United States Patent

Saunders

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[54] HYDRAULICALLY-OPERATED TROLLEY FOR HOSPITAL BEDS

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[52] **U.S. Cl.** **5/63,** 5/83, 177/136

[51] **Int. Cl.** **A61g 7/10,** A47c 3/32

[58] **Field of Search** 5/63, 68, 81, 83–86; 177/136, 137; 128/33

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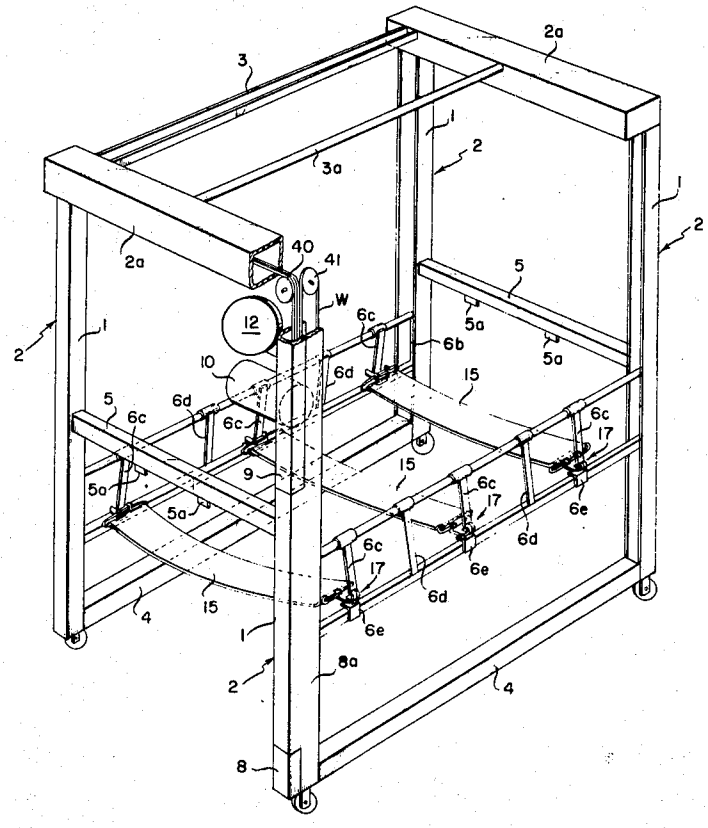
[57] **ABSTRACT**

A trolley for use in conjunction with a hospital bed, the trolley comprising a pair of end frames each having one transverse vertically movable bar which carries means to attach the trolley to the bed. There being a pair of side rail frames vertically movable connected between the end frames, and having a plurality of horizontally spaced webs interconnecting the side rail frames for supporting a patient. Lastly, there are hydraulic means for selectively raising and lowering the side rail frames and the webs. Optionally, a weighing device can be used in combination with the trolley to weigh patients in situ.

6 Claims, 6 Drawing Figures



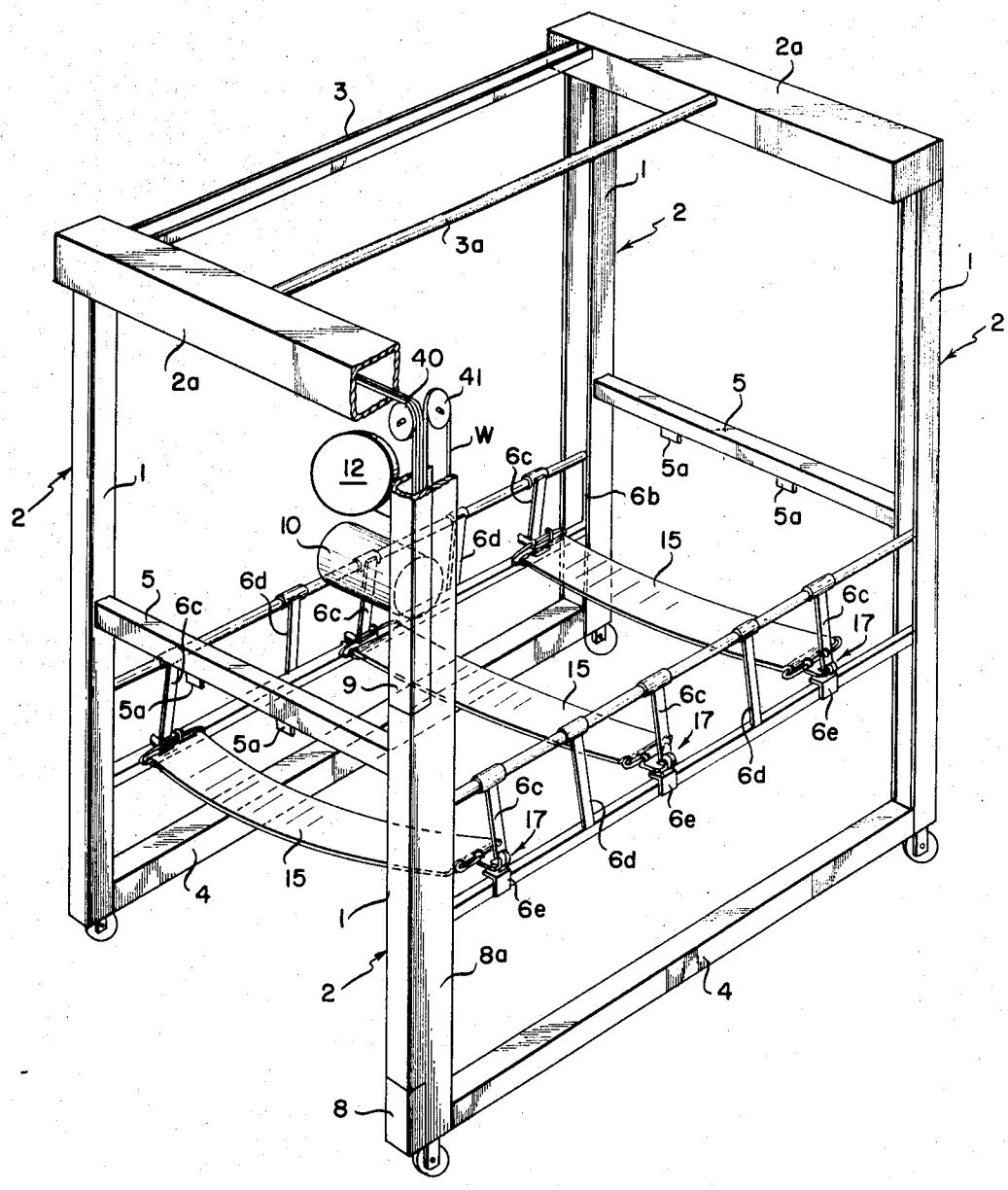


Fig. 1

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Fig. 2

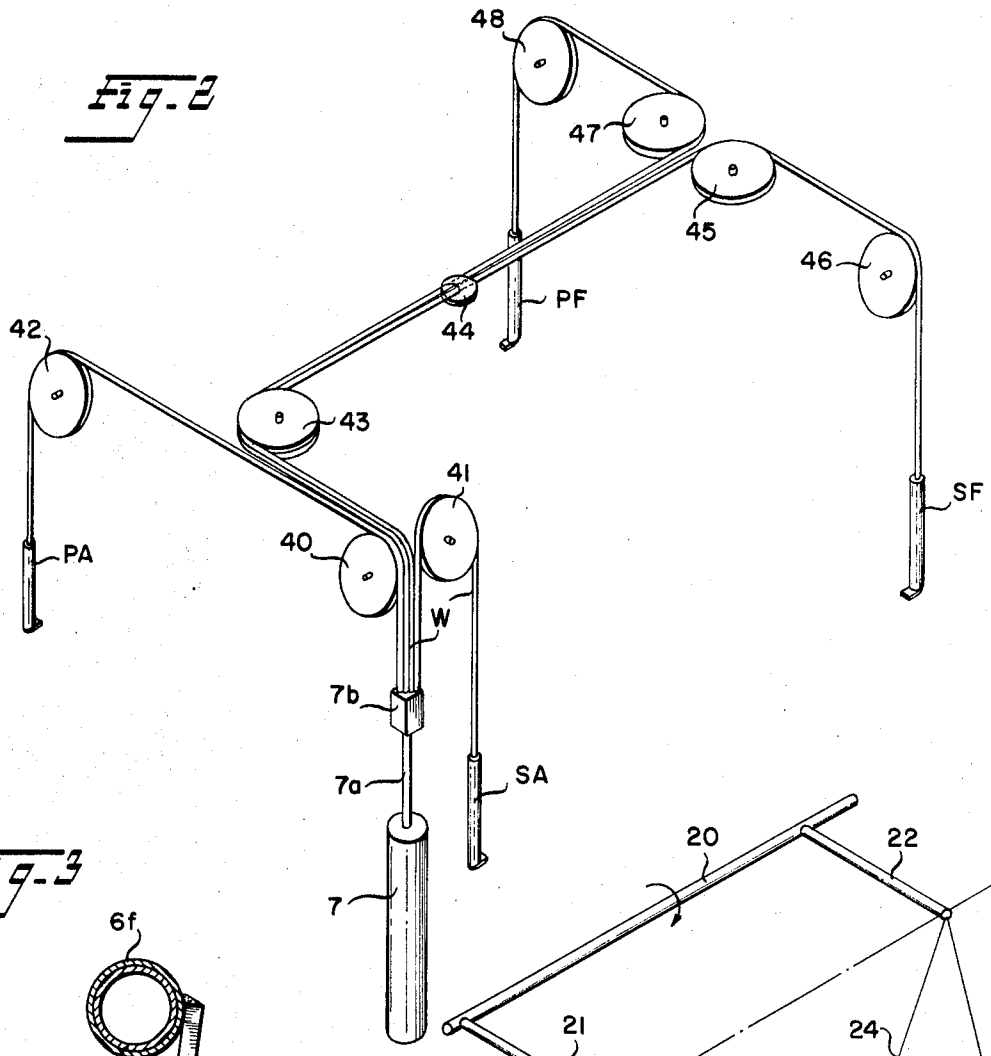

Fig. 3

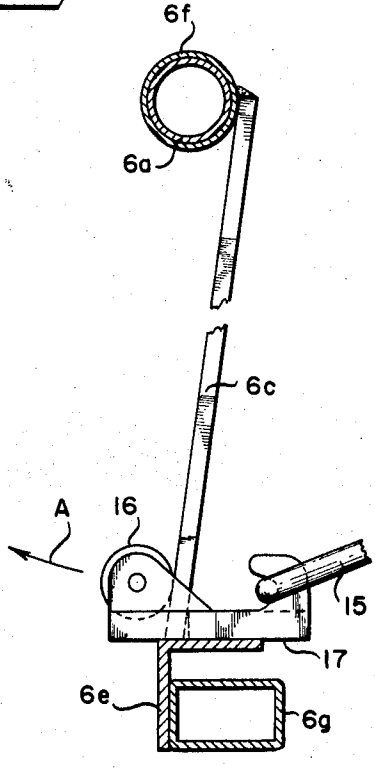

Fig. 4

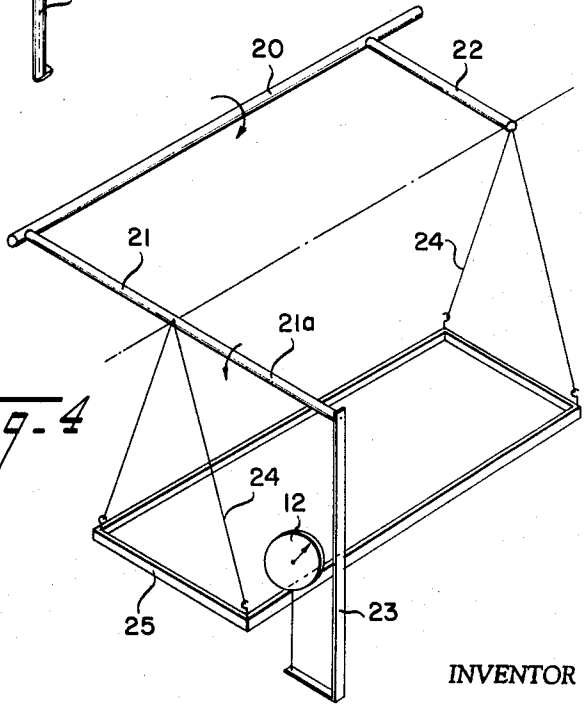

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Fig. 5

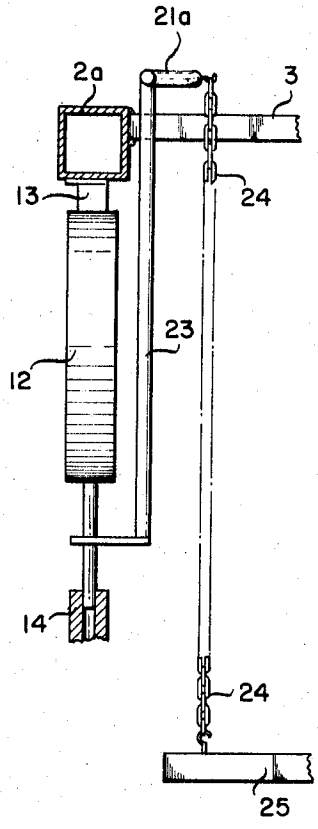
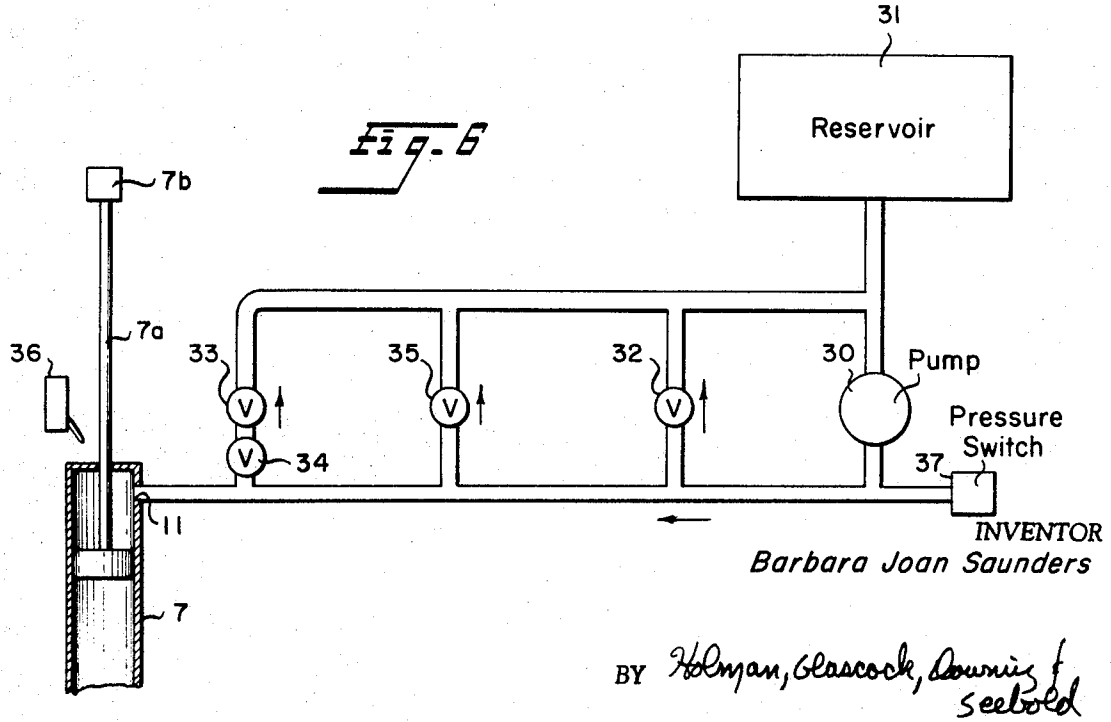


Fig. 6



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HYDRAULICALLY-OPERATED TROLLEY FOR HOSPITAL BEDS

This invention relates to trolleys for hospital beds and represents an improvement in the hospital bed disclosed and claimed in U.S. Ser. No. 634,258, filed on Apr. 27, 1967, now U.S. Pat. No. 3,438,067.

According to this prior disclosure the hospital bed was characterized by vertically movable side rail frames which were interconnected by horizontally spaced webs intended to overlie the bed mattress for supporting the patient, there being mechanical means for raising and lowering the side frames, and hence the webs, between lowered, raised and intermediate positions. In one specific and preferred embodiment of such a bed the side rail frames were raised and lowered by and under the control of wire cables which are wound upon mechanically driven winch drums. In a specifically described embodiment the winch drums are driven by an electric motor through a reduction gear-box. The mechanical means for raising and lowering the side rail frames may also be a hydraulically operated means. Such hydraulically operated means may comprise one or more rams coupled to the side frames, but in a convenient and at present preferred embodiment to be described hereinafter in relationship to a trolley by way of illustrative example, a single hydraulic ram is used to control wire cables which are coupled with the two side rail frames.

The present invention is drawn to such hydraulic means and ancillary components mounted on a trolley which can be moved into an operative position relative to most of the existing hospital beds, powered or not powered, providing they do not have side rails or that their side rails have been removed. This trolley has side rails which are vertically movable, as mentioned above, horizontally spaced webs connected to the side rails, and preferably a weighing device to accurately weigh the patient in situ. The trolley has a pair of inverted U-shaped channel section end frames connected together at each side by two lower parallel bars, on top by at least one bar, and supported on four casters. The length of the trolley would correspond to the length of a standard hospital bed. The inner width of the end frames between the legs would slightly exceed the width of the bed on which the trolley is to be used, and usually this means that the internal width should not be less than 38 inches. Furthermore, because of the door dimensions in most hospitals, the outer width of the end frames should not exceed 41½ or 42 inches. The trolley is supported upon casters so that it can be wheeled into position straddling the bed from either end thereof. The height of the trolley including the casters should be no more than about 6 feet.

A hydraulic ram is installed beside one of the legs supporting the end frames and an hydraulic pump and motor are installed in or upon the central top part of one of the end frames. Alternately, the hydraulic pump could be a hand pump for those occasions where electricity is not desired or available.

The ram cylinder is attached to one end frame and the piston rod, which projects upwardly, is coupled to a cross head to which are attached the wire cables. The cables pass over sheaves in the upper portion of the one end frame such that the cables pass down the channel formed by each U-shaped channel section leg of the one end frame. The ends of the cables are attached to longitudinally shaped weights movable in the leg channels. The cables pass longitudinally of the trolley on the upper bar, which is preferably U-shaped. The other end frame is provided with sheaves for guiding the cables down the channels formed in the U-shaped channel section legs of the other end frame where each cable is also attached to longitudinally shaped weights.

A system of single and multiple grooved sheaves guide the series of four separate wire cables from the cross head attached to the piston rod to the longitudinally shaped weight in each leg. Therefore, when the piston and associated cross head is moved downwards by hydraulic pressure the free ends of the cables are raised and thereby lift the weights which in turn lift the side rail frames. The longitudinally shaped weights are so constructed as to only actively lift the side rail frames and passively guide them in descent, as is explained in above-mentioned Patent No.

The legs of each end frame are formed with a vertical slot which can receive and guide the adjacent end part of the vertically movable side rail frames.

The legs of the end frames are of sufficient length to insure that the head of a doctor, nurse or other attendant cannot be injured by contact with the upper portion of the end frames or the top bar which connects them. A traction bar can be placed juxtaposed the top bar on the center line of the trolley.

The trolley can be rolled over either end of the existing hospital bed, attached thereto and used in conjunction with the bed. By use of the trolley the standard hospital bed is converted to one having side rails which are hydraulically movable between lowered, intermediate and raised positions. Furthermore, because of the horizontally spaced webs, the patient can be raised from the mattress of the bed to facilitate bowel movement, changing the sheets or, if the trolley is so equipped, weighing the patient. All of these advantages can be obtained from the trolley as herein disclosed, and yet the capital expense by the hospital is minimized. Of course, every patient does not require the safety precaution of side rails, assistance in his bowel movements, or weighing in the horizontal position, so to build in the advantages of the trolley in each hospital bed is not necessary, nor is it economically feasible. The movability of the instant trolley means that it can be moved to the patient requiring the intensive care, left there so long as required, and then moved off to the next patient. Furthermore, the trolley is portable, viz., the upper and lower longitudinal channels are easily disassembled from the end frames, and the wire cables passing longitudinal the trolley have a coupling so they can be quickly hooked together or taken apart.

The invention will be more clearly understood with reference to the exemplary embodiments of the accompanying drawings, in which:

FIG. 1 is a general view of the trolley with the weighing device omitted for clarity;

FIG. 2 is a diagrammatic view of the hydraulic means, wire cables and weights, all of which is to be sheathed in the end frames and upper longitudinal channel;

FIG. 3 is an enlarged view of one of the movable uprights on the side rail of the trolley;

FIG. 4 is a diagrammatic view of the weighing device;

FIG. 5 is an enlarged view of the scale connection to the trolley; and

FIG. 6 is a schematic diagram of the hydraulic system for the trolley.

TROLLEY FRAME

The trolley, as seen from FIG. 1, is generally rectangular in shape and has a greater inner width than the outer width of the bed over which it is to be rolled. With slight modification, the trolley could be rolled sideways over the bed rather than endways.

Basically, the trolley is made up of two end frames 2 connected together at either lower corner by a lower longitudinal channel 4 and on top by an upper longitudinal channel 3. Preferably, a traction bar 3*a* is fitted between two upper transverse housings 2*a* on the center line of the trolley. The end frames 2 each consist of two vertical legs 1 made of channel sections. The two legs 1 of each end frame 2 are intermediately braced by a transverse end bar 5 which is vertically adjustable on the legs 1, and each end bar 5 carried two or more saddles 5*a*. At the upper ends of the two legs 1 of each end frame is secured the upper transverse housing 2*a* which contains the sheaves (see FIG. 2) over which the wire cables W pass.

For purposes of this specification, nautical terms shall be given the trolley for future reference. The head part of the trolley (portion which is adjacent the head of the bed) shall be "forward" (F), and the opposite end "aft" (A). Therefore, as seen in FIG. 1, the right side is "starboard" (S), and the left

side is "port" (P). Now, adjacent one of the aft vertical legs **1**, and preferably the starboard aft leg, is contained an elongated single hydraulic cylinder **7**, having a piston rod **7***a* extending upwardly. At the extreme end of piston rod **7***a* is attached a cross head **7***b* to which is attached one end of the four wire cables W, which have their other ends respectively attached to a weight SA, SF, PA, PF (see FIG. **2**) in each of the four vertical legs **1**. This starboard aft leg is no wider than the other legs, although it extends aft of the trolley. It is this aft extension that houses the cylinder **7**, rod **7***a* and cross head **7***b*. Around the lower portion of cylinder **7** the aft extension is defined by a lower cylinder guard **8** and around the upper portion of the cylinder **7**, is an upper cylinder guard **8***a*. Between the upper part of guard **8***a* and upper transverse housing **2***a* is a guard **9** which also defines the aft extension and houses the piston **7***a*, across head **7***b* and a portion of cables W.

Attached adjacent the leg housing the cylinder is a housing **10** which contains a hydraulic pump, motor, etc., as will be further explained with reference to FIG. **6**. Preferably attached as shown in FIG. **1**, is a scale **12** provided the trolley is equipped with a weighing device. (see FIGS. **4** and **5**)

The legs **1**, and upper longitudinal channel **3**, are made out of channel sections of a dimension such as to completely contain the wires W, weights, etc. The aft extension guards **8**, **8***a* and **9** and upper transverse housing **2***a* is preferably made from structural steel plate or sheet. The cylinder **7** is securely fixed to the bottom of the aft leg, and lower cylinder guard **8** is fitted around the cylinder **7** as to act as a sump to catch leakage. The saddles **5***a* on the transverse end bars **5** have shallow channel cross-sections, downwardly facing, and are meant to rest on top of the forward and aft end frames of the bed. Means to more securely fasten the trolley to the bed may also be provided. The transverse end bars **5** are movably engaged with both legs by, for example, pressure clamps so as to allow the bars **5** to be raised or lowered to suit different bed end frames.

Bars **5** are raised before the trolley is rolled over the bed so as to be clear of the forward and aft end frames thereof. Furthermore, if the bed is capable of being elevated, it should be in its lowermost position. The transverse end bars **5** and saddles **5***a* are lowered so that the saddles rest on the end frames of the bed. When the bed is again elevated so is the trolley, and its side rail frames **6**, etc. remain in fixed relationship with the bed.

Movable side rail frames **6** are adjacent the sides of the bed and extend from each of the end frames **2**. These two side rail frames **6** each has an upper longitudinal tube **6***a* and a lower longitudinal rail **6***g* (FIG. **3**). Both rail **6***g* and tube **6***a* are connected to each other at their ends by vertical end bars **6***b*. These vertical end bars have upper and lower extensions respectively opposite the tube **6***a* and rail **6***g*. These extensions ride in channels in each of the legs **1**. The weights SA, SF, PA and PF carried within each leg have protrusions at their lower ends, which protrusions engage the lower extension and lift the side rail frames **6**. Adjacent each lower extension on vertical end bars **6***b* is a roller to reduce friction. It will be seen that the weight being attached to the wires provides only a positive upwards force and allows the side rail frames **6** to be lowered by gravitational force, the rate of descent being governed by the descent of the weights. The lower longitudinal rail **6***g* of the side rail frame **6** hits lower longitudinal channel **4** before the weights hit bottom, so that the wire cables W always remain taut. Should an appendage of the patient or some other obstruction get in the path of the descending side rail frame **6**, the downward force would be no greater than the weight of the side rail frame thereby preventing serious injury.

Intermediate the two vertical end bars **6***b* on each side rail frame **6** are movable and fixed uprights **6***c* and **6***d* respectively. The numbers and spacing of these uprights are optional, but preferably there are two fixed and three movable uprights as shown. The movable uprights **6***c* are each connected to an upper cylinder **6***f* and a L-shaped longitudinal base **6***e* as will be discussed in relation to FIG. **3**. On either side of each of the uprights **6***c*, **6***d* are two suspension plates **17** having a hook at one end to attach to webs **15** and a roller **16** at the other end. As the side rail frames **6** are lowered from the position seen in FIG. **3**, the mattress will prevent the suspension plates **17** from lowering and rollers **16** will traverse their respective uprights. The weight of the suspension plates **17** and roller **16** continually tension the webs **15** across the mattress.

TROLLEY WIRE CABLES AND WEIGHTS

Referring now to FIG. **2**, it will be seen how the wire cables W are operatively connected to the weights SA, SF, PA and PF. The cables W, as mentioned before, are all contained in the channel sections of the legs **1** and upper longitudinal channel **3**. The piston rod **7***a* of cylinder **7** preferably has about a 29 inch stroke which would move the side rail frames **6** an equal distance. Four wire cables W emanate from the cross head, the first cable passing over single groove sheave **41**, down the starboard aft leg **1** where it is fixed to weight SA. The second cable passes, along with the third and fourth cables, over a triple groove sheave **40**, a single groove sheave **42**, down the port aft leg **1** where it is fixed to weight PA. The third and fourth cables pass over a double groove sheave **43** to a coupling **44**. This coupling is provided so that the trolley can be easily completely disassembled for shipping, etc. The third and fourth cables, and preferably the coupling, are all contained in upper longitudinal channel **3**. Once the cables enter the forward upper transverse housing **2***a*, the third cable passes over single groove sheaves **45** and **46**, down the starboard forward leg **1** to weight SF; the fourth cable passes over single groove sheaves **47** and **48**, down the port forward leg **1** to weight PF.

SIDE RAIL FRAME

The components of the side rail frames **6** were discussed before under "Trolley Frame." The standard hospital bed mattress is 36 inches wide. It is preferred to anchor the webs **15** which are to overlay the mattress 39 inches apart, and allow a 3 inch slack, hence 42 inch webs. Many of the older hospital doorways are 42 inches wide, so width becomes critical if the trolley is to be rolled from one room to another without disassembling. Of course, different size trolleys can be designed, but the following features provide maximum flexibility.

The outer width of the trolley is preferably slightly under 42 inches to allow ready passage through the hospital doors. However, in the roller position as seen in FIG. **3**, the roller **16** extends beyond the 42 inch dimension. To permit the roller **16** to come with the 42 inch limit, the movable and fixed uprights **6***c* and **6***d* respectively are sloped inwardly, preferably about 8°. Then the suspension plates **17** and rollers **16** can be raised so that the roller moves along the slope, and the roller will be wholly within the 42 inch limit.

The L-shaped longitudinal base **6***e* on the movable uprights **6***c* merely abuts against lower longitudinal rail **6***g*, which could make a tight fit through the hospital door. To alleviate this, the movable upright **6***c* is connected to an upper cylinder **6***f* of larger diameter than, and slideable on, upper longitudinal tube **6***a*. Therefore, when the trolley is moved about the hospital the webs **15** can be removed, and the movable upright **6***c* can be rotated in the direction of arrow A to the inside of the trolley.

WEIGHING DEVICE

The trolley can be optionally provided with a weighing device, the preferred embodiment seen in FIGS. **4** and **5**. A tube **20** is rotatably secured to the top side of upper longitudinal channel **3**. This can be accomplished by a frictionless bearing at either end of tube **20**, e.g. a hardened knife edge, such that tube **20** is rotatable about an axis parallel to channel **3**. At the forward end of tube **20** is attached an arm **22**, and an arm **21** and extension **21***a* are attached at the aft end. A cradle **25** for carrying the patient to be weighed is attached by means (chains) **24** to the arms **21** and **22** at the center line of the trol-

ley. A scale **12** is fixed by an upper scale attachment **13** to the starboard aft portion of the upper transverse housing **2***a* (see FIG. **5**). The extension **21***a* is connected to a link **23** which in turn is connected to the underside of scale **12**. When a patient to be weighed is placed in cradle **25**, due to the reduced moment arm the scale will only be subjected to a downwards force less than the actual force and depending upon the ratio of arm **21** and extension **21***a*. This ratio can be varied as desired, but preferably is 1:1. Such a ratio will halve the weight registered on the scale vis-a-vis the actual weight of the patient, and allow more accurate weighing. Of course, the scale can be calibrated to read the actual weight of the patient. So as to prevent deleterious movement of the scale **12**, the lower portion of link **23** has an extension which rides in a scale guide **14**.

In use, the patient can be raised above the mattress on the webs **15** and the cradle **25** can be inserted under him. The patient is then lowered onto the cradle for weighing, the weight of the cradle and webs being predetermined. For extremely accurate weighing, the webs may be removed.

HYDRAULIC SYSTEM

The side rail frames **6** along with the webs **15** are raised and controllably lowered by means of hydraulic cylinder **7**. The hydraulic pressure can be generated manually by a hand pump, or preferably by an electric pump. Turning now to FIG. **6**, it will be seen that cylinder **7** is connected at **11** to the discharge of pump **30** which draws fluid from reservoir **31**. The arrows show the fluid flow. A relief valve **32** limits the pressure buildup by pump **30**. To raise the patient, pump **30** is actuated to force liquid through connection **11** to the top of the piston, forcing piston rod **7***a* and cross head **7***b* downwards, resulting in the weights SA, SF, PA, PF, side rail frames **6**, and webs **15** rising. The pump can be stopped when the patient is at the desired height where the pump is electrically driven. When the piston has reached the end of its stroke a limit switch **36** is actuated and the pump motor is turned off. Should the limit switch **36** fail to operate, a pressure switch **37** shuts down the pump.

To lower the patient a slit valve **33** opened and regulating valve **34** controls the descent. Should the power fail while the patient is elevated, a hand valve **35** is provided.

It will be seen from the above description of the preferred embodiment that this trolley will augment existing hospital beds and give them a capacity heretofore only available by purchase of extremely expensive combination equipment, such as that shown in U.S. Pat. No. 3,438,067. The hydraulic system can be either manual or electric, allowing operation during power failure and in regions which fail to have power. The optional weighing device permits the weighing of intensive care patients who are unable to move to a conventional scale. Furthermore, the side rail frames act as guard rails for such patients who can be lifted by the webs to allow bowel movement, bathing and bed changing.

What I claim is:

1. A trolley for use with a hospital bed, said trolley comprising a pair of end frames; a pair of side rail frames vertically movable between said end frames; a plurality of horizontally spaced webs interconnecting said side rail frames for supporting a patient; means for selectively raising and lowering said side rail frames and said webs; said end frames each comprising two vertical legs of channel section having a vertically adjustable transverse end bar and means on said bar for attaching the trolley to the hospital bed; an upper longitudinal channel being connected to the upper portion of each end frame; a series of wire cables attached between said raising and lowering means and vertically movable weights in each leg for actuating said side rails; said raising and lowering means including a single hydraulic cylinder and piston housed in one of said vertical legs; wire cables being guided within said channel sections and said upper longitudinal section by sheaves; and engagement means at the bottom of each of said weights for positively engaging and lifting said side rails and controlledly lowering them.

2. A trolley as claimed in claim **1** wherein said hydraulic means also includes a fluid reservoir connected to a powered pump; a slit valve and metering valve for regulating the downward speed of said side rails and an emergency hand valve should said aforesaid valves fail; and a switch for stopping said pump at the end of the piston stroke and an emergency pressure switch should said stopping switch fail.

3. A trolley as claimed in claim **2** wherein said powered pump is hand powered; and a traction bar is provided along the center line of the trolley attached to the upper portions of each end frame.

4. A trolley as claimed in claim **1** wherein said side rail frames each have upper and lower longitudinal bars interconnected by uprights, and suspension means connect said webs to said uprights.

5. A trolley as claimed in claim **4** wherein said suspension means includes two suspension plates on either side of an upright connected together at one end by a roller which rides on said upright and having web hook means at the other end; and said uprights are inwardly inclined.

6. A trolley as claimed in claim **5** wherein some of said uprights are fixed to said longitudinal bars and other of said uprights are movable therealong, said movable uprights are both slideable along and pivotable about said upper longitudinal bar.

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