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Barud et al.

[11] **3,896,704**

[45] **July 29, 1975**

[54] **OPERATIONAL TABLE FOR MEDICAL PURPOSES**

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[51] **Int. Cl.** **F15b 11/20**

[58] **Field of Search** 91/413; 137/636.4, 625.17; 269/325

[56] **References Cited**

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Assistant Examiner—Edward Look
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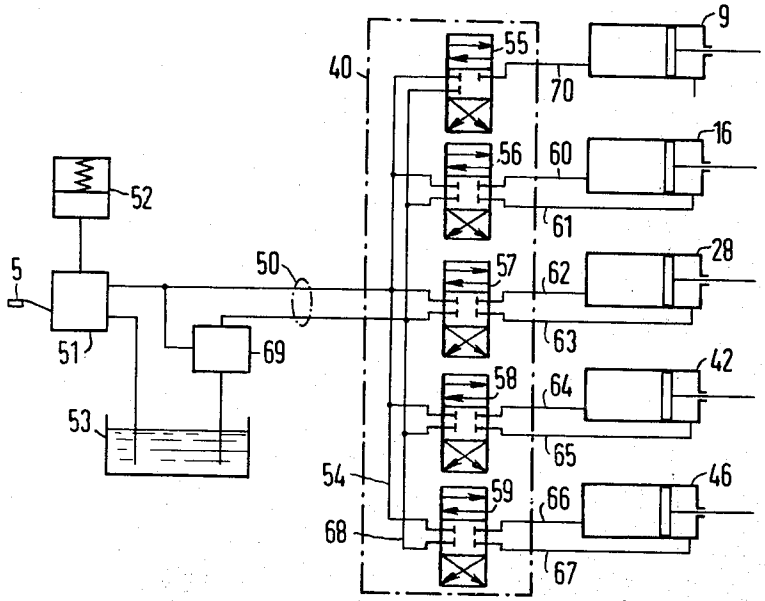
[57] **ABSTRACT**

An operational table for medical purposes has a number of elements movable independently from each other by a hydraulic system. The invention is particularly characterized by the provision of a central valve operating unit having a plurality of valves which can be selectively consecutively actuated by a single central lever in such manner that they produce a hydraulic connection between operating cylinders working with them and the pressure producing system, the cross-section of which depends upon the angular position of the lever. The valve operating unit and the pressure producing system are component parts of the apparatus. Pressure is produced by mechanical energy delivered from the outside.

4 Claims, 6 Drawing Figures



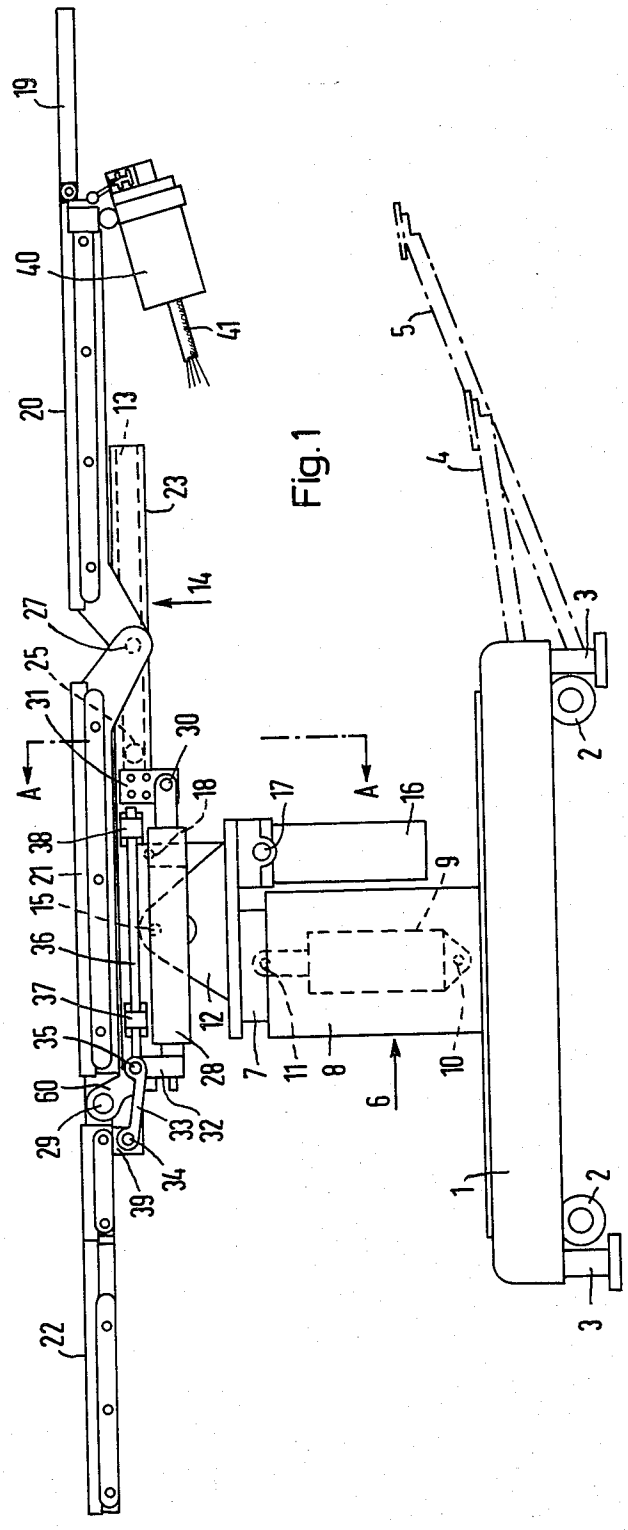


Fig. 1

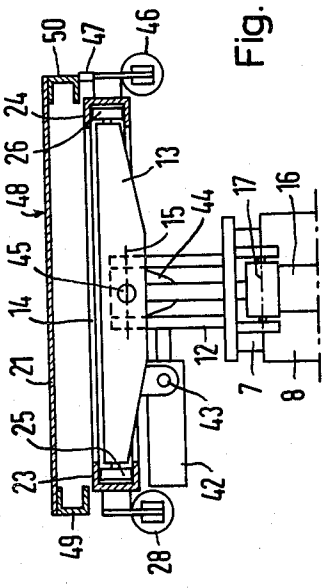
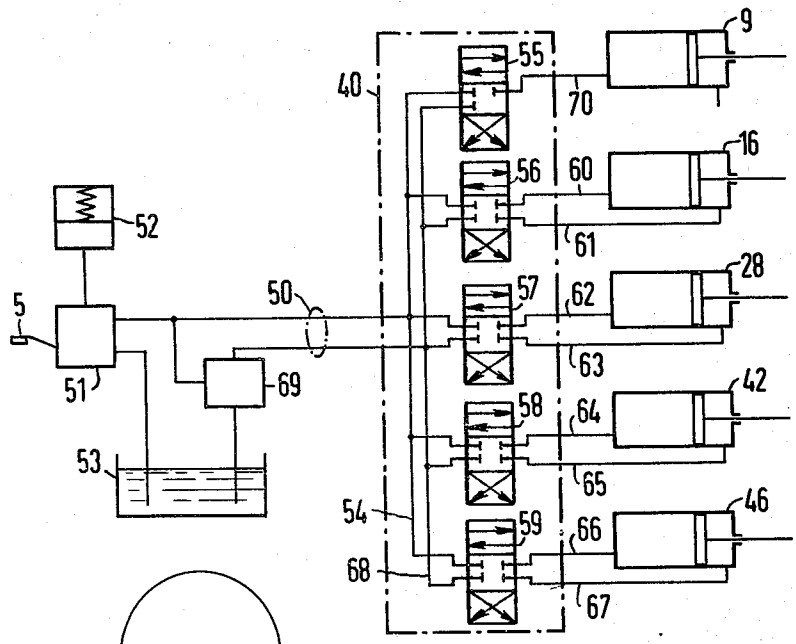


Fig. 2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66
67
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69
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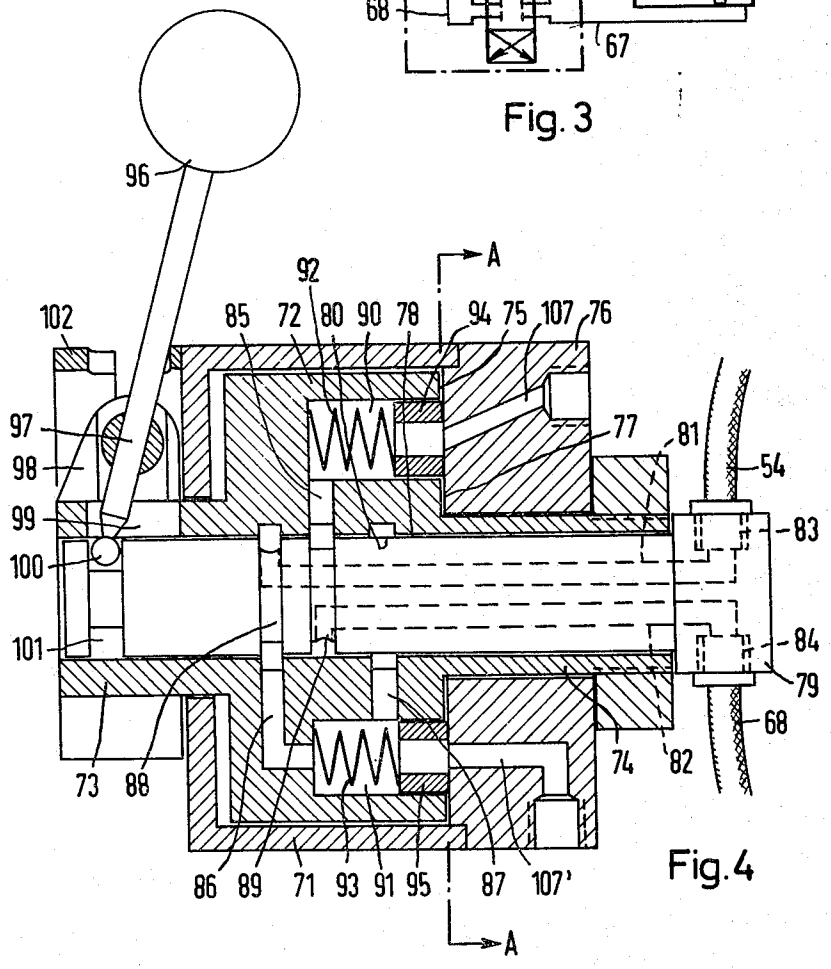
54
68

Fig. 3


96
A
92
102
85
72
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90
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94
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107
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101
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88
74
82
86
89
71
93
91
95
87
107'
A

Fig. 4

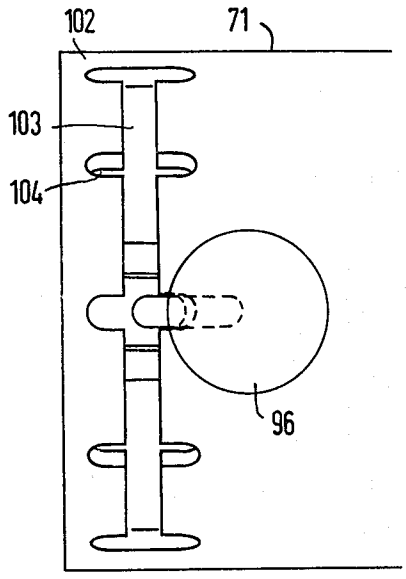
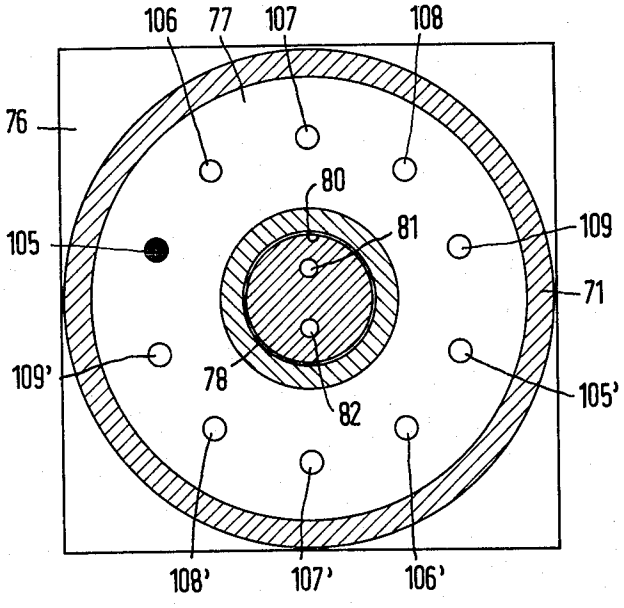

102
71
103
104
96

Fig.5


106
77
107
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76
80
81
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109
71
109'
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82
105'
108'
107'
106'

Fig.6

OPERATIONAL TABLE FOR MEDICAL PURPOSES

BACKGROUND OF THE INVENTION

This invention relates to an operational table for medical purposes having a number of elements movable independently from each other by a hydraulic system.

Modern operational tables for medical purposes consist of a supporting foot and a patient supporting plate which is mostly provided with hydraulic means for height adjusting relatively to the foot and for tipping it in the longitudinal and transverse direction of the table. Furthermore, the supporting plate can be divided into several elements which can be adjusted relatively to each other.

U.S. Pat. No. 3,281,141 describes an operational table of this type, the table plate of which has a plurality of elements hydraulically movable relatively to each other and to the supporting foot, which can be set by hydraulic operational cylinders. Hydraulic driving means used for the operation of the cylinders receive the required operational pressure from a pump driven by an electric motor. An operating unit connects by pressure keys for the desired time period the actuated operating cylinder or simultaneously several such cylinders with the pressure source.

A drawback of this known table consists in that the movements of the elements can be carried out only with a single speed. This speed is either too great to be able to change with sufficient fineness the body location of a patient during the operation, or too slow to be able to carry out a quick change in location from case to case. Another drawback is that the possibilities of a change in the location of the operating table are very limited since due to the danger of explosion of the narcotic gas located in the operating room the wire connections of the electric motor and the pump and the electrical switching elements must be connected to a cable and placed in an adjacent room. A further drawback consists in that when a change in location is necessary during an operation it is difficult to find a pressure key corresponding to the required element which is to be moved.

In other known hydraulically movable operational tables electrical circuits are used for the operation of the valves. However, the use of electrical circuits in an operational room has the drawback that the electrical contacts must be very thoroughly enclosed due to the danger of explosion. Such protective covers are expensive. Furthermore, their use does not safely eliminate the danger of explosion, but merely reduces it.

An object of the present invention is to produce a small compact operational table which can be easily moved from place to place and is independent from electrical energy in an adjacent room, so that it can be used for ambulance treatments in several specific rooms and also can be used on the location of an accident if a quick installation of an auxiliary operational room on that location is desired. Such a table must not be subject to disturbances and must be easily operated. For example, it must have an operating unit for the elements of the supporting table provided with an actuating member which can be used for the element to be actuated without a lengthy visual searching. Furthermore, the table must be absolutely safe from explosions, since air supply possibilities are very limited in auxiliary operational rooms.

SUMMARY OF THE INVENTION

In the accomplishment of the objectives of the present invention it was found desirable to provide a central valve operating unit having a plurality of valves which can be selectively consecutively actuated by a single central lever in such manner that they produce a hydraulic connection between operating cylinders working with them and the pressure producing system, the cross-section of which depends upon the angular position of the lever. The valve operating unit and the pressure producing system are component parts of the apparatus. Pressure is produced by mechanical energy delivered from the outside.

According to a preferred embodiment of the present invention pressure is produced by actuating a foot pedal connected with the pump of the pressure producing system. This produces a small compact movable operational table which does not have an electric motor and thus no current conducting cables. Due to the absence of an electrical system the danger of an explosion is eliminated.

The invention will appear more clearly from the following detailed description when taken in connection with the accompanying drawings showing by way of example only, a preferred embodiment of the inventive idea.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a side view of an operational table having the features of the present invention.

FIG. 2 is a partial section along the line A—A of FIG. 1 looking in the direction of the arrows.

FIG. 3 is a circuit diagram of the operational system.

FIG. 4 is a section through the valve operating unit.

FIG. 5 is a partial view showing the guides for the operating lever.

FIG. 6 is a section along the line A—A of FIG. 4 looking in the direction of the arrows.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The operational table shown in FIG. 1 has a foot base 1 provided with rollers 2 used in the known manner for moving the table. The base 1 also has stops 3 which can be operated by the pedal 4 for holding the table at a specific location. An additional foot pedal 5 operates a hydraulic pump indicated by the numeral 51 in FIG. 3.

The foot base 1 has a telescopic column 6 consisting of an inner casing 7 which can be moved piston-like in the outer casing 8. The relative movement of the inner casing 7 to the outer casing 8 is provided by an operating cylinder 9 which carries out the height setting of the telescopic column 6. The cylinder is connected with the outer casing 8 by a pin 10 and its piston is connected with the inner casing by a pin 11. The telescopic column 6 is connected by supports 12 with the frame 13 which is a part of the patient carrying frame 14 rotatably mounted in the axle 15. The operating cylinder 16 which carries out the swinging movement of the frame 14 relatively to the axis 15, is connected by the cylinder by the pin 17 to the telescoping column 6 and by its piston by the pin 18 with the frame 13. In the illustrated embodiment the patient supporting plate has four elements, namely, the head support 19, the back

plate 20, the seat plate 21 and the leg plate 22, whereby the three last-mentioned parts are located upon the supporting frame 14. The supporting frame 14 consists of two parallel profiled beams 23 and 24 which are supported by rollers 25 and 26 mounted upon the frame 13 so that the beams can be shifted relatively to the frame.

The back plate 20 is rotatably connected with the seat plate 21 by the axle 27. When the seat plate 21 is raised, the side of the back plate 20 directed to the feet is also raised, whereby the head support of the back plate 20, which is not fixed, slides upon the profiled beams 23, 24.

The working cylinder 28 is used to set the leg plate 22 which is rotatably mounted upon the axle 29. The cylinder 28 is connected with the beam 23 in that its piston is supported by pin 30 on a flap 31 connected to the beam 23 and that the cylinder itself is supported by the flap 32 in a bearing pivot 35. The piston rod of the cylinder 28 thus can actuate the leg plate 22 through the flap 32 and the lever 33 which is rotatably mounted in bearing pivots 34 and 35, so that the leg plate 22 can rotate about its axle 29. The bearing pivot 35 is connected with the guiding rod 36 which slides in bearings 37 and 38 provided in the profiled beam 23. The bearing pivot 34 is connected with the ring 39 which is fixed to the leg plate 22. The shifting of the frame 13 relative to the profiled beams 23 and 24 can take place by a coil device (not shown), whereby the female thread is provided at the frame 13 and the threaded rod with the corresponding actuating handle is arranged at the profiled beam 23. Obviously it is also possible to use a further operating cylinder for this purpose.

The valve operating unit 40 located at the back plate 20 is connected by a cable 41 shown diagrammatically and consisting of a bundle of hydraulic conduits, with the foot base 1, the pump 51 (FIG. 3) and the various working cylinders 9, 16, 28, 42, 46. The last-mentioned cylinders 42 and 46 are better indicated in FIG. 2.

According to FIG. 2 the cylinder part of the working cylinder 42 is fixed to the pivot 43 and its piston is fixed to the flap 44 of the frame 13. When the piston rod of the working cylinder 42 is shifted, the frame 13 is rotated about the axle 45, so that the patient carrying plate is tipped sidewise.

The profiled beam 24 carries the working cylinder 46 the piston rod of which is pivotally connected by the lever 47 with the leg side of the seat plate 21. The leg side of the seat plate 21 is rotatably mounted on the lever 33 (FIG. 1). The levers 33 and 47 are connected with separate profiled beams 23 and 24. When the piston rod of the working cylinder 46 is moved toward the head side of the patient supporting plate 19 to 22, the seat plate 21 will be rotated about the axle 29 (FIG. 1) and the back side of the seat plate 21 will be raised in relation to the profiled beams 23 and 24.

The supporting surfaces 48 of all elements 19, 20, 21 and 22 of the patient supporting plate consist of a material transparent to X-rays and are fixed to two other profiled beams 49 and 50. A carriage or some other suitable device with an X-ray photographing device can be pushed into the free space under the supporting surfaces 48. By using a supporting surface 48 transparent to X-rays, the operational table can be used for surgical operations under X-ray control. Since the supporting frame 14 is movable relative to the frame 13, it is possible to examine those body parts which are located over the foot base 1 or over the telescopic column 6 located close to it, and which thus normally would not be available for X-ray control. In the described operational table the number of adjustable sections and the number of used operational cylinders can be greater or smaller when using the described functional principle.

FIG. 3 shows a device comprising an oil pump 51 which is connected with a Durck storer 52. It is assumed here that the hydraulic means consist of oil, although any other hydraulic liquid can be used. Oil comes from a container 53 and flows from the pump 51 to a collecting tubular conduit 54 which feeds all valves belonging to the valve operating unit 40. The device shown in FIG. 3 has five operating valves 55 to 59. Each operating valve actuates a working cylinder. To the valve 55 belongs the working cylinder 9, to the valve 56 the working cylinder 16, to the valve 57 the working cylinder 28, to the valve 58 the working cylinder 42 and to the valve 59 the working cylinder 46.

The working cylinders 16, 28, 42 and 46 with their operating valves are connected by conduits bundled in the cable 50, whereby one of the two sides of the operating cylinder is connected to its valve, namely, the operating cylinder 16 and the valve 56 are connected by conduits 60 and 61; the operating cylinder 28 and the valve 57 by conduits 62 and 63; the operating cylinder 42 and the valve 58 by conduits 64 and 65 and finally the operating cylinder 46 and valve 59 by conduits 66 and 67. Due to the fact that oil through the respective valve goes into the conduit which extends to the first side of the operating cylinder, thus through the conduit 60 from the valve 56 to the operating cylinder 16, the piston belonging to the operating cylinder 16 with its piston rod is moved in a first direction wherein the piston rod causes a tipping movement of the patient supporting plate 19 to 22 (FIG. 1) of the operating table. Oil located upon the other side of the piston in the operating cylinder 16 is then pressed out of the cylinder 16. This takes place through the conduit 61 for the operating piston. The same procedure takes place with other working cylinders. Oil returned from the working cylinders 16, 28, 42 and 46 through the valves 56 to 59 is collected in the return tube 68 and flows to an overpressure valve 69. The valve 69 remains closed until oil from the pump 51 has reached a predetermined pressure. When this pressure is reached the valve 69 opens and allows the passage of oil which can flow back to the container 53. This stabilizes the movements of the pistons. The pump 51 naturally must produce a pressure which is greater than the opening pressure of the valve 69.

The working cylinder 9 connected with the valve 55 has a supply conduit 70 only upon its first side, while the space upon the other side of the piston which is not filled with oil is in direct connection with the surrounding atmosphere. The reason for this is that the working cylinder 9 is only used to raise the patient supporting plate 19 to 22. A supply of oil to the other side of the working cylinder 9 would have had no purpose since the piston rod and the piston are always loaded by the weight of the patient supporting plate.

The valves 56 to 59 are four-way valves with three positions while the valve 55 is a three-way valve with three positions. In the four-way valves 56 to 59 oil flows in a first position, for example of the valve 56, from the tubular conduit 54 through the valve 56 and the conduit 60 to the first side of the working cylinder 16, causing a movement of the piston and the piston rod.

Oil in the other cylinder space of the working cylinder **16** flows through the tubular conduit **61** and the valve **56** back to the container **53** through the tubular conduit **68** and the overpressure valve **69.** When the valve **56** reaches its second position which can be indicated as an intermediate position, all connections are closed. The result is that the piston of the working cylinder **16** remains in the position which it assumed when the valve **56** was in its first position. When then the valve **56** reaches its third position the connections are crossed and oil flows from the conduit **54** through the valve **56** and the conduit **61** to the second side of the working cylinder **16,** while oil in the first cylindrical space of the cylinder **16** flows through the conduit **60** and the valve **56** to the conduit **68** and through the valve **69** back to the container **53.**

The construction and working of the operating unit **40** will be now described in greater detail on the basis of FIGS. **4, 5** and **6.** As shown in FIG. **4,** the operation unit **40** has a valve casing **71** with a dividing member **72** located in the casing, which is ring-shaped and has projecting tubular shoulders **73** and **74.** The working surface **75** constitutes the front bottom surface of the dividing member **72** and is preferably a flat rotational surface. In the flange **76** of the valve casing **71** there are several oil channels which will be described later on and which are used to connect by an outwardly located connecting cable **41** the operating unit **40** with the working cylinders **9, 16, 28, 42** and **46.** The oil channels open in the operating unit **40** at the inwardly directed working surface **77** of the casing flange **76,** which is opposed to the working surface **75.**

In the cylindrical channel of the dividing member **72** which extends through tubular extensions **73** and **74** and also forms a working surface **78,** is located a round guiding pin **79** which is axially movable relative to the dividing member **72** and the valve casing **71** and which has a cylindrical working surface **80** cooperating with the working surface **78** of the dividing member **72.** The guiding pin **79** has two axial channels **81** and **82** extending through the pin, whereby the channel **81** is provided for the supply of oil from the pump **51** (FIG. **3**) and the channel **82** is used for the removal of oil from all working cylinders **9, 16, 28** and **46** into the return pipe indicated by the numeral **68** in FIG. **3.** The channels **81** and **82** extend over a large part of the longitudinal extension of the guiding pin **79** and open on the right side of the pin **79** into channel sections **83** and **84** extending radially outwardly to the outer surface of the pin **79** and terminating at this outer surface. To these sections which have the shape of connecting nipples, are attached flexible tubes of the connecting cable **50** for the supply and removal of oil. It is also possible to make the sections **82** and **84** axially shiftable for the supply and removal of oil and provide them with suitable parts for cooperation with a stationary connecting member (not shown) which would tightly connect with a cylindrical opening the right side of the guiding pin **79.**

The axial channels **81** and **82** provided in the pin **79** open into grooves **88** and **89** provided in the peripheral working surface of the guiding pin **79.** These grooves have such axial positions that when the pin **79** is placed in its left outer position, the groove **89** is located precisely opposite the opening into the pin, the channel extension **85** of the channel **90** is located at the working surface of the dividing member **72** and at the same time the groove **88** is located in front of the opening directed to the extension **86** of the channel **91** at the operating surface **78** of the dividing member **72.** When the pin **79** is placed into its outer right position by means which will be described later on, the groove **89** will be located axially precisely in front of the opening of the channel extension **87** of the channel **91** at the working surface **78,** and the groove **88** will be located precisely before the opening of the channel extension **85** at the working surface **78.**

As shown in FIG. **4,** when the pin **79** is located in the illustrated outer left position, oil flows from the pressure means connection **83** through the pin channel **81,** the peripheral groove **88,** the side channel **86** and through the channel **91** into the dividing member **72,** and also through the flow channel **107'** located in the flange **76** of the valve casing **71,** and from this channel through a connecting hose (not shown) of the connecting cable **41** to one side of the selected working cylinder. The piston in this selected working cylinder will be thus moved. Oil upon the other side of the piston will flow through a hose of the connecting cable **41** to the flow channel **107** of the casing part **76.** The returning oil will flow through the channel **90** and the channel branch **85** of the dividing member **72,** the groove **89** and the pin channel **82** to the pressure connection **84** and through the return conduit **68** as well as the overpressure valve **69** to the container **53** (FIG. **3**). When the guiding pin **79** is located in its outer right position, pressure oil flows from the pressure connection **83** through the pin channel **81,** the groove **88** and the channels **85, 90** and **107** to the other side of this selected working cylinder. Then the piston in this working cylinder will move in the opposite direction. Returning oil will flow through the connection to the channel **107'** and through the channel **91** of the channel extension **87,** the groove **89** and the channel **82** to the pressure connection **84** and thence to the return conduit **68** and through the valve **69** to the container **53** (FIG. **3**).

When the guiding pin **79** is located in its intermediate position between the two above-indicated extreme positions, the grooves **88** and **89** are not connected with any of the side channels **85, 86** or **87.** The piston of the selected working cylinder is then closed in its existing position. To reach the desired location the guiding pin **79** is held in its right or left outer position until the piston of the selected working cylinder has reached a position which corresponds to the desired position of the specific table element. A smaller setting speed can be obtained if the guiding pin **79** is moved to a position which is different from the extreme end positions, so that the grooves **88** and **89** will only partially cover the openings of the side channels **85, 86** and **87.** Then the oil flow to and from the selected working cylinder will be choked. The result is that the pistons will be moved more slowly. In this manner it is possible to provide changes in speed of movements of the various elements during their operation.

To prevent the outflow of oil into the valve operating unit **40,** sealing sleeves **94** and **95** tensioned by springs **92, 93** are located in channels **90** and **91** to provide a seal for the working surface **77** of the casing part **76.**

To actuate the guiding pin **79** in the axial direction and to make possible the rotation of the dividing member **72** a lever **96** is provided which is rotatable about an axle **97** extending at right angles to the geometrical

longitudinal axis of the pin 79. The axle 97 is located in the socket 98 upon a cylindrical tubular projection 72 of the dividing member 72 which extends out of the valve casing 71. A cutout 99 is located between the socket 98 and the projection 73, through which the lever 96 extends out of the axle 97 in the direction toward the guiding pin 79. The lever 96 terminates in a ball 100 which lies in the peripheral groove 101 provided in the guiding pin 79. When the lever 96 is rotated in the plane of the drawing about the axle 97, the guiding pin 79 is shifted axially in the cylindrical opening of the dividing member 72. A swinging of the lever 96 at right angles to the plane of the drawing causes a rotation of the dividing element 72 through the location of the lever 96 in the socket 98 firmly connected with the dividing element 72; the dividing element is rotated about the guiding pin 79 in the valve casing 71 and thus causes the placing of flow channels 90 and 91 precisely in front of the desired pair of channels, for example the channel pair 107 and 107' in the casing flange 76 for the connection of the corresponding working cylinder, in this case the cylinder 16. The valve casing 71 can be provided directly at the lever 96 with markings which indicate which working cylinder has been switched on, when the lever 96 is located in a specific position. The valve operating unit 40 is preferably so constructed that a swinging of the dividing member 72 by the lever 96 can only take place when the lever is in the middle position, this being the case when the grooves 88 and 89 of the guiding pin 79 are not located in front of any channel extension 85, 86, 87. Due to this arrangement the position of a piston of a working cylinder remains unchanged when the piston of another working cylinder is operated. As shown in FIG. 5 this locking is produced in that the lever 96 is guided in its comb-like stencil 102 having a longitudinal slit 103 extending in the middle location of the lever in radial swinging plane, for the guiding of the lever 96 in radial direction. Transverse slots 104 for the guiding of the lever in axial direction extend symmetrically on both sides of longitudinal slot 103 in axial swinging plane at a distance corresponding to the rotary angle for the selection of working cylinders 9, 16, 28, 42, 46. Due to this locking the lever 96 is swingable about the rotary axis of the pin 96 only when it assumes a position in which its grooves 88 and 89 have no connection with the channel openings.

FIG. 6 shows five pairs of flow channels 105, 105' to 109, 109' in the casing flange 76 of the valve casing 71. The channel pairs 105, 105' to 109, 109' are located upon a circle the center of which coincides with that of the ring-shaped dividing member 72 which is also located in the cylindrical hollow space of the valve casing 71. Each of the five pairs of channels 105, 105' to 109, 109' is provided with a valve. The channel pair 105, 105' has the valve 55, the channel pair 106, 106' the valve 56, the channel pair 107, 107' the valve 57, the channel pair 108, 108' the valve 58 and the channel pair 109, 109' the valve 59.

The channel pairs 106, 106' to 109, 109' are connected in pairs to their working cylinder. The pair of channels 107, 107' is connected each with one side of the operating cylinder 16 (FIG. 1) and the pair of channels 108, 108' with the other side of the working cylinder 28. By rotating the dividing member 72 about an angle located between two adjacent channels a new working position is provided, namely, a working cylinder pertaining to the newly selected pair of channels is actuated. In the illustrated example the angle between two adjacent pairs of channels amounts to 36°. Thus a rotation of the dividing member 72 about an angle of 36° is necessary to provide a transmission between two adjacent working positions. The channel 105 of the channel pair 105, 105' of the working cylinder 9, which should have been in connection with the other side of this working cylinder, is closed since the second side of the working cylinder 9 must be in direct connection with the surrounding atmosphere.

The illustrated construction provides that the channels in the casing flange 76, — with the exception of the pair of channels 105, 105', — have a double directed setting and permit the supply of pressure means to separate working cylinders or working cylinder groups.

The described and illustrated actuating unit 40 with only one axially movable pin 79 or a slide and a rotatable dividing member 72 is very simple in its construction as compared to heretofore known operating units for setting a plurality of hydraulic operating cylinders. To produce the desired four-way valve operation and a central position the used parts must consist of a separate slide for each working cylinder or a group of working cylinders. Furthermore, the operation of the actuating device of the present invention is simple since the lever 96 makes possible the setting of a desired operating cylinder and also the setting of the desired position of the piston of the operating cylinder.

What is claimed is:

1. An operational table for medical purposes, having a hydraulic operating system, said operating system having a pressure-producing device comprising a pump, a foot pedal actuating said pump and a central valve actuating unit comprising a valve casing having the shape of a hollow cylinder, a dividing member located piston-like in said casing and rotatable about the axis of said casing, a tubular outwardly extending shoulder carried by said dividing member, a cylindrical flange fixed to said casing upon the side opposed to said shoulder, said dividing member and said flange having concentrical passages, an axially movable pin extending through said passages, said flange having an inwardly radially extending working surface, a plurality of working cylinders having flow channels, said flow channels opening in pairs into said working surface and being uniformly divided over its circumference, said dividing member also having a radial working surface extending toward the first-mentioned working surface and sealed relatively thereto, means forming the other flow channels opening into the second-mentioned working surfaces, the openings of said other flow channels being alined with a pair of the first-mentioned flow channels, one of said other flow channels having a channel extension opening into one of said passages, the other one of said other flow channels having a fork-like extension with two side channels, said side channels extending at equal distances from and on opposite sides of said channel extension and opening into one of said passages, said pin having two grooves surrounding the pin and spaced at a distance corresponding to two openings, said pin also having two axial channels communicating with said grooves and extending to an outwardly projecting part of said pin, pressure means connection for the supply and withdrawal of pressure means, said axial channels being connected with said pressure means connection, an axially swingable lever

mounted upon the tubular shoulder of the dividing member, said lever swinging said dividing member relatively to said casing about a common axis of symmetry, and means pivotally connecting said lever with said pin and transmitting the axial movement of said lever to make the axial movement of said pin equal to the distance between the two axial channels of the pin, whereby, in the two end positions of said lever, the pressure means connection is crosswise connected with said other flow channels.

2. An operational table according to claim **1,** wherein said lever has readable markings indicating lever locations corresponding to individual operating cylinders.

3. An operational table according to claim **2,** wherein the axial distance of the grooves carried by the pin is at least equal to twice the width of the grooves, whereby the pin has a central position without connections, and a locking device connected with said lever and permitting a rotation of the pin about its axis only when it is in the central position.

4. An operational table according to claim **3,** comprising a comb-like sheet, said lever being guided in said sheet, said sheet having a longitudinal slit extending in the central position of said lever in radial swinging plane, said slit guiding said lever radially, said sheet also having transverse slits extending symmetrically on both sides of the longitudinal slit in the axial swinging plane, said transverse slits being located at a distance corresponding to the angles required for the selection of operating cylinders and guiding said lever axially.

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