

March 15, 1966

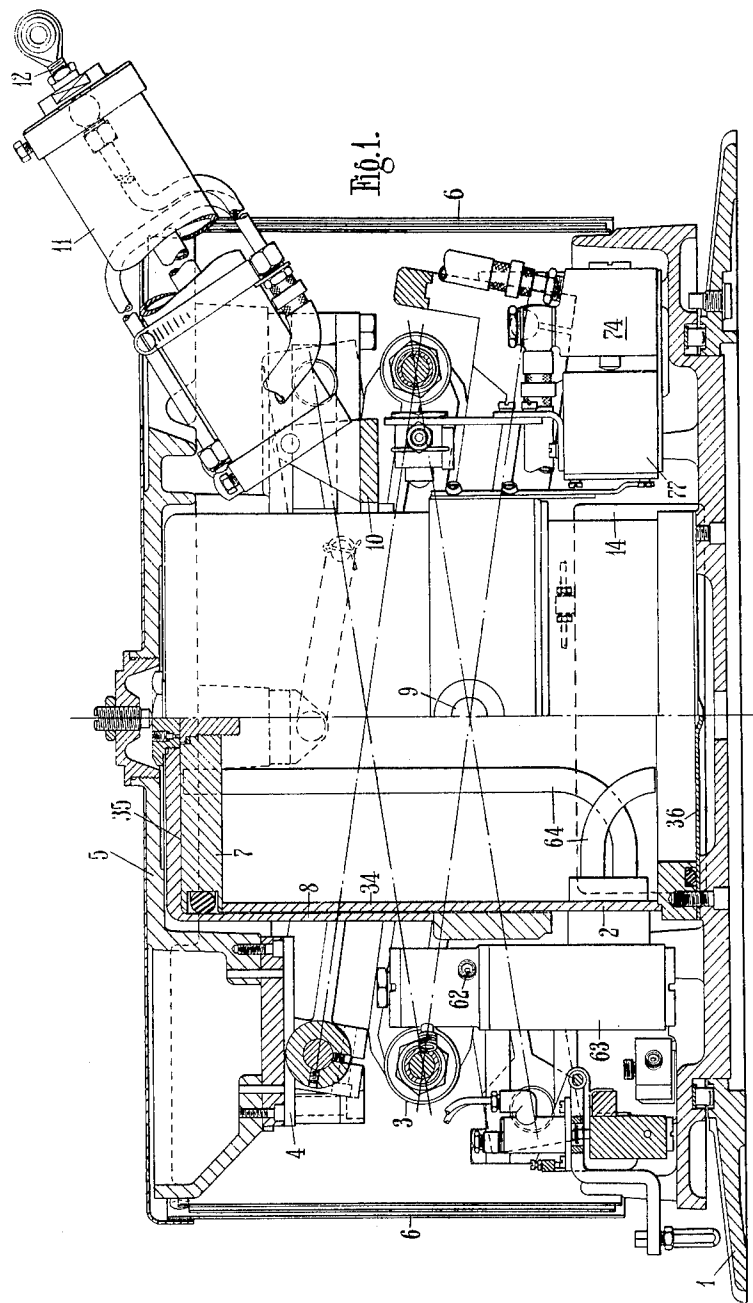
G. BOULSOVER

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HOIST

Filed Sept. 2, 1964

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March 15, 1966

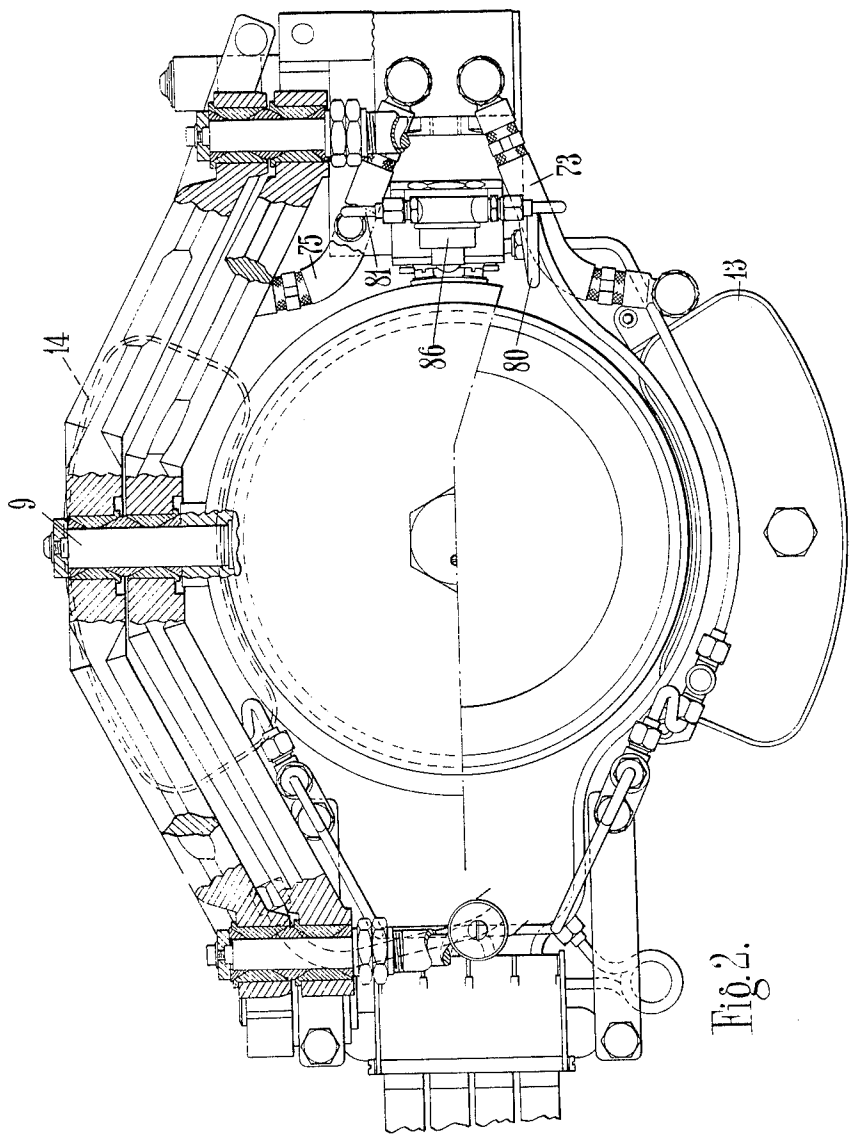
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March 15, 1966

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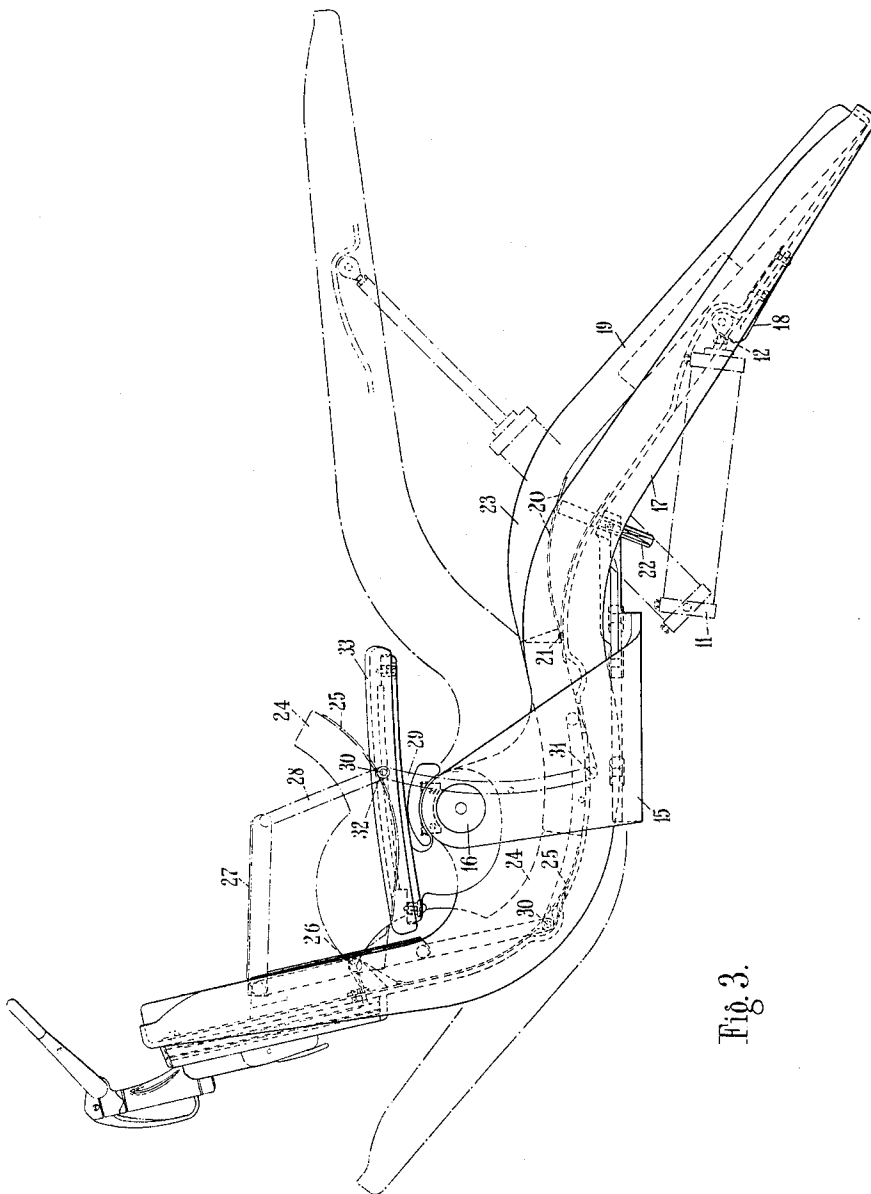


Fig. 3.

March 15, 1966

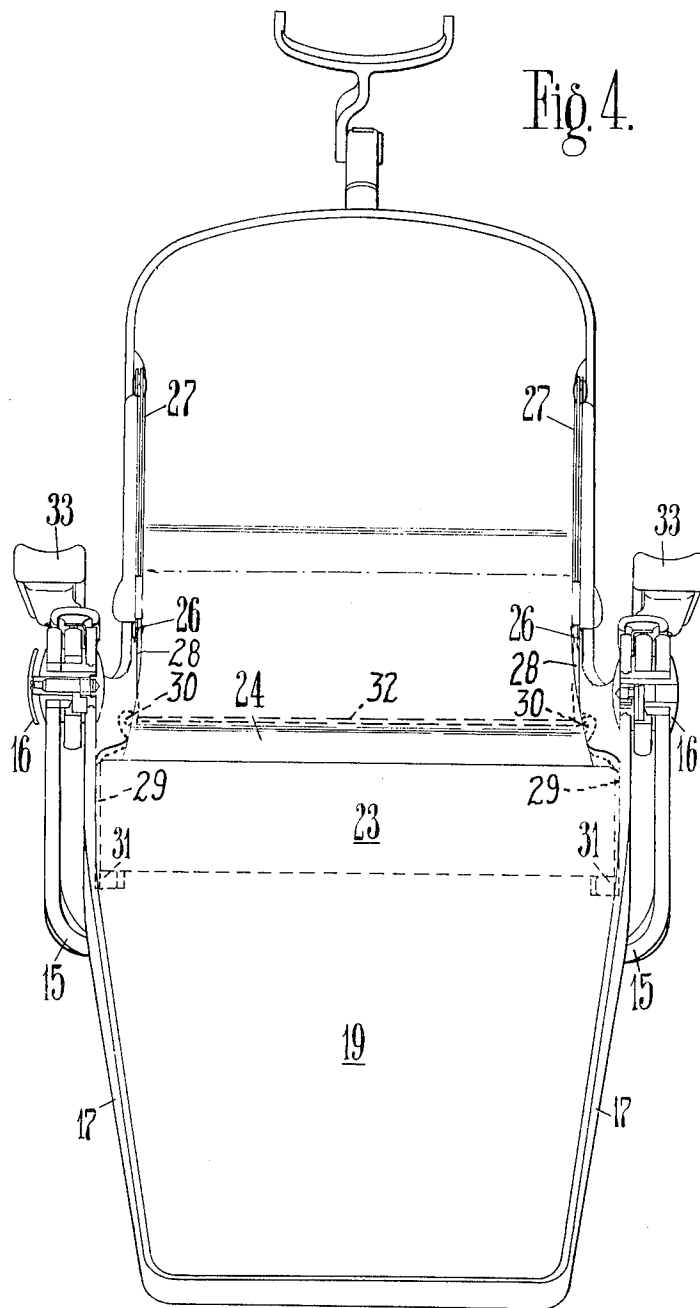
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Filed Sept. 2, 1964

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March 15, 1966

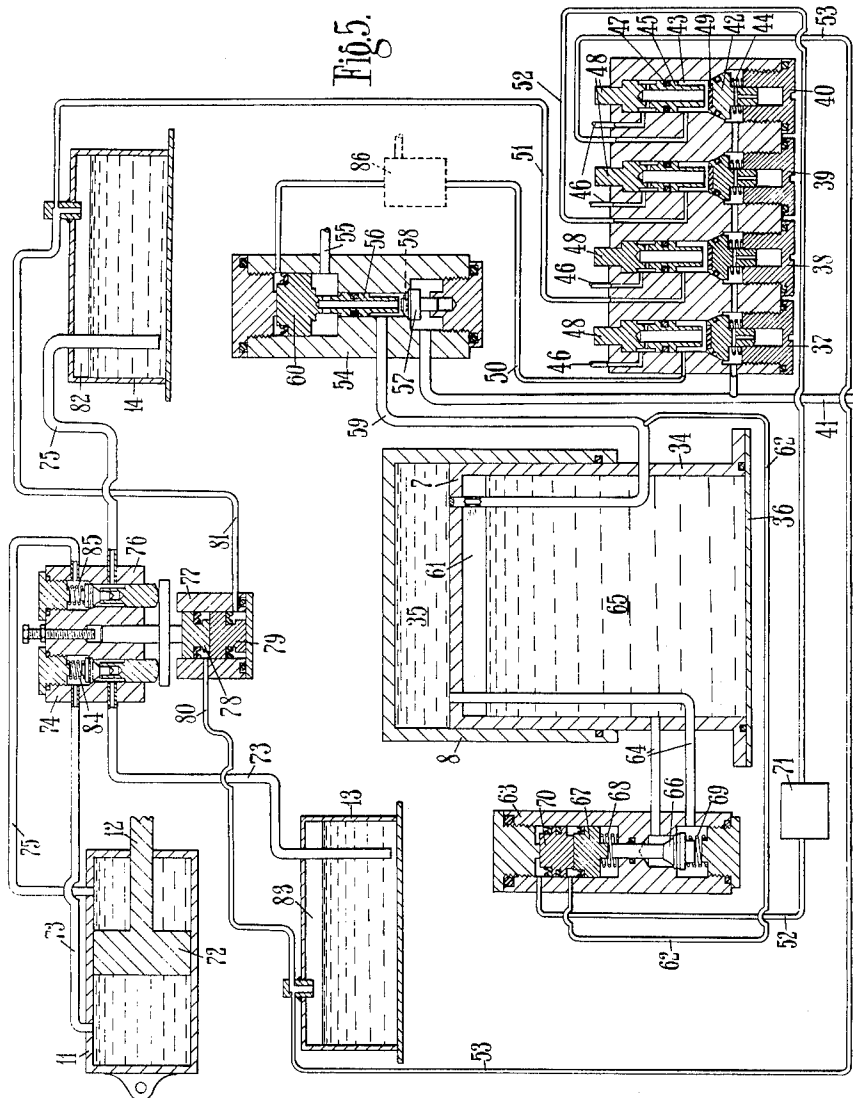
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5 Sheets-Sheet 5



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3,240,529

HOIST

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1 Claim. (Cl. 297—327)

This invention relates to supports for the body which are adjustable in height and furnished with ram mechanism for effecting the vertical movement. The most usual examples are dental chairs.

In my Patent No. 927,600 I have already described an arrangement of body support, comprising a base, a body support member such as a dental chair, and a lazy tongs mechanism holding these apart, the base also carrying a hydraulic ram mechanism linked to a centre line pivot of the lazy tongs mechanism whereby the vertical movement of the body support member may be amplified with respect to the movement of the ram mechanism. The ram mechanism on the other hand may incorporate an oil reservoir together with means for pressurising the air in the space above the oil, there being an operator controlled first valve for regulating the air pressure in the oil reservoir and a second valve for isolating hydraulic fluid in the ram from the oil in the reservoir at any desired elevation of the hoist. This use of pressurised air provides for a particularly smooth operation of the hydraulic ram and avoids the need for a separate pump taking into account the fact that modern dental units and other locations where the body support of the invention will be situated, almost invariably are furnished with a source or supply of compressed air. The second valve just referred to enables the ram to be locked at any desired elevation and may be arranged to close automatically when the first valve, for the pressurised air, is released.

The present invention is concerned with an additional, tilting movement of the body support and has as one object to provide means whereby the body support may be tilted forwardly or backwardly under power exerted by a hydraulic ram. Another object of the invention is to provide hydraulic and pneumatic circuitry whereby the body support may be raised or lowered and simultaneously may be tilted in a forward or reverse direction. Yet another object is to provide hydraulic and pneumatic circuitry whereby the raising and lowering of the body support may be accomplished by oil pressurised by compressed air, whilst the tilting of the body support is likewise accomplished by oil pressurised by compressed air from the same source whilst maintaining the respective pneumatic circuitries isolated from one another. In another aspect, it is an object of the invention to provide means whereby the shape of the body support may be varied automatically as the body support is tilted, to conform with a more natural or more comfortable position of the seated body.

In one aspect the invention consists in a body support comprising a base carrying a vertically extendable body support member and a first hydraulic ram mechanism for raising and lowering the body support member, this first hydraulic mechanism comprising a first hydraulic ram and an associated first oil reservoir with respective hydraulic circuitry and with an associated pneumatic circuitry incorporating an operator controlled first valve for pressurising the oil reservoir, the body support member being tiltably mounted and connected with a second hydraulic mechanism incorporating a respective second hydraulic, double-acting ram, each side of which is connected by hydraulic circuitry to a respective second and third oil reservoir associated with second pneumatic circuitry incorporating second and third operator controlled pneumatic valve arrangements for pressurising the second and

2

third oil reservoirs and exhausting air from the third and second oil reservoirs respectively, the hydraulic circuitry of each hydraulic ram mechanism incorporating a respective control valve associated with means for closing this control valve to lock the respective hydraulic ram in unison with release of the respective operator-controlled valve.

Preferably, the first hydraulic ram for raising and lowering the hoist, hereinafter referred to as the lifting ram, and the second hydraulic ram for tilting the support table or chair, hereinafter referred to as the tilting ram, have respective pneumatically operated valves for regulating the supply of compressed air to their respective oil reservoirs and for regulating the movement of the respective hydraulic fluid, these being the operator-controlled valves just referred to. These pneumatically operated valves may in turn be associated with pneumatic pilot valves grouped together to represent a portable control box linked by flexible piping to the remainder of the hoist, but may additionally or alternatively be operated directly by a foot control. Generally, four pilot valves will be thus provided, the actuation of one affording a forward tilt response from the tilting ram, actuation of the next affording a rearward tilt response, actuation of a third affording hoist lift whilst actuation of the fourth affords hoist lowering. The foot control may be furnished with plunger devices as an alternative means for actuating the pneumatically operated valves remotely, by means of a flexible hydraulic linkage leading to, for example, a hydraulic bellows for manual operation.

Broadly, the invention therefore provides hydraulic rams and pneumatic circuitry and hydraulic circuitry whereby a lifting ram may be actuated to raise or lower a body support under the influence of thrust derived from compressed air, the position heightwise of the body support being locked by a hydraulic valve which comes into operation automatically as the operator-control is released, whilst functioning independently of this, there is a tilting ram for tilting the body support forwardly or backwardly likewise associated with a hydraulic locking valve. Two separate oil reservoirs are provided for each side of the double-acting tilting ram and either side can be pressurised simultaneously with pressure release on the other side for immediate tilting action. Generally, the operator-control valve for the lifting ram circuitry and the operator-control valve for the tilting ram circuitry are each doubled one valve of each pair serving for initiating movement in one direction and the other for initiating movement in the reverse direction. The general arrangement permits the tilt to be reversed, immediately or after a delay, as soon as the respective control valve is operated and without having to rely upon a powerful return spring.

In addition to the valves which have already been enumerated, a valve or valves may be incorporated, suitably operated by being tripped, to control the maximum movement of the lifting and/or tilting rams in one or both directions. Thus, a "maximum lift" trip valve may be arranged to be tripped automatically when the hoist reaches a certain height thereby for example cancelling the actuation of the "lift" pilot valve for the lifting ram.

To provide an enhanced degree of comfort and security in a chair type body support, the support in accordance with a further feature of the invention comprises a seat portion which is pivotally mounted in relation to the remainder of the support and associated with a cam or stop arranged to tilt this seat portion differentially as the support as a whole is tilted so that the seat portion assumes a more acute angle with a chair back portion and more obtuse angle with a chair leg portion as the body support as a whole is tilted towards an upright position. The chair type body support in this case preferably has a band

3

of flexible upholstery overlying the seat portion so that the change in angle is transmitted through this upholstery. In the preferred and simplest arrangement, the relative tilting of the chair seat portion is accomplished by hinging this rearwardly and providing a stop below a more forward part of the seat portion so that as the chair as a whole tilts forwardly, the seat portion engages this stop and is held at a predetermined inclination to the horizontal whilst the remainder of the chair continues to swing forwardly. Other mechanical arrangements could of course readily be contrived, all serving the common purpose of converting a relatively flat S-shape to a relatively acute S-shape being more appropriate to a reclining position and an upright position respectively.

The invention will be described further with reference to the accompanying drawings, of which:

FIGURE 1 is a side sectional view of the base portion of a dental chair,

FIGURE 2 is a part sectional plan view corresponding to FIGURE 1,

FIGURE 3 is a side view of the upper portion of the dental chair,

FIGURE 4 is a front view corresponding to FIGURE 3, and

FIGURE 5 is a hydraulic/pneumatic circuit diagram.

As shown in FIGURES 1 and 2, the lower portion of the dental chair assembly comprises a base 1 for standing on the floor supporting a lifting ram 2. The base also supports a lazy tongs or trellis mechanism 3, the upper end 4 of which carries a platform 5 on which is carried the seat illustrated in FIGURES 3 and 4 described hereinafter. The platform 5 also carries a skirt 6 which shields the lazy tongs and lifting arm mechanism.

The double-acting lifting ram 2 comprises a fixed piston 7 and a sliding cylinder 8, the latter at its lower end carrying a pin 9 constituting a lower centre pivot of the lazy tongs mechanism 3, whereby any upward movement of the cylinder 8 gives rise to a magnified upward movement of the platform 5. The platform 5 also supports a bracket 10 to which is pivoted the lower part of a hydraulic tilting ram 11, having an extending piston rod 12.

Set round the lifting ram 2 are the various control valves described more particularly hereinafter in connection with the hydraulic/pneumatic circuit diagram, together with separate pressurisable oil reservoirs 13 and 14 for the tilting ram. These are all shielded within the skirt 6.

Referring now to FIGURES 3 and 4, a large bracket 15 mounted on platform 5 provides a pivot at 16 at which is suspended a one-piece chair shell 17. The shell carries a bracket 18 towards its foot end, at which the piston rod 12 is pivoted, so that extension of the rod 12 will cause the shell 17 to swing about the pivot 16 in an anti-clockwise direction as seen in FIGURE 3. The rearwardly tilted position of the shell is shown in FIGURE 3 in chain dotted outline. Sectional upholstery 19 is fitted to the shell 17. In the vicinity of the angles between the seat portion and leg-supporting portion of this upholstery, a plate 20 is hinged at 21 to the shell 17, with its free forward end pointing towards the foot of the shell. The bracket 15 carries a post 22 which protrudes through a hole in the shell 17 when the latter is rotated to its forwardly tilted position, to engage the plate 20, thereby preventing the plate from completing its return movement to a fully forward position. In consequence, as shell 17 is swung from a backwardly tilted to a fully forward position, that is, in a clockwise direction as seen in FIGURE 3, a point is reached where the plate 20, lying on the upper face of the shell 17 below the upholstery 19, is contacted by the post 22. Following this, continued rotation of the plate 20 to follow the shell 17 is prevented, and in consequence the portion 23 of the upholstery immediately over the plate 20 is lifted away from the shell 17. This corresponds to an increase in the obtuse angle between the seat portion and leg portion of the upholstery 19, as the seat swings to a forwardly tilted or seated posi-

4

tion or, conversely, to a diminution in this angle as the seat swings from a seated to a reclining position. In the latter position, therefore, the patient is supported in a natural, resting position with the lower part of the body comparatively straight while on being returned to an upright, seated position the angle at the knee is automatically altered so that the knee becomes bent, which is appropriate to a seated position.

For the accommodation of a child, intermediate section 24 of the upholstery 19 is supported by a metal shell 25 hinged at 26 and associated with struts 27, 28 and 29 which are pivoted together and normally lie tucked in at the side of the upholstery as seen in FIGURE 4. The shell 25 and the upholstery portion 24 can thus be swung up, as illustrated in chain dotted outline in FIGURE 3 and thereby serve as a child's seat. To lock the struts 28 and 29 it is arranged that the hinge 30 therebetween permits only a limited rotation of the strut 29 in a clockwise direction relative to the strut 28. A recess 31 is provided in the shell 17, in which the lower end of the strut 29 can seat when the hinge 30 has been pulled out (to the right) beyond the over-centre position of the struts 28 and 29, so that downward pressure against a supporting bracket 32 carried by the hinge 30, exerted by the shell 25, holds the strut 29 locked in its position of maximum clockwise rotation. The struts 27 serve as arm supports for a child, whereas separate arm supports 33 are provided for the chair as a whole.

Referring now more particularly to the circuit diagram, FIGURE 5, the lifting ram is seen to be single-acting with its upward extension powered by the admission of hydraulic fluid under pressure in the space 35 between the piston 7 and cylinder 8. The return movement is of course effected by gravity. The skirt 34 of the piston 7 is sealed by a plate 36 at the bottom and serves as return reservoir for the hydraulic fluid in space 35.

Operation of the lifting and tilting mechanisms is initiated by pneumatic pilot valves 37, 38, 39 and 40 which serve respectively for the movements raise, forward tilt, lower and backward tilt. These pilot valves, which are all connected in parallel to a supply pipe 41 for compressed air, have the same construction. Each comprises a poppet valve member 42 which seals the compressed air from a central chamber 43 until depressed against the action of a return spring 44. The chamber 43 is occupied by a valve spool or bobbin 45 which is tubular at its inner end, serving in its rest position to connect the inner portion of the chamber with an exhaust port 46 situated towards the outer end of the chamber 43. A sealing ring 47 carried by the spool 45 prevents communication between the inner part of the chamber 43 and the exhaust port 46 except by way of the tubular spool. The latter has an extension 48 serving as a press button for actuating the valve, by inward movement of which the spool 45 is brought to bear against the poppet valve member 42. Further inward movement depresses the valve member 42 and thereby admits compressed air from pipe 41 to the inner part of the chamber 43; at the same time a sealing disc 49 obturates the normally open end of the tubular spool 45 thus shutting off connection to the exhaust port 46. Upon release of button 48, air pressure acting on the inner part of the spool 45 returns the latter to its initial, resting position; the pressure differential across the valve member 42 resulting from chamber 43 now being connected to exhaust, aided by the spring 44, presses the valve member 42 to its closed position shown in the drawing. The inner part of the chamber 43 of the valves 37, 38, 39 and 40 is connected to an air line 50, 51, 52 and 53 respectively. Each of these is therefore connected to exhaust when the respective button 48 is released, and to the compressed air supply when the respective button is depressed.

Taking first the pilot valve 37, the pilot air line 50 leads to the main air "raise" valve 54. This generally resembles the valve 37, having an exhaust port 55 corresponding to the port 46, a tubular spool 56 correspond-

5

ing to the spool 45, and a poppet valve member 57 similar to the valve member 42 carrying a sealing disc 58. The action of the valve 54 is to connect a pipe 59 to the compressed air supply pipe 41 or to exhaust depending on the position of the spool 56, but in this case the latter is moved by compressed air from line 50 acting on the head 60 of the spool. The pipe 59 leads to the air space 61 within the skirt 34, just below the piston 7, whilst a small branch line 62 leads to an oil lock valve 63. This oil valve is inserted in an oil pipe 64 connecting the hydraulic fluid in the space 35 with the space 65, serving as oil reservoir, within the piston skirt 34 below the air space 61. A poppet valve member 66 controlling the movement of oil through the valve, is depressed to open the valve 63 by the action of compressed air from the pilot air line 62, on a piston 67. The latter, which is detached from the valve member 66, has its own return spring 68. Thus, when valve 37 is actuated, valve 54 is opened to admit compressed air to space 61 and more or less instantaneously pressurise the hydraulic fluid in space 65. This operation of valve 54 results from the fact that the area of head or piston 60 is greater than the area of poppet valve member 57 and consequently, even though poppet valve member 57 is normally held closed by pressure from air supply line 41, the force exerted by head or piston 60 will be greater than that holding poppet valve member 57 closed and therefore, upon depressing the button 48 of valve 37, the poppet valve member 57 of valve 54 will be opened. At the same time the compressed air is fed along the pilot air line 62 and acting on the piston 67, automatically opens valve 63 so that the now pressurized hydraulic fluid can flow into space 35, lifting the ram cylinder 8. As soon as the respective button 48 is released line 50 is connected to exhaust, so that spool 56 in valve 54 moves to connect the air line 59, and hence space 61 and line 62, to exhaust. Piston 67 moves under its return spring 68, permitting valve member 66 to close under oil pressure and under its own return spring 69. Closure of valve 63 locks the cylinder 8 in position.

To lower the ram cylinder 8 and with it, the chair of FIGURES 3 and 4, the "lower" pilot valve 39 is actuated. This is connected by its pilot air line 52, only to the oil valve 63. To avoid cross connection with valve 54 by way of the pilot air line 62, the air from line 52 is led to the back of a separate, free piston 70 which depresses oil valve member 66 by pushing piston 67. Since the air in space 61 is already connected to exhaust through valve 54, the hydraulic fluid in reservoir space 65 is at atmospheric pressure and the fluid in space 35 is expelled by gravity acting upon the supported dental chair. When button 48 of valve 39 is released this flow of hydraulic fluid is stopped by return movement of valve member 66 closing the oil valve 63, locking cylinder 8 in position. A restriction such as a needle valve 71 may be inserted in line 52 to cushion the downward movement by slowing the opening and closing of valve 63 by valve 39.

The double-acting hydraulic cylinder 11 is connected at one side of the piston 72 by way of an oil pipe line 73 to a valve 74 and from there by a continuation of the oil line 73 to the oil reservoir 13. At the other side of the piston 72, the cylinder 11 is connected by an oil line 75 to a valve 76 and from there by a continuation of the oil line 75, to the reservoir 14. For convenience, these two reservoirs are shown in FIGURE 5 on their side. The valves 74 and 76, which are simple poppet valves serving to close the respective oil line when released, are mounted side by side for simultaneous actuation by a pneumatic ram 77. As in the case of the oil valve 63, the pneumatic action of the ram 77 contains two separate pistons 78 and 79 arranged so that the ram can be operated either by compressed air supplied through the air line 80 behind the piston 78, or by compressed air supplied through the air line 81 behind the piston 79. In the latter case, the piston 79 will push the piston 78 forwards, but the arrangement maintains a permanent air seal between the lines 80 and

6

81. The line 81 is an extension of the line 51 from pilot valve 38, which supplies compressed air to the space 82 in the top of the oil reservoir 14, whilst the air line 80 is an extension of the air line 53 which supplies compressed air to the space 83 in the top of the oil reservoir 13. In the resting state, when neither valve 38 nor valve 40 is actuated, each of these pilot valves maintains the respective lines 51, 81 and 53, 80 open to exhaust so that the hydraulic fluid on neither side of the piston 72 is pressurised, whilst each of the valves 74, 76 is held shut under the influence of a respective return spring 84, 85 to lock the position of the piston 72 by preventing movement of hydraulic fluid to and from the reservoirs 13, 14. As soon as one of the pilot valves 38, 40 is actuated, the respective oil reservoir is pressurised by the admission of compressed air, whilst through the action of the pneumatic ram 77 each of the valves 74 and 76 is opened thus permitting hydraulic fluid to flow from the pressurised reservoir to the respective side of the piston 72 and from the other side of the piston 72, to the reservoir which is not pressurised and is still therefore open to exhaust through its respective pilot valve 38 or 40.

The arrangement according to the invention thus permits the use of comparatively simple valves affording the minimum of obstruction to the flow of hydraulic fluid, whilst keeping the various hydraulic and pneumatic circuits separate.

If desired, a further valve shown in dotted outline at 86 may be provided in the pilot air line 50 arranged to close the connection to valve 37, and open valve 54 above piston 60 to exhaust when tripped. The result will therefore be to arrest the upward movement of the lifting ram, the valve 86 conveniently serving as a limiting valve for the maximum height of the dental chair. Provision will in general be made for positioning this valve so that it is tripped when a desired maximum extension of the lifting ram has been reached. It will be appreciated that, although the valves 74 and 76 are shown as being entirely separate valves, actuated in unison, the respective valves for the two oil reservoirs can be constructed as parts of a double valve having for example a single sliding spool or bobbin. It will also be appreciated that the pin 9 is duplicated as is the trellis mechanism 3 on each side of the ram 2; likewise to maintain a proper balance, the post 22 is duplicated and fitted one to each side of the bracket 15.

I claim:

A body support comprising a vertically movable ram mechanism, a chair pivotally mounted on a horizontal axis on said ram mechanism for movement between an upright and reclining position, a double acting hydraulic cylinder connected to said chair for moving the same between said positions, a pair of reservoirs for hydraulic fluid, one reservoir being connected to one end of said hydraulic cylinder and the other reservoir being connected to the opposite end of said hydraulic cylinder, an on-off valve in the connection between each reservoir and each end of said hydraulic cylinder, pneumatic means for simultaneously opening said on-off valves, spring means for closing said on-off valves, an air pressure supply pipe, a control valve connecting said supply pipe to one reservoir and said pneumatic means, said control valve in one position serving to supply air pressure to said one reservoir and pneumatic means to force fluid into one end of said hydraulic cylinder while connecting said opposite end of said cylinder to said other reservoir, and in another position to connect said one reservoir and pneumatic means to an exhaust, and a second control valve connecting said supply pipe to the other reservoir and said pneumatic means, said second control valve in one position serving to supply air pressure to said other reservoir and pneumatic means to force fluid into the opposite end of said hydraulic cylinder while connecting said one end of said cylinder to said one reservoir, and in another position to connect said other reservoir and pneumatic

7

means to an exhaust, whereby operation of said hydraulic cylinder in either direction is controlled by said first and second control valves.

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5

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