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2,865,175

HYDRAULIC POWER SYSTEM

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2 Sheets-Sheet 1

FIG. 2

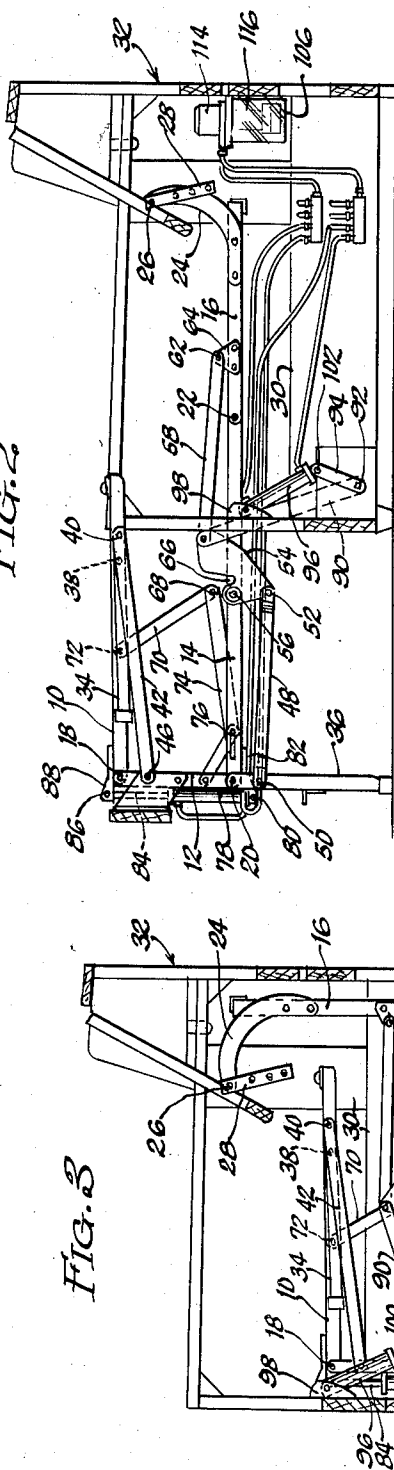
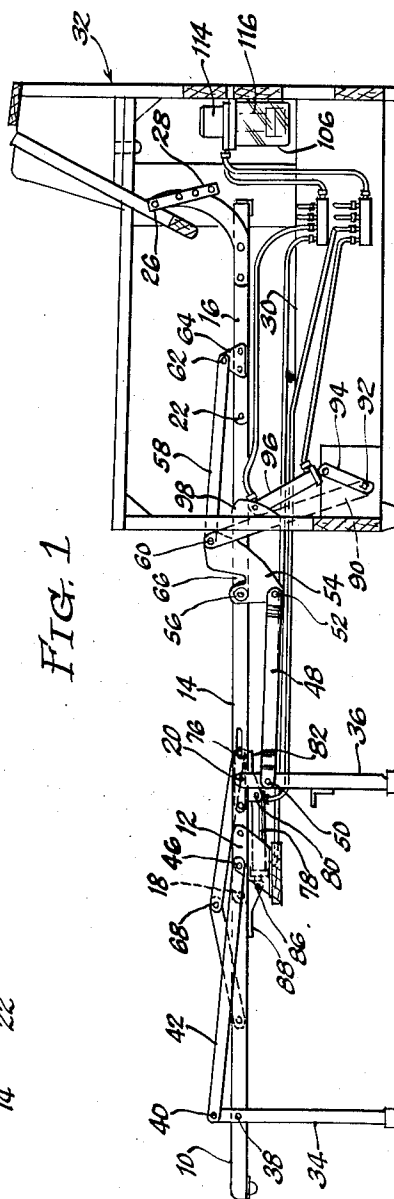


FIG. 3

FIG. 1



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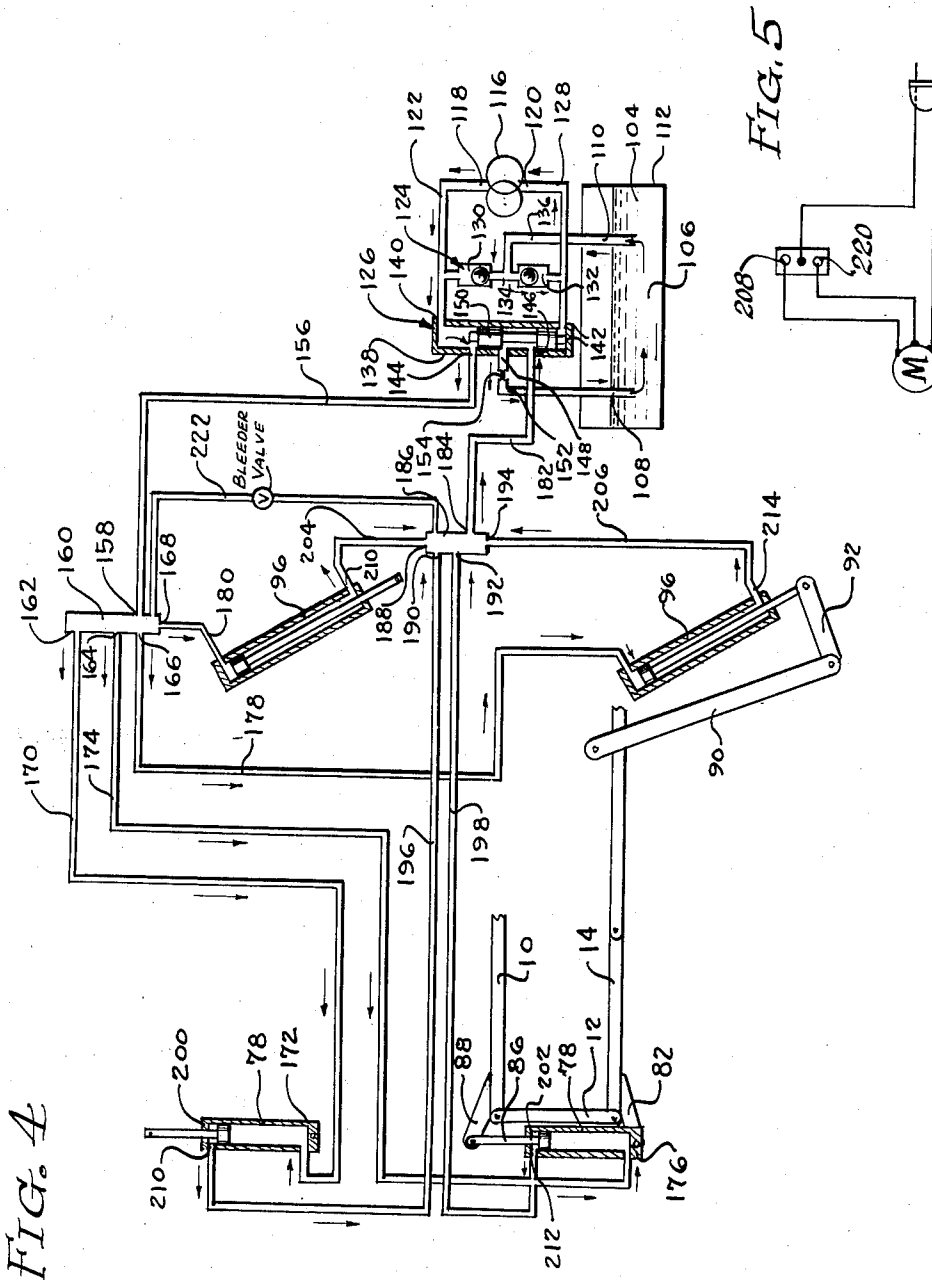
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HYDRAULIC POWER SYSTEM

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3 Claims. (Cl. 60—97)

This invention relates to a new and improved power system and it relates more particularly to a hydraulic system of the type described including a plurality of hydraulic cylinders operatively connected to mechanism for operation of the mechanism in a desired sequence to effect predetermined movements.

It is an object of this invention to produce a hydraulic system of the type described for operation of power-operated mechanism automatically in a desired sequence, and it is a related object to produce a hydraulic system of the type described which is simple in construction, easy and safe in operation automatically to power hydraulic cylinders in a desired sequence of operations.

Another object is to produce a hydraulic system of the type described for the automatic operation of a sofa bed in opening and closing movements, and it is a related object to produce a hydraulic system of the type described which is self-cleaning and which is reversible in flow thereby to enable operation in a simple and efficient manner with a minimum amount of service and repair and which embodies safety means for conservation of the equipment and elements which might be associated therewith.

These and other objects and advantages of this invention will hereinafter appear and for purposes of illustration, but not of limitation, an embodiment of the invention is shown in the accompanying drawings, in which—

Figure 1 is an elevational view of a folding sofa bed having a power system embodying the features of this invention operatively connected to the foldable frame sections of the sofa bed for movement between folded and unfolded positions;

Figure 2 is a sectional elevational view similar to that of Figure 1 showing the bed frame sections in a partially folded position;

Figure 3 is a sectional view similar to that of Figures 1 and 2 showing the bed frame sections folded into the sofa frame in folded position;

Figure 4 is a diagrammatic sketch of the hydraulic system embodying the features of this invention illustrated in connection with the frame members of a convertible sofa bed; and

Figure 5 is a diagram of the electrical system employed in the practice of this invention.

Description herein will be made of the hydraulic power-operated system embodying the features of this invention as applied to a sofa bed automatically to effect opening and closing movements of the bed frame sections between folded or sofa position and unfolded or bed position. It will be understood that the concepts embodied in the hydraulic power-operated system described will have application to other structures in which elements are operated in sequence in one direction and in opposite sequence for return, thereby automatically to effect displacement from a normal to an operated

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position and back from the operated position to normal in response to initiation from an external control.

For a detailed description of the convertible sofa bed structure illustrated in Figure 1 of the drawings, reference may be had to the copending application Serial No. 453,808, filed September 2, 1954, and entitled "A Sofa Bed With Automatic Operation." Briefly described, the convertible sofa bed comprises four frame sections, including an outer frame section 10, an outer intermediate frame section 12, an inner intermediate frame section 14, and an inner frame section 16. The outer frame section 10 is pivotally connected at 18 at its inner end to the outer end portion of the outer intermediate frame section 12. The inner end of the outer intermediate frame section 12 is pivoted at 20 to the outer end of the inner intermediate frame section 14. The inner end of the intermediate frame section 14 is pivoted at 22 to the outer end of the inner frame section 16 and the inner end of the inner frame section 16 is fixed to the lower end of an arcuate arm 24 which is pivoted at its upper end 26 to a bracket 28 fixed to the side wall 30 of the sofa bed frame 32. It will be understood that the sections of the sofa bed comprise a pair of identical members in laterally spaced-apart relation connected by cross frame members for operation of each section together, and in the following description reference will be made to one side of the bed frame with the understanding that the parts are repeated on the other.

When in the unfolded or bed position shown in Figure 1 of the drawings, the four bed frame sections are horizontally disposed in endwise alignment with the outer frame section 10 resting on leg 34 and with the outer intermediate frame section 12 and the inner intermediate frame section 14 resting on leg 36. The leg 34 is pivoted at 38 to the outer frame section 10 intermediate its ends, and at 40 to a link 42 which is pivotally secured at its inner end 46 to a portion of the outer intermediate frame section 12 in closely spaced relation to the pivot 18 to cause the leg 34 to be folded into a position alongside the outer frame section 10, when displaced to folded position, as shown in Figure 2 of the drawings, and to cause the leg to extend perpendicularly downwardly from the frame section, when displaced to unfolded bed position.

The leg 36 is pivoted at its upper end to the pivots 20 between the outer intermediate frame section 12 and the inner intermediate frame section 14. A link 48 pivoted at its outer end 50 to an upper portion of the leg 36 in closely spaced relation with the pivot 20 and at its inner end 52 onto a portion of a latching lever 54 offset from its pivot 56, operates to fold the leg 36 upwardly to a position alongside the inner intermediate frame section 14 when displaced to folded or sofa position, and to extend the leg perpendicularly downwardly from the frame sections when unfolded to bed position.

The latching lever 54 pivoted at 56 to an intermediate portion of the inner intermediate section 14 has a link 58 pivoted at its outer end 60 to a portion of the latching lever 54 offset upwardly and inwardly from the pivot, while the other end 62 of the link is pivoted to a bracket 64 fixed to an intermediate portion of the inner frame section 16. The link 58 causes the latching lever to turn about its pivot in the counter-clockwise direction responsive to the final fold of the inner intermediate frame section 14 and the inner frame section 16 from unfolded to folded position within the sofa frame. The link causes the latching lever 54 to turn about its pivot in the opposite or clockwise direction responsive to movement of the frame sections from folded to unfolded or bed position.

The latching lever 54 has a cut-out portion 66 extending inwardly from the upper edge. A latching pin 68 which

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extends laterally from the pivot between a link 70 pivoted at its outer end 72 to an intermediate portion of the outer frame section 10 and another link 74 pivoted at its inner end 76 to an intermediate portion of the inner intermediate frame section 14, is located directly in the path of movement of said cut-out portion 66 when the outer frame section 10 and the outer intermediate frame section 12 are in folded position. Thus, the latching pin is in position to be received within the cutout for locking the outer frame section 10 and the outer intermediate frame section 12 in folded position as the latching lever 54 is rocked in the counter-clockwise direction about its pivot responsive to movement of the inner intermediate and the inner frame sections to folded position. Thus, the outer frame section and the outer intermediate frame section are locked in folded position, while the inner intermediate frame section and the inner frame section are in unfolded position. The outer frame section and the outer intermediate frame section are not released by the latching lever until the inner intermediate frame section and the inner frame section are displaced from folded to unfolded or bed position. Thus, it becomes impossible to unfold the outer frame section and the outer intermediate frame section until the inner intermediate frame section and the inner frame section have been returned to unfolded or bed position.

For automation of the sofa bed, means should be provided for actuation of the outer frame section to rock about its pivot 18 between folded and unfolded positions and for rocking movement of the outer intermediate frame section 12 about the pivot 20 to between folded and unfolded positions whereby, when in folded position, the outer frame section extends substantially perpendicularly from the outer intermediate frame section with the outer frame section horizontally disposed in parallel relation with the underlying inner intermediate frame section and with the outer intermediate frame section 12 extending vertically therebetween. Means should also be provided for rocking the inner frame section and the inner intermediate frame section upwardly and downwardly about the pivot 26 and angularly with respect to each other from unfolded to folded position and vice versa, to bring the inner frame section into a vertical position in the back portion of the sofa frame when in folded position, and to bring the inner intermediate frame section 14 into a position extending outwardly horizontally from the lower end portion of the inner frame section and in the lower portion of the sofa frame with the folded outer frame section still in parallel relation above. When in folded position, the outer frame section 10, which is horizontally disposed above the inner frame section 14 folded into the sofa frame, provides the support for the cushions of the sofa.

Actuation of the outer frame section 10 and the outer intermediate frame section 12 for rocking movement about their pivots is achieved by a hydraulic cylinder 78 on each side of the sofa frame. The base end of each cylinder is pivoted at 80 on a bracket 82 which depends from the outer end portion of the inner intermediate section 16 with an offset which extends downwardly and outwardly of the pivot 20. The piston rod 84, shiftable endwise in the cylinder, is pivoted at its outer end at 86 to a bracket 88 which is fixed to the inner end portion of the outer frame section and has an extension which projects downwardly and inwardly of the pivot 18.

Thus, responsive to the flow of fluid into the base of the cylinder 78, the rod 84 is caused to be displaced outwardly to cause the outer frame section 10 to rock through an angle of about 90 degrees about the outer intermediate frame section 12. The pivot point 86 of the bracket extends inwardly below and beyond the pivot 18 sufficiently so that continued displacement of the piston rod 84 causes the outer intermediate frame section 12 to rock about its pivot to folded position, as illustrated in Figure 2

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of the drawings. Because of the offset of the pivot 80 below and outwardly of the pivot 20, and because of the offset of the pivot 86 below and inwardly of the pivot 18, reversal of flow of fluid from the head end of the cylinder to the base will cause the application of force on the brackets sufficient to rock the outer intermediate frame section and the outer frame section in the counter-clockwise directions about their pivots from folded sofa position to unfolded bed position, illustrated in Figure 1 of the drawings.

For actuation of the inner intermediate frame section 14 and the inner frame section 16 between folded and unfolded positions, there is provided an elongate operating lever 90 pivoted at 92 to the lower forward edge portion of the side wall 30 of the sofa frame, while the outer free end of the lever is pivoted at 60 on the latching lever 54. Rocking movement of the actuating lever 90 about its pivot 92 is effected through a lever arm 94 which extends angularly upwardly from the pivot 92, but is fixed for operation with the actuating arm 90 for rocking movement together. Rocking movement of the actuating lever 90 between folded and unfolded position is effected by a second hydraulic cylinder 96 which is pivoted at its base to a bracket 98 secured to the side wall of the sofa frame, while the piston rod 100 reciprocable in the cylinder is pivotally connected at its free end 102 to the outer end portion of the lever arm 94. Thus, responsive to the flow of fluid into the base end of the cylinder 96, the piston rod is displaced outwardly in a direction to rock the actuating lever 90 in the clockwise direction about its pivot 92 thereby to displace the inner intermediate frame section and the inner frame section 16 from unfolded to folded position within the sofa frame. Reversal of flow will cause the actuating lever 90 to be rocked in the counter-clockwise direction about its pivot to unfold the sofa frame sections. It will be understood that the same arrangement of lever arms and cylinders is repeated on the other side of the bed frame for balanced operation.

Description will now be made of the fluid system shown in the flow diagram of Figure 4 for operation of the described cylinders in the desired sequence for folding and unfolding the sofa bed frame members. The fluid 104 is housed within a sealed reservoir 106 provided with an inlet tube 108 and an outlet tube 110, each of which extends downwardly into the lower portion of the reservoir housing 112 to submerge the ends in the hydraulic fluid. Mounted on the reservoir housing is a reversible electrical motor 114 for driving a fluid pump 116 preferably in the form of a gear pump having one port 118 in communication with one side and another port 120 in communication with the other for the flow of fluid under pressure in one direction or the other, depending upon the direction of turning movement of the gear members. One port 118 is connected by tube 122 to one side of a suction valve 124 and to one side of a compensating valve 126 while the other port 120 is in communication through tube 128 with the other side of the suction valve and with the other side of the compensating valve.

The suction valve 124 comprises a pair of endwise spaced passages 130 and 132 of larger diameter in direct communication one with the other through a tubing 134 of smaller diameter connecting the adjacent ends, while the opposite end of one is in communication through tubing 122 to one side of the pump while the opposite end of the other is in communication through tubing 128 with the other side of the pump, as previously described. A tubing 136 communicates the outlet 110 from the reservoir with the tubing 134 interconnecting the pair of suction valve housings 130 and 132.

The compensating valve 126 comprises an elongate housing 138 having ports 140 and 142 in the opposite ends in communication with the opposite sides of the pump through tubing 122 and 128, respectively, as pre-

viously described. Intermediate the ends, the housing 138 is provided with three ports including one outer port 144, another outer port 145, and a middle port 148 located in equally spaced-apart relation therebetween. Reciprocable within the housing is a double-headed piston 150 shiftable endwise between two positions of adjustment. When in one position, one head of the piston occupies the space in the housing between the outer port 144 and the middle port 148 so as to block communication between said ports and to provide for direct communication between the port 140 and the outer port 144. The other head occupies the space between the outer port 146 and the port 142 in the other end of the housing thereby to block communication between the ports 146 and 148 and the pump 116, and the heads are spaced one from the other by an amount to permit direct communication between the port 146 and the middle port 148. When in the other position of adjustment, the double-headed piston has one part between the port 140 and the outer port 144 to block communication therebetween, while the other part is positioned between the port 146 and the middle port 148 to block communication therebetween and to provide for communication between the ports 142 and 146. When in this position, direct communication is available between the port 144 and the middle port 148.

The middle port 148 is in communication through tubing 152 to the inlet 108 of the reservoir. An orifice 154 is provided in the tubing 152 to regulate the flow of fluid, thereby to prevent uncontrolled and rapid movements of the bed sections when the weights thereof contribute to the rocking force.

The outer port 144 is in communication through tubing 156 with a port 158 in a header 160. The header has four additional ports 162, 164, 166 and 168. The ports 162 and 164 are in communication through tubing 170 and 174 to the base ends 172 and 176 of the outer fluid cylinders 78. The two other ports 166 and 168 are in communication through tubing 178 and 180, respectively, with the base ends of the inner fluid cylinders 96.

The other outer port 146 of the compensating valve 126 is in communication through tubing 182 with a port 184 in a second header 186. The second header is provided with additional ports 188, 190, 192 and 194. Two of the ports, 190 and 192, are in communication through tubing 196 and 198, respectively, to the head ends 200 and 202 of the outer fluid cylinders 78. The other two ports, 188 and 194, are in communication through tubing 204 and 206, respectively, with the base ends of the fluid cylinders 96.

The position of the pistons in the hydraulic cylinders 78 and 96 indicate that the outer frame section 10 and the outer intermediate frame section 12 are in folded position and that the inner frame section and the inner intermediate frame section are in unfolded bed position. When it is desired to fold the frame sections from unfolded to folded or sofa position, the button 208 of the switch member is depressed to start the motor 114. This rotates the gears of the pump in the direction to produce flow as indicated by the arrows in Figure 4. This will cause fluid 104 to be drawn through port 120 into the pump housing. Fluid will be sucked into the tubing from the suction valve housing to cause the ball to be unseated in the portion 132 for communicating the suction valve housing with the tubing leading into the bottom of the reservoir. Fluid will flow under pressure from the pump 116 through the port 118. The pressure of fluid in the tubing 122 will cause the ball in the housing 130 to seat, thereby to prevent flow of pressure fluid through the suction valve. The pressure fluid entering the compensating valve 126 will cause the piston 150 to be displaced in the direction away from the port 140, as illustrated in Figure 4 of the drawings, with the result that the port 140 through which the pressure fluid flows communicates directly with the outer port 144 for continued flow of

the pressure fluid through the tubing 156 to the header 160.

From the header, the pressure fluid flows through the ports 162 and 164 and the tubing 170 and 174 to the base of the cylinders 78. Because of the force required to lift the inner intermediate frame section for rocking movement from unfolded to folded position, it is substantially greater than the force required to rock the outer frame section and the outer intermediate frame section about their respective pivots, and flow of pressure fluid will automatically be directed first through the ports 162 and 164 and through tubing 170 and 174 to the base end of the cylinders 78. Flow of fluid into the base end of the cylinders 78 will cause outward displacement of the piston rods to the position shown in Figure 4 of the drawings. When in this position, the outer intermediate frame section is rocked to extend upwardly substantially perpendicularly from the outer end of the inner intermediate frame section 14, and the outer frame section 10 is rocked about its pivot to extend horizontally substantially perpendicularly from the outer end of the outer intermediate frame section 12 and in parallel spaced relation above the inner intermediate frame section 14.

After the pistons 84 have completed their stroke, flow of fluid under pressure can continue only from ports 166 and 168 through tubing 178 and 180 to the base ends of the fluid cylinders 96 to effect endwise displacement of the piston 100. Outward displacement of the piston causes rocking movement of the actuating lever 90 in the clockwise direction to fold the inner intermediate and the inner frame sections 14 and 16 into the sofa.

As the fluid under pressure enters the base ends of the cylinders to cause endwise displacement of the pistons, the fluid in the cylinders on the opposite side of the piston is displaced from the cylinders. The fluid in the cylinders 78 is displaced through ports 210 and 212 in the head end of the cylinders 78 for passage through tubing 196 and 198, respectively, to the header 186. Similarly, fluid from the cylinders 96 is displaced through ports 214 and 216 into tubing 206 and 204 leading into the header 186. From the header, the fluid flows through tubing 182 to the port 146 of the compensating valve housing and through the housing to the middle port 148. From the middle port, the fluid flows through the tubing 152, through the speed control orifice 154, to the reservoir to replace fluid taken from the reservoir to the pump for circulation under pressure.

When in the folded or sofa position, the reverse flow takes place. The gears of the pump 116 are rotated in the opposite direction to that previously described by depression of the switch button 220 so that the fluid is drawn into the pump through the port 118. This creates a suction in the tubing 122 which becomes effective through the suction valve housing 130 to unseat the ball so that the fluid will be drawn from the reservoir 112 through the tubing 136 to the pump. Output pressure of the pump also operates to seat the ball in the other housing 132 of the suction valve to block passage through the tubing 128 and housing 132 to the reservoir. With the ball seated, the fluid from the pump flows through the port 120 to the compensating valve housing to cause endwise displacement of the piston to the other position of adjustment. Fluid under pressure thus flows through the compensator housing to the port 146 and through the tubing 182 to the header 186. From the header, the fluid flows through ports 188, 190, 192 and 194 into the tubing 204, 196, 198 and 206 in communication with the head end of each of the fluid cylinders 78 and 96.

Since the outer frame section 10 and the outer intermediate frame section 12 are locked in folded position until the inner intermediate frame section 14 and the inner frame section 16 are displaced to unfolded bed position, fluid will flow from the header 186 through the ports 188 and 194 into the tubing 204 and 206 to the cylinders. This will cause the actuating arm 90 to rock

about its pivot in the counter-clockwise direction to lift the inner intermediate frame section and the inner frame section out of the sofa for rocking movement to unfolded bed position. As the described frame sections are shifted to unfolded position, the latching lever 54 is rocked about its pivot to release the latching pin 68 holding the outer frame section and the outer intermediate frame section in folded position. Thus, fluid will thereafter be able to flow from the header 186 through the ports 190 and 192 and into the tubing 196 and 198 to the fluid cylinders 78 to cause inward displacement of the pistons. This will result in rocking movement of the outer frame section 10 and the outer intermediate frame section 12 to unfolded bed position.

The fluid on the other side of the pistons will flow through the ports in the cylinders through the respective tubings communicating said ports with the header for return through the tubing 156 to the port 144 of the compensating valve housing and through the housing to the middle port 148 and through the tubing 152 for return to the reservoir.

It will be apparent from the description that fluid for flow under pressure is constantly removed from the reservoir so that the fluid fed under pressure to the cylinders is constantly returned to the reservoir. Thus, unidirectional flow through the reservoir is achieved to enable foreign material in the fluid system to settle out in the reservoir where it can be extracted from the system.

In the event that it is desirable to permit movement of the bed frame sections independently of the pump, such as when an obstruction is encountered which resists folding or unfolding operation, or in the event that failure occurs in the pump or fluid system, the headers 160 and 186 can be interconnected through a tubing 222 having a bleeder valve therein for enabling fluid to be bypassed slowly from one header to the other to enable flow of fluid under pressure without piston displacement or to enable piston displacement without operation of the pump.

It will be understood that other changes may be made in the details of construction, arrangement and operation and that the fluid system described may be applied to other devices without departing from the spirit of the invention, especially as defined in the following claims.

I claim:

1. In a hydraulic power system for the displacement of pistons in one group of fluid cylinders in advance of displacement of pistons in another group of fluid cylinders in direction sequence in one direction and in reverse se-

quence in the other direction, a fluid reservoir, a reversible pump having ports at opposite sides thereof, suction valves in communication one with the other at one end and in communication with opposite ports of the pump at opposite ends, means communicating the fluid in the reservoir with the ends of the suction valves in communication with each other, a compensator valve housing having ports in opposite ends thereof and three additional ports in spaced relation in the intermediate portion of said housing, including an outer port, a middle port and another outer port, a double-headed piston shiftable endwise in said compensator valve housing between one position of adjustment whereby one head is located between the outer and the middle of said intermediate ports to block communication therebetween with the other head located between the other outer port and the adjacent port in the end of the housing to block communication therebetween and to communicate the other port in the end of the housing with the outer intermediate port and with a spaced relation between the heads to enable communication between the other outer intermediate port with the middle intermediate port, a header in communication with the outer intermediate port of said compensator valve housing, another header in communication with said other outer intermediate port of said compensator valve housing, fluid passages between the first header and one end of each of the fluid cylinders, other fluid passages between the other header and the opposite end of the fluid cylinders, a passage communicating the middle intermediate port of the compensator valve housing with the fluid reservoir for return of fluid thereto.

2. A hydraulic power system as claimed in claim 1 which includes a restricted orifice in said fluid passage connecting the middle intermediate port of the compensator valve housing with the fluid reservoir to control the flow of the fluid.

3. A hydraulic power system as claimed in claim 1 which includes a passage communicating one header with the other, and a bleed valve in the passage.

References Cited in the file of this patent

UNITED STATES PATENTS

1,307,839	Williams	June 24, 1919
1,981,400	Tobin	Nov. 20, 1934
2,105,473	Dean	Jan. 18, 1938
2,657,533	Schanzlin et al.	Nov. 3, 1953
2,696,403	Baugh	Dec. 7, 1954