April 22, 1958 E. D. OLSEN 2,831,200

ADJUSTABLE BED

Filed Nov. 9, 1953 2 Sheets-Sheet 1

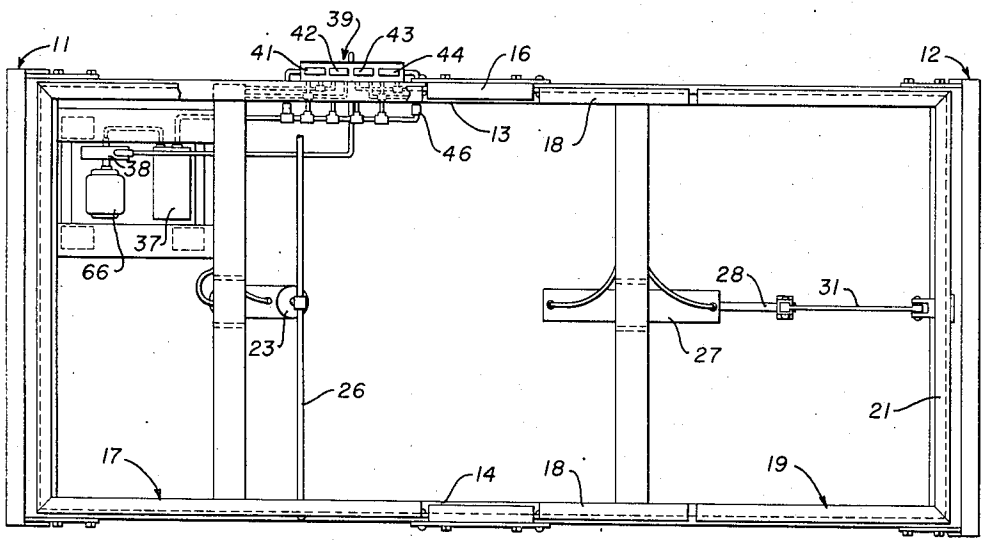


Fig. 1.

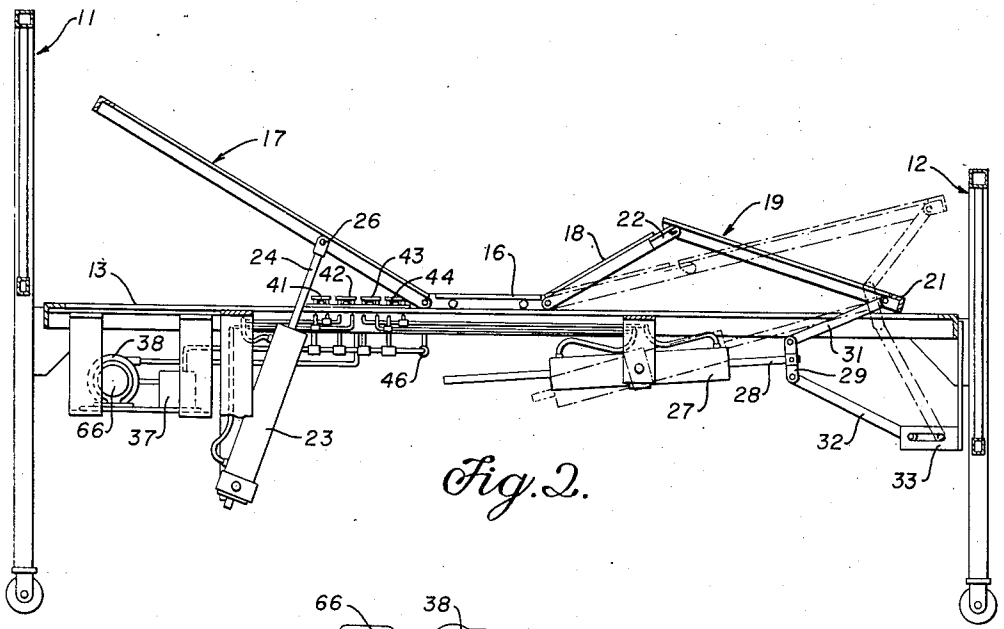


Fig. 2.

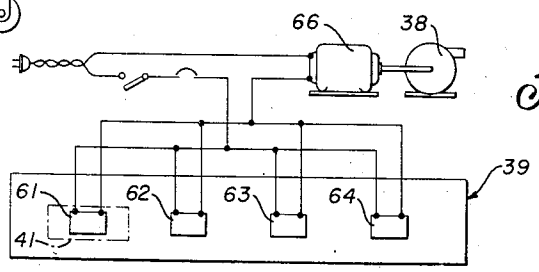


Fig. 3.

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April 22, 1958 E. D. OLSEN 2,831,200

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Filed Nov. 9, 1953 2 Sheets-Sheet 2

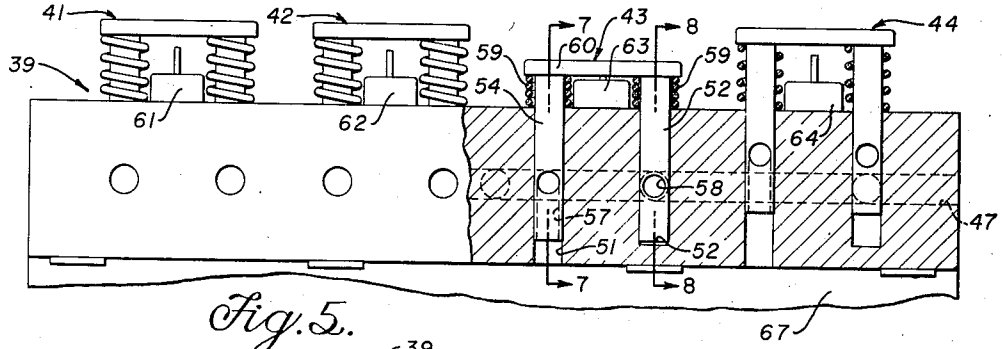


Fig. 5.

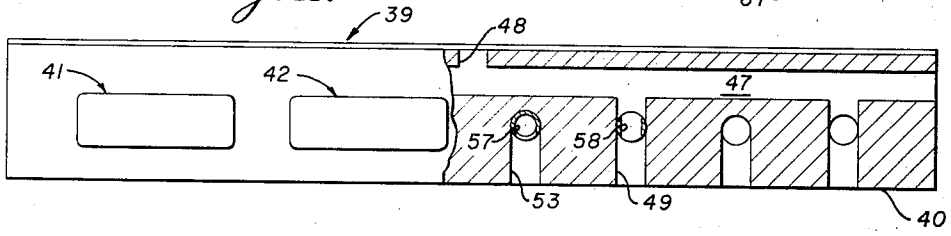


Fig. 6.

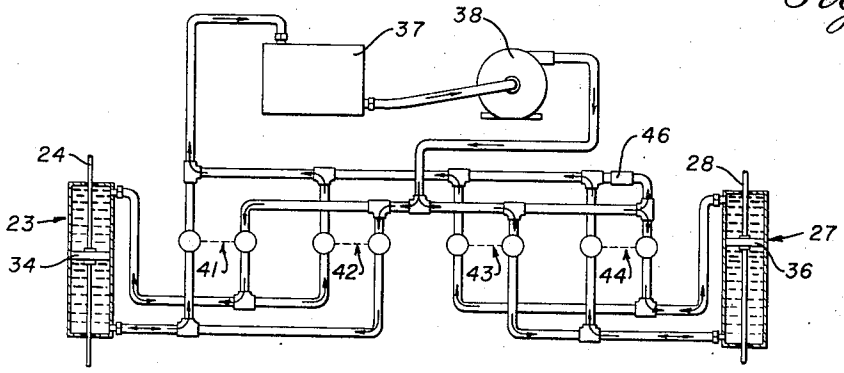


Fig. 4.

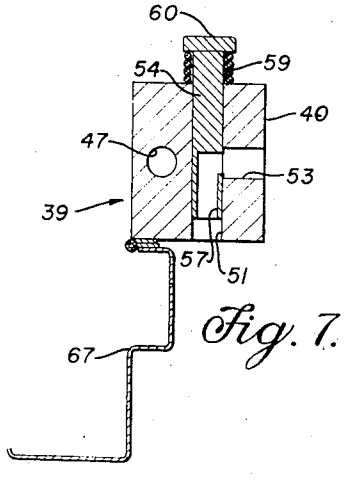


Fig. 7.

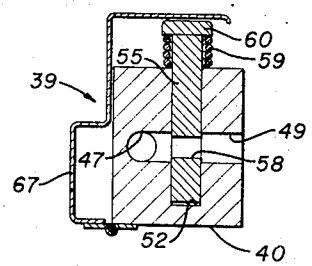


Fig. 8.

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ADJUSTABLE BED

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Application November 9, 1953, Serial No. 390,892

2 Claims. (Cl. 5—69)

The present invention relates to an improved adjustable bed adapted for use in hospitals and the like and having a power operated hydraulic system providing fingertip control of the bed adjustment for the bed's occupant.

There have been developed numerous adjusting means for hospital or invalid beds including hydraulic systems therefor, however, these devices are normally quite complicated in that they include a large number of operating parts and are therefore not only costly but are further disadvantageous in requiring relatively more maintenance and repair. The present invention provides an hydraulically operated adjusting mechanism for a bed with the inclusion of a minimum number of operating parts and a maximum simplicity together with a large latitude of easily controlled adjustment.

It is an object of the present invention to provide an improved adjustable bed.

It is another object of the present invention to provide an hydraulically adjustable bed having a minimum number of operating parts and a maximum number of adjustments.

It is a further object of the present invention to provide an improved adjustable bed having head, foot, and knee adjustments with a pair of hydraulic cylinders.

It is yet another object of the present invention to provide an improved adjustable bed having an hydraulic system readily controlled by the bed's occupant.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the preferred form of the invention which is illustrated in the drawings accompanying and forming part of the specification. It is to be understood, however, that variations in the showing made by the said drawings and description may be adopted within the scope of the invention as set forth in the claims.

A preferred embodiment of the invention is illustrated in the accompanying drawings wherein:

Figure 1 is a plan view of the bed;

Figure 2 is an elevational section view taken at the center line of the bed;

Figure 3 is a wiring diagram of the adjusting mechanism;

Figure 4 is a piping diagram of the adjusting mechanism;

Figure 5 is an elevational view of the hydraulic control valve partially in section as indicated;

Figure 6 is a plan view of the hydraulic control valve partially in section as indicated;

Figure 7 is a section view taken at 7—7 of Figure 5;

Figure 8 is a section view taken at 8—8 of Figure 5.

Considering now the structural details of the invention and referring first to Figures 1 and 2, the adjustable bed portion or gatch is adapted for mounting upon a standard bed frame including a head portion 11, foot portion 12, and a pair of horizontal connecting rails 13 and 14 all adapted for rigid joinder in conventional manner. The gatch frame includes a pair of short horizontal rails

16 adapted for mounting one upon each of the horizontal bed rails 13 and 14 adjacent the center thereof, as shown in Figure 1. A head frame 17 is formed of a pair of parallel rails connected at one end by a cross member and pivotally mounted at the free ends of the parallel rails to the front ends of the central gatch rails 16. The head frame 17 has substantially the same dimensions as the forward portion of the bed frame so as to rest upon the horizontal bed rails 13 and 14 when the head frame is horizontally disposed and the head frame is pivotable upward from this position. Extending toward the foot of the bed from the central gatch rails 16 are a pair of relatively short bars 18 which pivotally connect to the gatch rails 16 and which are vertically aligned with the horizontal bed rails 16 above same. Attached to the bars 18 is a foot frame 19 formed of a pair of parallel bars connected at the foot of the bed by a cross member 21 and pivotally joined at their free ends to the bars 18. The bed and gatch members may be formed of angle iron or the like as is common and in the case where the bars 18 and longitudinal foot frame members are formed of angle stock having the horizontal portion uppermost and extending inwardly of the bed from the vertical rib the pivotal connection of the foot frame may be produced by a pair of longitudinal extensions 22 of the vertical ribs of the bars 18 which extend toward the foot frame and beneath the horizontal web of the longitudinal rails thereof. Each of these extensions 22 has a short boss or nub extending laterally therefrom outward of the bed and slidably engaging the longitudinal rails of the foot member in slots formed in the vertical web thereof, these slots extending longitudinally of the rails toward the free ends thereof and being inclined upward at the ends thereof. This particular pivotal connection provides for a locking together of the bars 18 and foot frame 19 when the frame is raised at its end as the extensions 32 thus engage the under surface of the horizontal web of the longitudinal foot frame rails and the connection further providing for the foot frame overriding the bars 18 when the frame is urged toward the bars to offset the frame and bars for producing a relative pivoting of these members, all as set out below.

Movement of the head, foot, and knee portions of the gatch is herein accomplished hydraulically with a first hydraulic cylinder 23 being suitably mounted below the front part of the bed in rigid relation to the bed rails 13 and 14 and having a piston rod 24 extending therefrom. The piston rod 24 is connected to a transverse bar 26 rigidly joined to the longitudinal members of the head frame 17 with this bar 26 being joined to the piston rod 24 in rotatable relation thereto, as by extending through an aperture end thereof. Extension and retraction of the piston rod 24 from the hydraulic cylinder 23 will thus be seen to pivot the head frame 17 about its foot end so that it is adapted to be raised and lowered. A slightly more complex arrangement is provided to adjust the foot frame with there being provided for this purpose a single hydraulic cylinder 27 pivotally mounted at its center at a distance from the foot 12 of the bed and the mounting being rigidly affixed to the bed rails 13 and 14, preferably equidistant therebetween. A piston rod 28 extends from the hydraulic cylinder 27 and is pivotally connected to the center of a generally vertical link 29 that in turn is pivotally connected to a pair of arms 31 and 32. These arms 31 and 32 are joined to opposite ends of the link 29 and extend generally toward the foot of the bed with the upper arm 31 being pivotally connected to the cross member 21 of the foot frame 19. The lower arm 32 has a lateral projection thereon extending through a longitudinal slot in a bracket 33 rigidly affixed to the stationary portion of the bed and below the gatch proper. The lower arm 32 is thus pivotally mounted at both ends

as is the upper arm **31** and additionally is limitedly slidable at its foot end. Adjustment of the foot frame includes both knee and foot motions with both being shown in Figure 2. With the piston rod **28** of the foot hydraulic cylinder **27** in central position the foot frame **19** and bars **18** assume a horizontal position. Movement of the piston rod **28** toward the foot of the bed places the lower arm **32** in maximum displacement toward the foot of the bed in the bracket **33** so that this arm pivots about its lower end. The piston **27** thus pivots about its center mounting and the upper arm **31** exerts an upward force on the foot frame cross member **21** to pivot the foot frame **19** and bars **18** together about the front ends of the bars **18**, the position shown in phantom in Figure 2 resulting. The foot frame **19** and bars **18** remain in alignment during this adjustment as the extensions **22** of the bars **18** bear upon the horizontal webs of the longitudinal foot frame members to prevent buckling of these joints. Movement of the piston rod **28** back to central position returns the foot frame and bars to a horizontal position and further movement of the piston rod **28** toward the front of the bed draws the lower arm **32** forward to the front of the slot in the bracket **33** and at the same time causes the upper arm **31** to exert a horizontal force upon the foot frame cross member toward the head of the bed. The longitudinal foot frame rails thus slide forward and upward upon the lateral bosses upon the bar extensions **22** so that the foot frame and bars are misaligned. Further forward force on the foot frame causes same to pivot with respect to the bars **18** into the position illustrated in solid lines in Figure 2, i. e., a bent knee position.

Control and actuation of the above described bed adjustments is provided by an hydraulic system including the head and foot hydraulic cylinders **23** and **27** each of which includes pistons **34** and **36** respectively. The hydraulic system, shown in Figure 4, includes a fluid reservoir **37** to which is connected the inlet line of a fliud pump **38**. Control of the hydraulic system is accomplished by a single valve manifold **39** having four double valves **41, 42, 43** and **44** of which each includes an inlet and an outlet valve portion. The pump outlet is connected to the inlet valve portions of each of the four valves **41—44** and in turn these valve portions are connected one to each end of each of the hydraulic cylinders. Additionally, the pump outlet is connected through a pressure reducing valve **46** to the reservoir **37** so that maximum hydraulic pressure in the system is limited by the setting of the reducing valve **46**. Each end of each hydraulic cylinder **23** and **27** is connected through the outlet portion of one of the valves **41—44** to the reservoir **37** and each valve has the inlet portion connected to one end of a hydraulic cylinder and the outlet portion connected to the other end of the same cylinder so that actuation of any valve opens lines to both ends of a single cylinder. From the piping diagram it will be seen that actuation of the first valve **41**, for example, will open the inlet portion thereof to the top of the front hydraulic cylinder **23** so that hydraulic fluid from the pump **38** may be pumped thereto. At the same time the outlet portion of the valve **41** opens the bottom end of the hydraulic cylinder **23** to the reservoir so that as hydraulic fluid under pressure forces the piston **34** downward the fluid below the piston is forced back to the reservoir and the piston rod **24** retracts to lower the head frame **17**. Other valves operate similarly and should the patient or other operator continue to hold any valve open after the connected piston has reached the end of its travel the reducing valve **46** permits a return flow of fluid to the reservoir **37** from the pump **38** while at the same time maintaining sufficient pressure in the system to hold the piston in maximum displaced position. Release of a valve after hydraulic actuation of a piston seals the associated cylinder so that the piston is hydraulically constrained to remain in position.

Control of the hydraulic system is provided by the valves and, referring to Figures 5–8, these valves will be seen to be housed in and partially defined by an elongated valve manifold **39** which may be formed of a block **40** of metal or the like suitably apertured and preferably this manifold is rigidly affixed to the bed rails **13** or **14** or to one of the central gatch rails **16** in position for convenient operation by one reclining in the bed. Within the block **40** there is formed a longitudinal bore **47** extending through at least one end of the block and communicating with the block exterior through a transverse aperture **48** extending through the side of the block. The aperture **48** is adapted for connection to the pump outlet so that the bore **47** is filled with high pressure hydraulic fluid when the pump **38** is operating. Each of the valves **41—44** in the valve manifold is identical and thus considering as an example valve **43** there will be seen to be provided a lateral passage **49** extending from the bore **47** through the block to the exterior thereof and adapted for connection thereat to suitable piping means leading to the bottom end of hydraulic cylinder **27**. A pair of vertical apertures **51** and **52** are formed in the block extending from the top thereof downward with the first aperture **51** extending through the block and the second aperture **52** intersecting the lateral passage **49** and extending slightly below same. A second lateral passage **53** extends from the first vertical bore **51** through the back side of the valve block and is adapted for connection to the top end of the hydraulic cylinder **27**. The bottom end of the first vertical aperture **51** is connected to the reservoir **37**. Controlled passage of fluid through the valve block **40** is provided by a pair of valve rods **54** and **55** which mate with the block within the vertical apertures **51** and **52** respectively and the rod **54** is hollow at its lower end with a lateral opening thereto displaced from the lower end and facing the back side of the valve block to define a passage **57** through the rod adapted to communicate between the passage **53** and the bottom of the vertical aperture **51** when the valve rod **54** is depressed. Likewise the second valve rod **55** has a passage **58** therethrough but in this instance extending laterally through the rod to provide communication between the bore **47** and the lateral passage **52**. The valve rods are normally disposed in raised position to close the passages therebetween with a pair of springs **59** disposed one about the top end of each valve rod and disposed between the top of the valve block and a button plate **60** rigidly joined between the upper ends of the valve rods. Depression of the button **60** of valve **43** compresses the springs **59** and forces the valve rods **54** and **55** downward to open the passages **57** and **58** respectively therethrough. The pump outlet is thus connected to the lower end of the hydraulic valve cylinder **27** so that fluid flows to raise the piston **36** thereof and the fluid displaced from the upper or far end of the cylinder flows back to the reservoir through the outlet portion of the valve **43** including valve rod passage **57**. Connection of the pressure reducing valve **46** to the open end of the bore **47** in the valve block provides a return path for very high pressure fluid.

Completely automatic operation is produced by the provision of an electrical control circuit, shown in Figure 3, and including four micro-switches or the like **61—64** disposed atop the valve block and one under the button of each valve **41—44** respectively. These switches are electrically connected in parallel between a suitable source of electrical current, here shown as a conventional plug adapted to engage a wall socket, and an electric motor **66** which drives the pump **38**. Suitable protective devices such as switches and fuses or circuit breakers may be installed between the power source and motor to protect the latter. It will be seen that with the switches **61—64** being of the normally open type and with the springs **59** maintaining the valve rods raised the pump normally is shut off. Depression of the desired valve button, as

button **60**, closes the switch **63** to energize the motor **66** to drive the pump **38** and at the same time depresses the valve rods **54** and **55** to open the passages **57** and **58** respectively therethrough so that hydraulic fluid is pumped to the near end of the foot hydraulic cylinder **27** to force the piston toward the foot of the bed. The other end of the cylinder is connected to the reservoir **37** to provide a fluid return path and the foot frame is thereby moved until the valve button **60** is released and the adjusted position of the foot frame **19** is retained.

To guard against damage to the valve block and piping connected thereto a valve block cover **67** may be provided to swing over the valve manifold **39** and same may be hinged at the bottom edge of the valve block for pivotal motion from an enveloping relation to the valve manifold to a position beneath the valve block out of the way. Piping in the hydraulic system may be formed of copper tubing or other suitable pipe means and the pump and motor may conveniently be mounted below the bed frame by brackets depending therefrom and interior of the bed sides and ends to be out of the way.

What is claimed is:

1. Drive means for an adjustable bed having a rigid bed frame including horizontal rails, a head frame pivotally connected to said bed rails, a pair of bars pivotally mounted on said bed rails toward the foot of the bed from said head frame connection, a foot frame pivotally connected to said bars for pivotal motion only downward with respect to said bars, comprising: a first hydraulic piston adapted to be rigidly mounted on and below said bed rails and having a movable piston rod extending upward for engagement with said head frame for pivoting same, a second hydraulic cylinder adapted to be pivotally mounted on and below said bed frame in a substantially horizontal position and having a movable piston rod extending toward the foot of the bed, a link pivotally connected to the end of said second piston rod, first and second arms pivotally connected to said link, said first arm extending upward from said link and adapted for pivotal connection with said foot frame at the foot of said bed and said second arm extending downward and adapted for pivotal connection with an extension of said bed and being adapted for limited horizontally slidable movement with respect thereto whereby displacement of said piston rod toward the foot of the bed pivots the foot frame and aligned bars about the pivoted bar ends and displacement of said piston rod in the opposite direction pivots the foot frame with respect to the bars for raising the connected ends thereof, and a hydraulic system including a pump and valve control means for selectively actuating said hydraulic cylinders to adjust said bed.

2. Drive means as defined in claim 1 further characterized by an electric pump motor, said valve control means including four valves for moving the piston of each cylinder in both directions, and four switches associated one with each valve for closing by valve actuation, said switches being connected in parallel to said motor and adapted for connection across a power supply whereby actuation of any valve automatically starts said pump to operate the selected hydraulic cylinder.

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