft projects into a transverse wall portion 168 of the switch box 26. A detent comprising a ball 169 and a spring 170 therefore is mounted in a bore 171 in the wall portion 168 for engagement with the shaft 157 in the respective grooves 167 when the lugs 158 are properly positioned with respect to the switches 138, 138a and 138b.

To limit the extent of longitudinal shifting of the block 156, a pair of washers 164 backed by snap rings 166 are mounted on the shaft 157. The washers 164 respectively engage with the wall portion 168 and the transverse wall at the other end of the shaft 157 and limit the axial movement of the shaft.

The block 156 is, in this instance, manipulated by the remotely located control handle 30 which is connected by the Bowden wire 27 to the shaft 157. The handle 30 (see FIG. 10) comprises a sleeve 177 threadedly connected at one end, as at 178, to the flexible sheath 173 of the Bowden wire. A manually movable plunger 181 is mounted in the opposite end of the sleeve 177, and is rigidly connected to the end of the wire core 182 of the Bowden wire 27 by a set screw 183. The plunger 181 projects from the sleeve 177 and has a knob portion 184 formed on its outer end by which the plunger 181 and the wire core 182 of the Bowden wire may be rotated in either direction and longitudinally shifted. The handle 30 can, of course, be provided with suitable indicia corresponding to the various operating positions of the plunger 181.

At its end opposite the handle 30, the Bowden wire 27 is connected to the switch box 26. The end of the wire core 182 is rigidly connected to the shaft 157 by a coupling 186 while the end of the flexible sheath 179 of the Bowden wire is rigidly secured to the switch box 26 by a connector assembly 187. Thus, the movements of the plunger 181 are transmitted to the shaft 157 and the block 156.

The above-described drive unit is adapted to selectively operate in either direction any one of the mechanisms in

a hospital bed. The unit is controlled by a single control handle and, therefore, can be operated by an untrained person. Moreover, the unit is instantly responsive to manipulation of the controls and includes mechanisms that prevent abuse of the unit or of the mechanisms operated thereby when operated by such an untrained person. Furthermore, the unit may be easily manually operated, in part, in the event of a power failure.

Although the invention has been described in connection with a certain specific structural embodiment thereof, it is to be understood that various modifications and alternative structures may be resorted to without departing from the scope of the invention as defined in the following claims.

I claim:

1. A drive unit comprising a reversible electric motor having a drive shaft, a driven shaft, a drive element having a driving connection with said drive shaft and rotatably mounted on said driven shaft, clutch means for connecting said drive element with said driven shaft and including a member shiftable between a neutral position in which said drive element is free to rotate about said driven shaft and a drive position in which said member provides a drive connection between said drive element and said driven shaft, and manually controlled means for selectively shifting said member from either one of said positions to the other, said manually controlled means including switch means connected in circuit with said motor to control the operation and direction of rotation of said motor.

2. A drive unit according to claim 1, including limit switch means connected in circuit with said motor, and means mounted on said driven shaft for actuating said limit switch means for deenergizing said motor upon rotation of said driven shaft to pre-established limits of rotation in either direction.

3. A drive unit according to claim 1, in which said manually controlled means includes electrically operated means engageable with said member for shifting said member between said positions, and said switch means is also connected in circuit with said electrically operated means to control the operation of said clutch means.

4. A drive unit according to claim 1, in which said clutch means also includes a shiftable actuator engageable by said member on rotation of the latter for shifting said member between said positions, and said manually controlled means includes an electrically operated device for shifting said actuator to effect shifting of said member, and said switch means is also connected in circuit with said device to control operation of said clutch means.

5. A drive unit according to claim 3, including limit switch means connected in circuit with said motor and said electrically operated means, and means mounted on said driven shaft for actuating said limit switch means for deenergizing said motor and said electrically operated means upon rotation of said driven shaft to pre-established limits of rotation in either direction.

6. A drive unit comprising a reversible electric motor having a drive shaft, a plurality of parallel driven shafts, a plurality of drive gears respectively mounted on said driven shafts, said drive gears being in meshing relation to form a gear train and each being rotatively mounted on its associated shaft, one of said drive gears having a driving connection with said drive shaft, a plurality of clutch means for connecting the respective drive gears to their associated driven shafts, each clutch means including a member shiftable between a neutral non-driving position to a drive position providing a drive connection between the associated drive gear and its associated shaft, and a manually controlled means for selectively shifting said members between said positions, said manually controlled means including switch means connected in circuit with said motor to control the operation and direction of rotation of said motor.

7. A drive unit according to claim 6, in which said manually controlled means includes a plurality of electrically operated actuators for the respective members, each actuator being operable to shift its associated member between said positions, and said switch means is also connected in circuit with said actuators to control the operation of the respective clutch means.

8. The unit according to claim 7, in which said switch means is operable to energize said motor for rotation in either direction of rotation and at the same time is operable to energize only one of said actuators.

9. A drive unit comprising an electric motor having field windings, a plurality of driven shafts, a clutch mechanism for each of said driven shafts engageable to interconnect its associated shaft in driving relation with the motor, an electrically energized actuator for each of said mechanisms, each actuator being operable when energized to effect engagement of its associated clutch mechanism, and a control circuit comprising reversing switch means for selectively connecting said windings for forward and reverse operation of said motor, and control switch means for selectively connecting one of said actuators across a power source and at the same time connecting said windings through said reversing switch means across said power source.

10. The unit according to claim 9, in which said control switch means is in series with said reversing switch means and is operable to connect the selected one of said actuators and said windings in series across said power source.

11. The unit according to claim 9, in which each of said driven shafts is provided with a normally closed limit switch device operable to open upon rotation of its associated shaft to a pre-established limit in either direction of rotation, each of said limit switch devices being connected in series between its associated clutch mechanism actuator and said control switch means.

12. In a drive unit of the character described, in combination, a shaft adapted to be connected in driving relation to a mechanism and having a keyway, and a clutch assembly adapted to be rotatably driven by a power unit, said assembly being rotatably mounted on said shaft and including a rotatably driven member having a key rigid therewith, said member being transversely shiftable on said assembly with respect to said shaft between a first position in which said assembly is freely rotatable with respect to said shaft and a second position in which said key is disposed in said keyway and provides a driving engagement between said shaft and said assembly.

13. In a drive unit, a driven shaft having a keyway therein, a drive element adapted to be driven by a power unit and rotatably mounted on said driven shaft, said drive element having a keyway therein, and clutch means comprising a member mounted on an end face of said drive element for rotation therewith but shiftable transversely thereof, and a key rigid with said member and located in the keyway of said drive element, said key being shiftable into and out of the keyway in said shaft on shifting movement of said member.

14. The combination of claim 13, in which said member is cup-shaped and has an end wall mounted on said end face of said drive element and a side wall, and said key extends through said end wall and is rigidly secured to the inner surface of said side wall.

15. The combination of claim 13, in which said member has a pair of diametrically opposite axially offset peripheral cam surfaces, and an actuator shiftable axially of said member for engagement by the respective cam surfaces for shifting said member on rotation thereof.

16. The combination of claim 15, including spring means for holding said member in the position in which said key is engaged in the keyway in said shaft.

17. The combination of claim 15, in which said member is cup-shaped and has a side wall, one of said cam surfaces being formed on said side wall, and the other of said cam surfaces being formed on a lip extending from said side wall.

18. The combination of claim 15, in which said actuator upon engagement with one of said cam surfaces shifts said member in a direction to move the key toward said shaft, and spring means is provided to shift said member farther in said direction, when rotation of said member brings the key into alignment with the keyway in said shaft, to move the key into the keyway in said shaft.

19. The combination of claim 18, in which said drive element and said member are provided with means for holding said key spaced outwardly from said shaft when said actuator has shifted said member in the opposite direction to move the key out of the keyway.

20. The combination of claim 19, in which said member has a depression forming a shoulder extending perpendicular to the direction said member is moved and said holding means comprises a spring pressed detent carried by said drive element for engagement with said shoulder to releasably hold said key spaced outwardly from said shaft.

21. The combination according to claim 19, in which said member has a pair of depressions aligned parallel to the direction said member moves and has a shoulder separating said depressions, and said holding means comprises a spring pressed detent releasably engaging said shoulder when said member is in neutral position.

22. In a drive unit, a driven shaft having a keyway therein, a drive element adapted to be driven by a power unit and rotatably mounted on said driven shaft, clutch means including a key engageable in such keyway for releasably interconnecting said shaft and said drive element, said clutch means being rotatable with said element and shiftable with respect thereto so that said key moves radially with respect to the shaft to effect engagement and disengagement therewith in said keyway, spring means cooperable with said clutch means to urge said key toward said shaft for engagement in the keyway, releasable holding means cooperable with said clutch means for holding said key in spaced relation to said shaft, and manually controlled means for effecting release of said holding means.

23. The combination of claim 13, in which said drive element has an eccentrically positioned guide post for guiding said member in its shifting movement, and said spring means comprises a yoke mounted on said guidepost, and a pair of springs each secured at one end to said yoke and at its other end to said member.

24. The combination of claim 13, in which said driven shaft is tubular, a plunger is slidably mounted in said shaft, said plunger being engageable by a hand crank for rotating said shaft and shifting said plunger longitudinally in said shaft, said plunger having a cam surface thereon, and a pin mounted in said shaft and engageable by said cam surface for shifting said pin radially, said pin being engageable with said key to shift it out of engagement with the keyway in said shaft when the hand crank is engaged with said plunger.

25. The combination of claim 2, in which said limit switch means comprises a pair of switches mounted adjacent said shaft in spaced relation longitudinally of the shaft, a pair of nuts threaded on said shaft and engageable with the respective switches for opening the latter on rotation of the shaft, and means for holding said nuts against rotation, each of said switches comprising a fixed contact and a leaf spring carrying a movable contact normally engaging said fixed contact, said leaf spring projecting into the path of movement of an associated one of said nuts and being engageable by said one nut to disengage said contacts.

26. The combination of claim 25, in which each of said nuts has a flange for engaging its associated switch, said flange having a plurality of notches therein, and said holding means comprises a fixed bar engageable in one of said notches for holding the nut against rotation.

27. The combination of claim 26, in which said fixed bar is flexible for removal from engagement with a notch

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in the nut to permit the nut to be adjusted by rotation relative to said shaft.

28. In a drive unit comprising a reversible electric motor, a plurality of driven shafts, a plurality of clutch means for connecting the motor to the respective shafts, and a plurality of solenoids for actuating the respective clutch means, switch means for controlling said motor and said solenoids and comprising a plurality of switches, one for reversing said motor and the others for energizing said solenoids, each switch comprising a pair of spaced fixed contacts and an intermediate contact movable from a disengaged position in opposite directions into engagement with the respective fixed contacts, a manually operable member longitudinally movable for selectively engaging the respective intermediate contacts of the solenoid energizing switches and engageable with the intermediate contact of said reversing switch in all positions of longitudinal movement, said member being rotatably movable in opposite directions for moving the intermediate contacts of said reversing switch and the selected solenoid switch in opposite directions into engagement with the respective fixed contacts thereof, and spring means tending to move said member to a position where said intermediate contacts are in said disengaged position.

29. A control switch mechanism comprising a plurality of switches, each comprising a pair of spaced contacts and an intermediate contact movable from a central disengaged position in opposite directions into engagement with the respective fixed contacts, a manually operable member longitudinally movable for selectively engaging the respective intermediate contacts and rotatably movable in opposite directions for moving the intermediate contact in opposite directions into engagement with the respective fixed contacts, and spring means tending to move said member to a position where said intermediate contact is in said disengaged position.

30. A control switch mechanism according to claim 29, including detent means for holding said member at positions for selective engagement with the respective intermediate contacts.

31. A control switch mechanism according to claim 30, in which said member comprises a block mounted on a longitudinally movable shaft, and said detent means engages said shaft.

32. A control switch mechanism according to claim 29,

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in which said member comprises a longitudinally movable and rotatable rectilinear block having a flat side face, a pivotally mounted plate engages said side face, and a spring holds said plate against said side face, said spring thereby resisting rotative movement of said block in either direction.

33. A control switch mechanism according to claim 29, in which said member has a pair of laterally spaced lugs movable by longitudinal movement of said member into selective alignment with the respective intermediate contacts on opposite sides thereof, whereby rotative movement of said member in opposite directions moves the selected intermediate contact in opposite directions.

34. A control switch mechanism according to claim 33, in which an additional similar switch is positioned adjacent said plurality of switches, and said member has a pair of laterally spaced ribs longitudinally spaced from said lugs for moving the intermediate contact of said additional switch for all positions of longitudinal movement of said member.

35. A control switch mechanism according to claim 29, including a manually operable control device comprising a sleeve, a manually actuated plunger slidably and rotatably mounted in said sleeve, and a flexible connection from said plunger to said member for moving the latter longitudinally and for rotating it.

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