

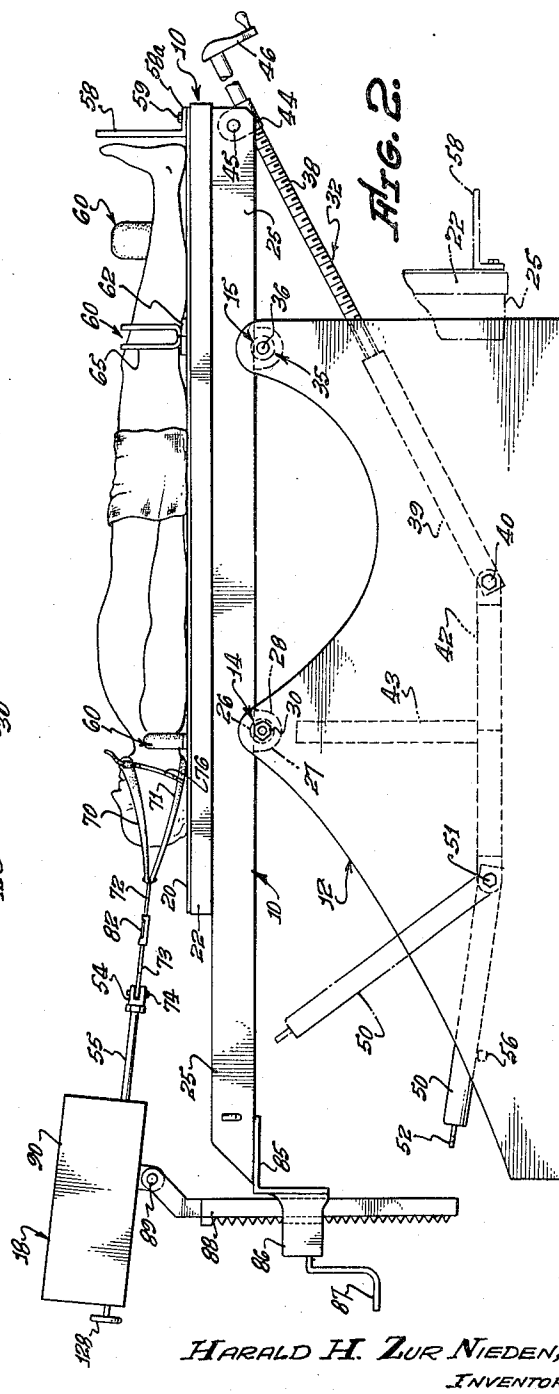
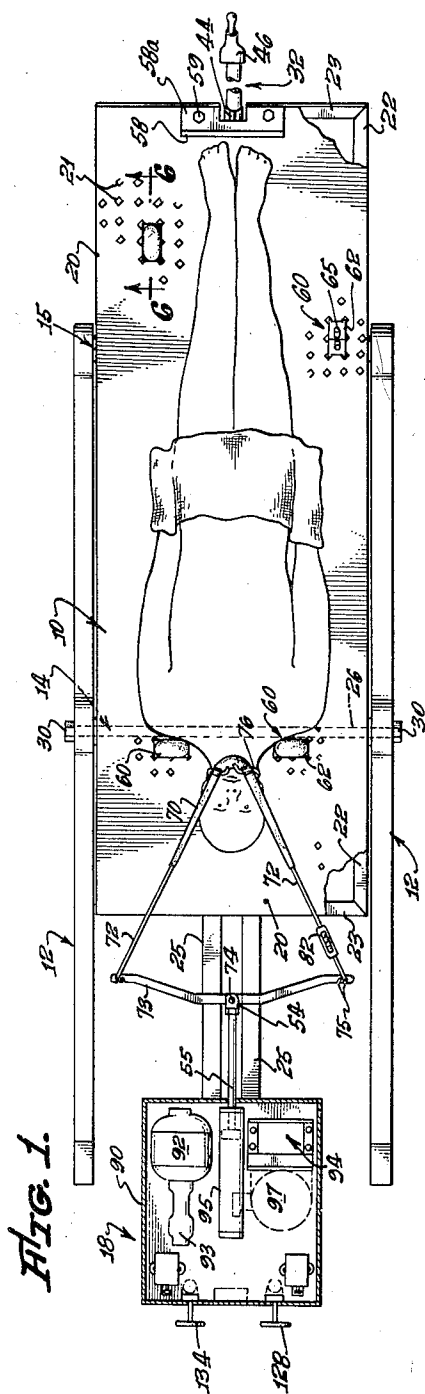
Dec. 11, 1956

H. H. ZUR NIEDEN
HYDRAULICALLY ACTUATED INTERMITTENT DRIVE
IN PHYSICAL THERAPY APPARATUS

2,773,499

Filed Jan. 27, 1955

3 Sheets-Sheet 1



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FIG. 6.

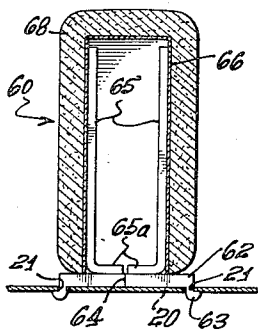


FIG. 4.

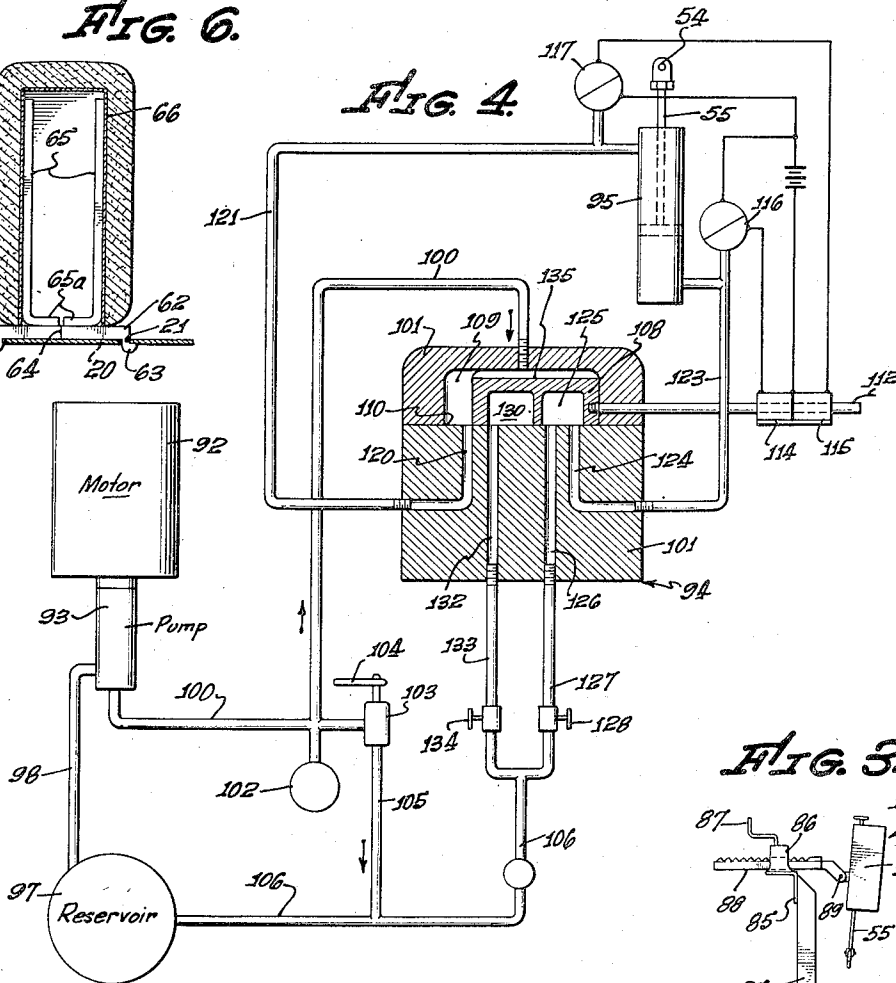


FIG. 3.

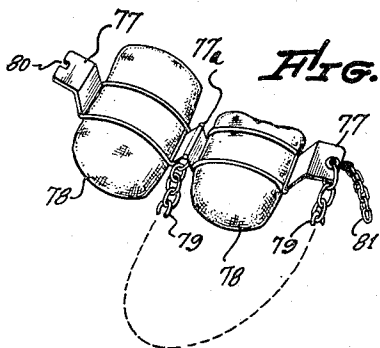
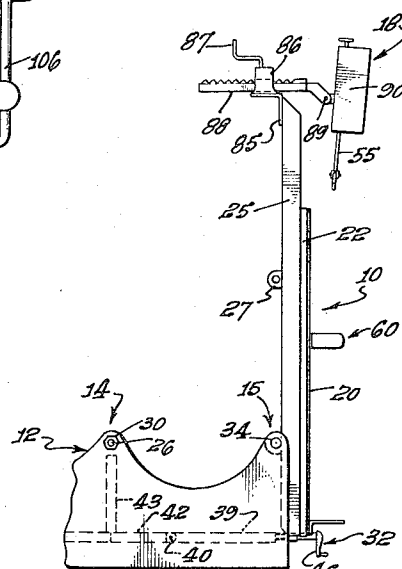


FIG. 5.

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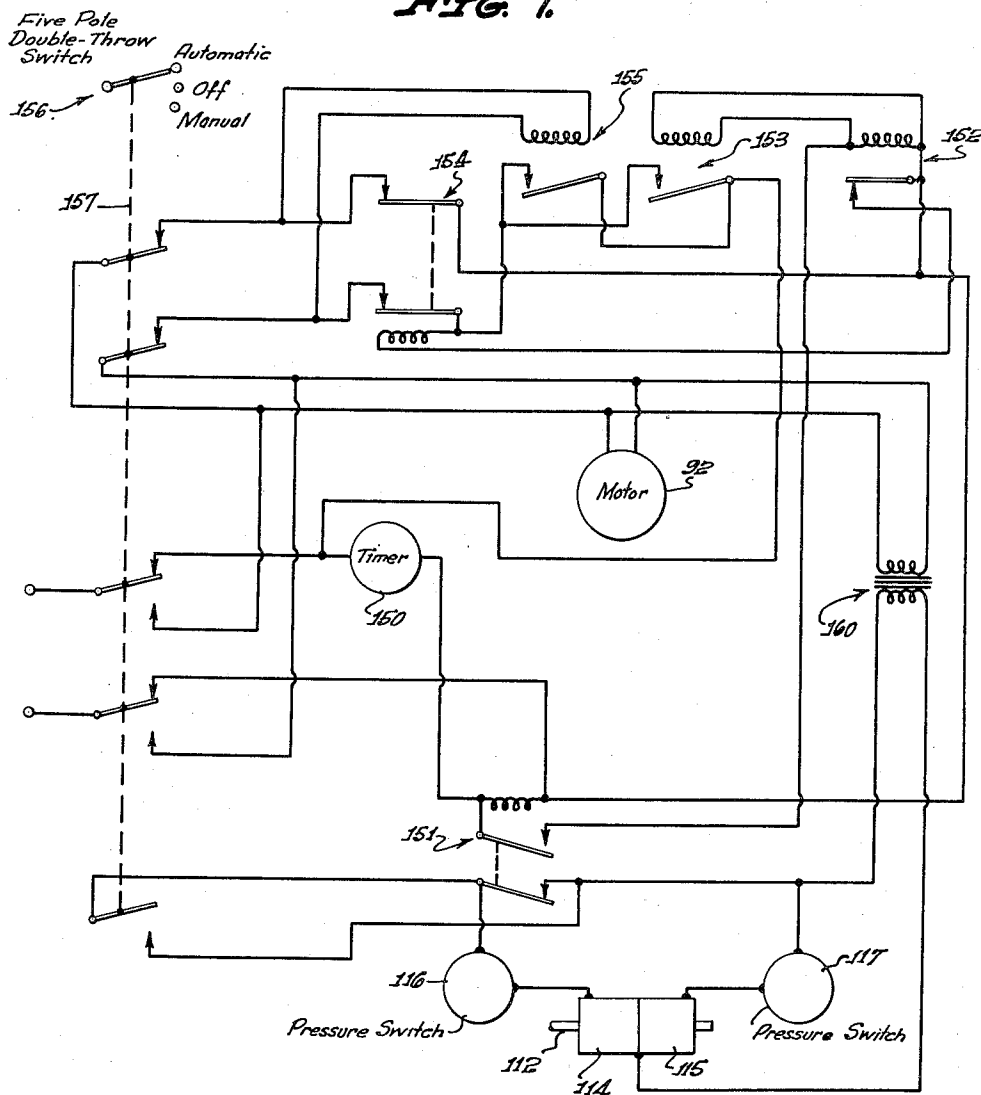
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Fig. 7.



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2,773,499

**HYDRAULICALLY ACTUATED INTERMITTENT
DRIVE IN PHYSICAL THERAPY APPARATUS**

Harald H. zur Nieden, South Pasadena, Calif.

Application January 27, 1955, Serial No. 484,476

2 Claims. (Cl. 128—75)

This invention relates to equipment for use in physical therapy, and more particularly to table-like structures having means for producing rhythmic movements for stretching, flexing and loosening of muscles, joints, and the like in the practice of orthopedic physicians and surgeons, physiotherapists, osteopaths and hospitals.

A principal object of this invention is to provide equipment for manipulating various portions of the body of a patient, such equipment, which may be used on a table or like, possessing relatively simple means for readily controlling rhythmically produced movements to treat the patient, such table or the like, if desired, also containing simple means for adjusting its position and for properly locating the patient thereon.

Another object of the invention is to provide apparatus of the indicated nature which is relatively simple and easy to operate.

An additional object of the invention is to provide equipment of the indicated nature which is readily installable in offices, schools, sanitariums, hospitals and the like for the treatment of patients as indicated, and which may be produced comparatively inexpensively, while being easy to position and control, and also being durable and retaining its efficiency over long periods of time.

A still further object is to provide a therapy table which may be adjusted when required to a strictly vertical position so that the patient may be disposed upon his feet for certain types of treatment or manipulation of the body when required.

Another object is to provide a therapy unit which may be used as a rocking table or rocking bed for certain types of treatment.

A further object is to provide a therapy unit with an easily detachable drive unit arranged in such a manner that the drive unit can be used with existing tables, beds, chairs, and the like, and, being small, is easily portable.

Other objects of the invention, together with various features thereof will become apparent to those skilled in the art upon reference to the following specification and the accompanying drawings wherein certain embodiments of the invention are illustrated.

In the drawings:

Fig. 1 is a plan view showing apparatus of the present invention in the form of a suitably mounted table structure associated with appropriate equipment having convenient controls;

Fig. 2 is a side elevation of the equipment illustrated in Fig. 1;

Fig. 3 is a side elevation of the equipment of Fig. 2 showing the table in an upright position when mounted on its forward pivot;

Fig. 4 is a diagrammatic view of the valve means and associated equipment controlling the required movements and capable of producing the mentioned rhythmic movements;

Fig. 5 illustrates one type of pad structure which may be employed to position the patient's feet;

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Fig. 6 is in part a large scale vertical section showing one of the padded body-positioning devices as indicated by the line 6—6 of Fig. 1; and

Fig. 7 is a diagrammatic showing of the circuits involved.

The present apparatus includes an adjustable table generally indicated at 10 to receive the patient, an appropriate support generally indicated at 12 on which at a middle position the table 10 may be pivoted on an underlying pivot as indicated at 14, or at one end of which the table may be selectively pivoted as generally indicated at 15, there being also controlled mechanism generally indicated at 18 for applying rhythmic movements to the patient or to the table as required.

The table includes a perforated sheet metal top 20, upon which the patient is to be supported, with or without padding, the perforations 21 also serving for reception of appropriate patient-positioning means presently to be described. The table structure indicated comprises a rectangular framework formed from suitable side rails 22 and end rails 23 rigidly connected together at their ends and having the edge portions of the sheet steel top 20 secured thereto. Extending longitudinally of the under side of the framework 22, 23 and along the middle portion of the table 10 there are provided longitudinal main supporting rails 25 spaced somewhat from the median axis of the table on the opposite sides thereof, the rearward ends of these rails 25 supporting the control unit 18. The end rails 23 of the table are fixed upon the longitudinal rails 25, and a transverse pivot shaft 26 is secured to the under faces of intermediate portions of the longitudinal rails 25, end portions of this pivot shaft 26 being carried in brackets 27 on the side rails 22 (or the main rails 25) and extending through into bearings 28 provided in upper portions of the respective side walls of the standard or support 12 providing the mounting 14 for the table 10. The outer ends of the pivot shaft 26 may be retained as by means of nuts 30 lying outside of the respective upstanding walls of the standard or support 12. By such a mounting the whole table structure 10 may be adjusted about the mounting 14 as a pivot point, this being accomplished through the medium of a telescopic jackscrew or crank structure 32, whereby the inclination of the table 10 may be at any such degree as desired. Or, should it be desired to pivot the table 10 near its forward end at the previously mentioned mounting 15, so that it may be moved into a vertical position such as partly indicated in dotted lines at the lower right corner of Fig. 2 and in Fig. 3, a pivot shaft 34 may be introduced into a hole 35 in the side walls of the standard 12 at the mounting position 15 and passed through brackets 36 carried by the longitudinal rails 25 and similar to the brackets 28 which carry the pivot shaft 26. The pivot shaft 26 at the middle portion of the table would then be withdrawn so that adjustment by the telescopic crank mechanism 32 may be effected. The mechanism 32 includes a conventional externally threaded crank shaft 38 telescoping into an internally threaded sleeve 38 which is pivoted at 40 to a forward edge of a positioning platform 42 between the side walls of the standard 12 and cooperating with an upstanding positioning wall 43 to space and position the upright walls of the standard 12 in the relationship illustrated. The forward end of the threaded shaft 38 rotates in a conventional bracket 44 which constitutes a bearing preventing longitudinal movement of the shaft 38 therein, this bracket being pivoted at 45 between the adjacent ends of the rails 25. A crank handle 46 on the outer end of the shaft 38 provides means for turning the threaded shaft 38 into and out from the sleeve 39, so that the table is tiltably adjusted upon either the mounting 14 or the mounting 15 as desired.

The pivot 45 for the bearing bracket 44 is detachable,

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as may also be the pivot means 40 for the inner end of the threaded sleeve 39. By disconnecting the adjusting means 32 from the table 10, it is possible to connect the other end of the table 10, through the medium of the rhythmic, movement control means 18, with the respective end of the standard 12 so that the table may be given a continuous rocking movement upon the mounting 14 (or upon the mounting 15 as desired). For this purpose a suitable attachment rod or sleeve 50 has its lower and inner end pivotally connected at 51 to the rearward edge portion of the previously mentioned positioning platform 42 between the upright members of the standard 12. Its outer end provides an eye member 52 which is removably connectable to a clevis 54 mounted upon the outer end of a reciprocating rod 55 which extends forward from the control mechanism 18. With this arrangement the rod or sleeve 50 may be carried in a lowered inoperative position where it rests, for example, on a stop 56 or it may be raised into the broken line position and connected with the clevis 54 when required. By the indicated structures, the table 10 is mounted and arranged so that it may have a variety of positions and have a variety of movements imparted thereto, depending upon whether the forward end of the reciprocating rod 55 carrying the clevis 54 is attached to a harness to be connected with the patient, as presently to be described, or to the rod or sleeve 50, and whether the table is pivoted at the mounting 14, or at the mounting 15, or is rendered immovable by introducing both of the bearing shafts 26 and 34 above described.

In order to properly position the patient when the table 10 is tipped to the upright position of Fig. 3, a foot rest 58 is secured to the forward end of the table in any appropriate manner, such as through the medium of an offset flange portion 58a and screws or bolts 59 which anchor the plate and its flange to the corresponding cross rail 23 of the framework of the table, or by means of the mountings described in the following paragraph with respect to devices 60. Thus, the upright patient has a place upon which to stand.

Since important movements and influences to which patients are commonly subjected are often pulling movements, devices are provided for attachment to the perforated sheet metal table top 20, to be positioned with respect to various portions of the patient's body for resistance means as required. Such structures are shown on an enlarged scale in Fig. 6, where the showing is a vertical section, and on a small scale in Figs. 1 and 2 where the showings are in plan and in elevation, the devices being generally indicated at 60. As best indicated in Fig. 6, each of these devices is in the form of two opposed, substantially identical, upstanding elements, each of which includes a base or anchor plate 62 having anchoring tongues 63 depending therefrom at each end and projecting outward. These fingers or tongues 63 are respectively passed through adjacent openings 21 in the sheet metal top plate 20, their inner end portions being then swung downward into abutting relationship to form between them a contacting joint at 64. Thus the abutment joint 64 prevents the anchor plates 62 from moving toward each other and the tongues or fingers 63 prevent them from moving away from each other. Each anchor plate 62 has secured to the upper face thereof, as by welding, an upstanding rod member 65 whose integral lower portion 65a is welded in position. To retain the plates 62 and the upwardly extending rods 65 from swinging so as to become disengaged, a flattened metal sleeve 66 (which may be formed from a section of tubing or the like) is employed to pass down over the rods 65, the narrow dimension of such sleeve being, for example, a little greater than the diameter or thickness of the rods 65. In order to make the positioning member 60 comfortable to the patient, the sleeve 66 in each case is well padded by a flattened roll of padding material 68 which may be foam rubber or cotton wadding or the like suitably covered as with leather or plastic sheeting as deemed most

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suitable. As indicated in the plan view of Fig. 1, and also in the elevation of Fig. 2, these positioning members 60 are somewhat elongated when assembled and may be disposed either transversely of the metal table top 22 or longitudinally thereof whereby to engage sidewise against the patient's shoulders or lengthwise against his legs, or under his armpits when leg or back stretching is applied, or when the table is used as a standing table, the padding material 68 comfortably resisting pull or other straining or tensioning movements against corresponding portions of the patient's body.

A common treatment to which patients are commonly subjected upon tables of the indicated type involves a stretching of the neck by placing a harness under the wearer's chin and about the back of his head as indicated in Figs. 1 and 2, or a stretching of the legs and back by reversing the position of the patient indicated in Figs. 1 and 2 so that the harness mentioned or a variation thereof illustrated in Fig. 5 attached to the patient's ankles serves to produce the required pull. To stretch the patient's neck, as illustrated in Figs. 1 and 2, the cushioned positioning devices 60 are preferably positioned transversely so as to engage the patient's shoulders beside the neck. If the patient is to be reversed as above indicated, the cushioning devices are placed longitudinally as indicated at the opposite end of Fig. 1 and Fig. 2.

As seen in Figs. 1 and 2, such a harness for the head may include a chin strap 70 and a strap to the back of the head indicated at 71, the ends of each of the two straps being connected at each side to a common attachment strap 72, the opposite end of each attachment strap being connected in any suitable manner with a yoke 73 which is attached to the previously mentioned clevis 54 carried at the outer end of the reciprocating rod 55. A pivot pin 74 serves to mount the yoke 73, and notches 75 at the ends of the yoke 73 may receive the straps 72, or chains as later mentioned. There is also indicated a tie strap 76 at each side of the patient's head for retaining the chin strap 70 and the head strap 71 in operative relationship on the patient's head.

When it is desired to reverse the patient's position for connecting the harness with the feet, a pair of padded harnesses may be used. A typical harness for the left foot is shown in Fig. 5. This may include a pair of bowed metal straps 77 hingedly connected at 77a, provided with pads 78, and provided with an attachment chain 79 to be connected in any suitable manner with the clevis 54, as by passing one or more of the links of the chain over the yoke 73 where they are secured in notches 75 or by passing the pivot pin 74 through one of the lengths of the chain. The leg of the patient is secured between the two pads 78 by folding one part 77 up over the other part 77. Any suitable means may be employed for connecting the free ends of the bowed metal straps 77 together, such as a notch 80 in the end of one strap and a short chain 81 at the end of the other strap 77. With either form of harness, a scale or strain gage 82 shown in Figs. 1 and 2 may be used to indicate the pull of the control apparatus 18 now to be described. Such gage 82 may be installed in one of the pull lines 72 of the harness, in the form shown, such lines 72 being also used for the form of harness of Fig. 5, or the gage may be otherwise located in the means connecting the harness in Fig. 5 directly to the reciprocating rod 55, or by way of the yoke 73, if appropriate.

The control mechanism 18 is mounted on the rearward ends of the longitudinal mounting rails 25 through the medium of an angle bracket 85 welded to the under faces of the rearward ends of the rails 25, the vertical section of the bracket 85 carrying any standard or preferred head 86 for raising and lowering, as through the medium of a crank 87, a rack bar 88 which has a pivotal connection 89 with mounting means carried on the under side of a housing 90 which contains the actuating control mechanism for effecting the previously mentioned rhythmic movements required for stretching various portions of

the body of the patient, or rocking the table 10. The pivot connection 89 may include friction locking means to set the housing 90 and the reciprocating rod 55 at any preferred angular position either for pulling on a harness attached to the patient or for rocking the table 10 when the reciprocating rod 55 is connected with the positioning rod or sleeve 50, the elevation of the housing 90 being established as necessary through the actuation of the crank 87 in conjunction with the rack bar 88. By disconnection of the pivot 89 the control mechanism 18 can be used as a separate drive unit on existing beds, chairs, or operating or other tables. In this case the control mechanism 18 is preferably equipped with a handle for carrying and a bracket, such as a standard table clamp or similar device which engages with the pivot 89. It might also be preferable to make a disconnection possible between the bracket 85 and the rail 25, so that the feature of elevation of the housing 90 can be used in combination with the portable drive unit.

Referring both to Fig. 1 and Fig. 4, the housing 90 contains an electric motor 92 which operates a pump 93 for supplying fluid pressure by way of a slide valve unit 94 to a cylinder 95 containing a piston 96 which actuates the previously mentioned reciprocating piston rod 55 on which is mounted the clevis 54. A reservoir 97 receives spent hydraulic fluid (or other fluid) and serves as a supply for the pump 93, being connected thereto by a feed line 98.

A pressure line 100 leads from the pump 93 to the upper housing portion 101 of the slide valve assembly 94. Desirably a pressure gage 102 is connected with the line 100 as is a relief valve 103, which may be adjusted by a handle 104 and is connected by a by-pass 105 with a return line 106 leading back to the reservoir 97. To control fluid flow to the cylinder 95 for actuating the piston 96, a slide valve 108 is carried in a cavity 109 in the upper portion of the valve housing 101 and is slidable to and fro on a contact face 110 formed at the top of the lower section of the valve housing. Shift of the slide valve 108 is effected through the medium of a valve stem 112 which projects from the housing 101 and is actuable selectively by a solenoid 114 or a solenoid 115, the solenoid 114 being controlled by an electric pressure switch 116, and the solenoid 115 being controlled by an electric pressure switch 117, each of these switches being a conventional or preferred regulatable type of switch well known on the market.

When the slide valve 108 is in the position illustrated in Fig. 4, it uncovers a duct 120 in the lower portion of the valve housing which communicates with a pressure line 121 connected with the pressure switch 117 and leading to the fluid pressure cylinder 95 above the piston 96, the piston 96 being thus positively moved to its lower position for pulling the piston rod 55 back into the cylinder 95 and exerting pull upon the yoke 73 of Figs. 1 and 2 and the harness connected therewith and to the patient. When pressure applied by the pump 93 to the system builds up to a predetermined value within the cylinder 95 as determined by the setting of the relief valve handle 104 and/or the pressure switch 117, the latter is shifted by such pressure to complete a circuit which energizes the solenoid 115 and shifts the valve 108. Of course, during the interval in which the valve 108 is in the illustrated position and the piston 96 is descending, the pressure fluid is being exhausted from the under side of the piston 96 through a line 123 which communicates with a duct 124 in the lower portion of the valve housing 101 and vents through a small chamber 125 in the valve 108 to a discharge duct 126 leading by way of a line 127 to the return line 106 which returns the exhausted fluid to the reservoir 97. The line 127 is supplied with a valve 128 such as a needle valve which is adjustable to regulate the flow of fluid from the valve chamber 125 by way of the line 127 to the return line. In this manner the descent of the piston 96 and the speed of the pulling stroke of the piston rod 55 on the harness attached to the patient

are easily timed as required. Similarly the maximum pulling pressure is easily regulated by the setting of the relief valve handle 104 and/or the pressure switch 117.

When the solenoid 115 shifts the valve stem 112 and the valve 108 to the opposite side of the valve housing 101 from that shown, a second small chamber 130 in the under side of the valve 108 connects the pressure duct 120 and the pressure line 121 with a second venting duct 132 which leads to a discharge line 133 and past another needle valve 134 to the return line 106. At the same time fluid pressure in the main pressure supply line 100 is conducted, by way of a pressure fluid channel 135 at the top of the valve 108, through the duct 124 at the right of the valve assembly and thence to the line 123 connected with the pressure switch 116 and with the under side of the piston 96. Thus, the piston 96 and the reciprocating piston rod 55 are moved outward on the return stroke, thereby relieving tension on the harness attached to the patient; or, in the case of connection with the rod or sleeve 50 for rocking the table 10, as previously described, the rearward end of the table structure (which carries the control mechanism 18) is elevated in the respective phase of the rocking movement. Outward movement of the piston 96 thus continues until pressure built up thereunder in the cylinder 95 is such as to actuate the pressure switch 116 to energize the solenoid 114 at the completion of the return stroke or release stroke whereby to restore the slide valve 108 to its initial position so as to commence another pulling stroke. As indicated in connection with the return movement of the piston 96, outward movement thereof is regulated by reason of the needle valve 134 and the discharge line 133, whereby to attain a speed of stroke that is desired. It will be seen that by relative adjustment of the needle valve 128 and of the needle valve 134 the speed of the pull stroke may be made very slow, for example, and the speed of the release may be made quite rapid, the shifting of the valve 108 by the solenoids 114 and 115 being automatically effected at the adjusted pressures by means of the pressure-operated switches 116 and 117 respectively.

As is apparent from the foregoing, the table 10 of this invention may be adjusted to any desired angle by means of the telescoping jackscrew construction 32, the tilting being effected about the mounting 14 or about the mounting 15 as desired in accordance with whichever pivoting shaft 26 or 34 is used. Also, the patient may be placed under desired tensioning influences from the movement control apparatus 18, whether this be stretching at the neck by reason of the harness shown in Figs. 1 and 2 or stretching at the feet by way of the harness in Fig. 5 when the patient is reversed, the patient's body being maintained by appropriate location of the various body-positioning devices 60. Also, required angular position of the reciprocating rod 55 is readily effected by raising and lowering of the controlled device through the medium of the rack bar 88 and tilting about the pivotal mounting 89. It will be further seen that if rocking movements of the table are required, this is easily effected, about either of the mountings 14 or 15, by disconnecting the piston rod 55 from the harness and attaching its clevis 54 to the eye 52 at the outer end of the stiff rod or sleeve 50 which is connected to the platform 42 of the standard 12 at 51, the jackscrew mechanism 32 being disconnected at the pivot point 45 for this function. In addition to using the yoke 73 as a means to which to attach the head harness of Figs. 1 and 2, or to attach the chains 79 of a pair of the padded ankle grips of Fig. 5, the yoke 73 may be also employed as means to be grasped by the patient's hands so that the pulling of the automatic control mechanism will provide for resistive exercise and for breathing exercises. In such a situation, muscles throughout substantially the full length of the prone patient's body will be pulled or otherwise exercised, this being especially true if the chains 79 of the ankle grips in Fig. 5 are caught over the foot plate 58 in a manner to resist the longitudinal movement of the patient's body upward along the

table 10. It will be noted additionally that, besides pressure adjustment on the strokes through the medium of the pressure switches 116 and 117 and by reason of adjustment of the needle valves 128 and 134, the pressure may be further adjusted through the medium of the adjustable relief valve 103 which by-passes the pressure fluid, beyond the set pressure, back to the storage reservoir 97. Since a given pressure cannot be exceeded because of the pressure switches 116 and 117, the length of the strokes of the rod 55 will be automatically limited at the points reached when the pressures for which the switches are set have been attained either because of the patient's resistance or any other reason. If desired to make the whole operation automatic, corresponding circuits, such as shown in Fig. 7, may be used. Thus, an appropriate timer 150, settable for a suitable interval such as 30 minutes, is used in conjunction with a double-pole relay 151, which is a normally open relay and controls the pressure switch 116 so that it does not function to energize the solenoid 114 and cause return of the piston 96 at the end of the out stroke, whereby to stop the movement of the piston rod 55 in its outermost or slack position.

The timer 150 and the relay 151 operate also in conjunction with a single-pole relay 152 which is a normally closed relay, a single-pole relay 153 which is a normally open relay, a double-pole time-delay relay-switch 154, and another single-pole relay 155 which also is a normally open relay.

In order to make this circuit system available for manual as well as automatic use, a five-pole double-throw switch 156 having "automatic," "off" and "manual" positions as indicated, may be used, the position illustrated being the automatic position, a connecting linkage 157 between the poles being diagrammatically indicated. The place of power-input is through poles two and three (counted from the bottom of the drawing) of the five-pole double-throw switch 156—157 as indicated in Fig. 7.

If desired, the pressure switch circuit may be on a lower voltage basis (e. g. 12 volts), and a transformer 160 used for this purpose.

In operation of the above-described automatic phase of the circuit system, when a treatment period terminates, the timer 150 automatically operates the double-pole relay 151, thereby disconnecting the pressure switch 116 and breaking the circuit to the relay 152 and the relay 153. The relay 152 feeds current to the time-delay relay switch 154, and, after the period for which this relay is set elapses, the coil of the relay switch 154 is energized to open both its contacts and disconnect the motor 92 and the trans-

former 160. The relay 155 is deenergized simultaneously with the cutting off of the motor and the transformer, thus cutting off current to the time-delay switch 154, all the electric coils being thereby deenergized.

I claim as my invention:

1. In a combination in hydraulically actuated intermittent drive in physical therapy apparatus reciprocating means adapted to be connected to a patient for producing pulling and releasing movements, said reciprocating means including pressure fluid responsive means, a valve for shifting fluid flow, solenoid means for shifting said valve; and pressure switches sensitive to the pressures in said reciprocating means for energizing said solenoid means and therewith shifting said valve.

2. In a combination in hydraulically actuated intermittent drive in physical therapy apparatus, automatic means for effecting reciprocating movements including a fluid reservoir connected by reservoir conduit means with a motor-driven hydraulic pump; said hydraulic pump being connected by pump conduit means with valve means for supplying said fluid under pressure selectively by conduit means to a cylinder having a projecting actuating rod with means to engage with patient connecting means; said cylinder exhausting such fluid through said conduit means and valve means selectively through valve exhaust conduit means into said fluid reservoir; and pressure switches connected with said conduit means for selectively shifting said valve means on attainment of predetermined pressures in said conduit means to reverse the movement of said piston.

References Cited in the file of this patent

UNITED STATES PATENTS

35	1,205,649	Miller	Nov. 21, 1916
	1,261,424	Miller	Apr. 2, 1918
	1,765,669	Henze et al.	June 24, 1930
	1,974,774	Gilberg	Sept. 25, 1934
	2,194,651	Franklin	Mar. 26, 1940
	2,262,271	De Camp	Nov. 11, 1941
40	2,273,088	Byers	Feb. 17, 1942
	2,429,834	Madden et al.	Oct. 28, 1947
	2,598,204	Allen	May 27, 1952
	2,678,857	Hans	May 18, 1954
45	2,712,820	Robinson	July 12, 1955

FOREIGN PATENTS

13,398	Great Britain	Nov. 5, 1885
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