April 23, 1963 N. L. BARLOW ETAL 3,086,518

HYDRAULIC INTERMITTENT TRACTION DEVICE

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FIG. 2

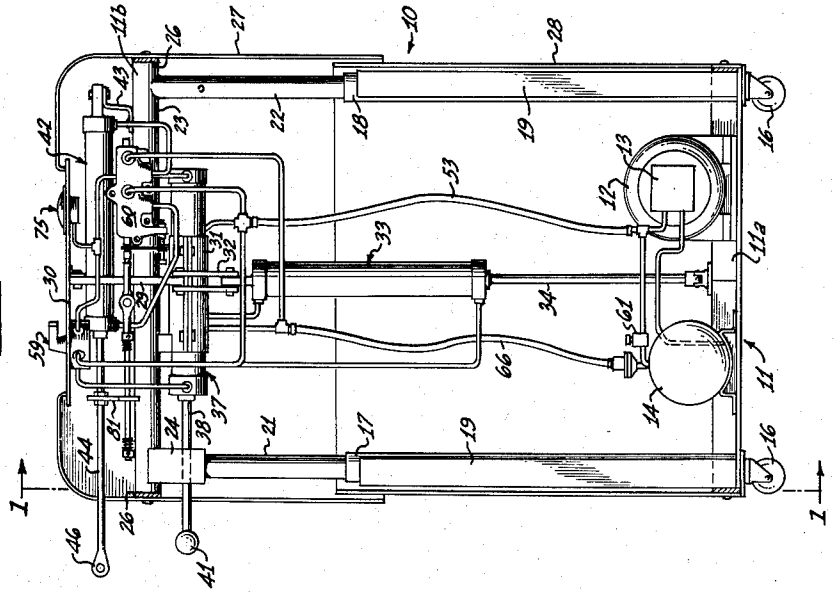
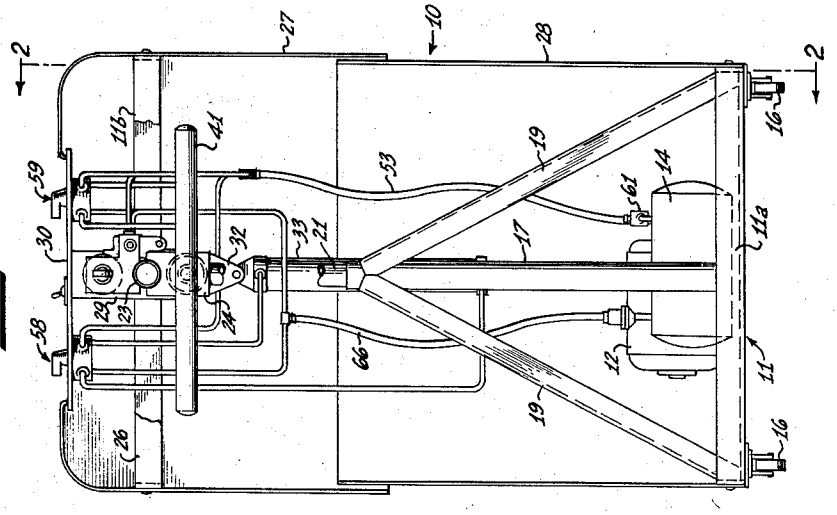



FIG. 1




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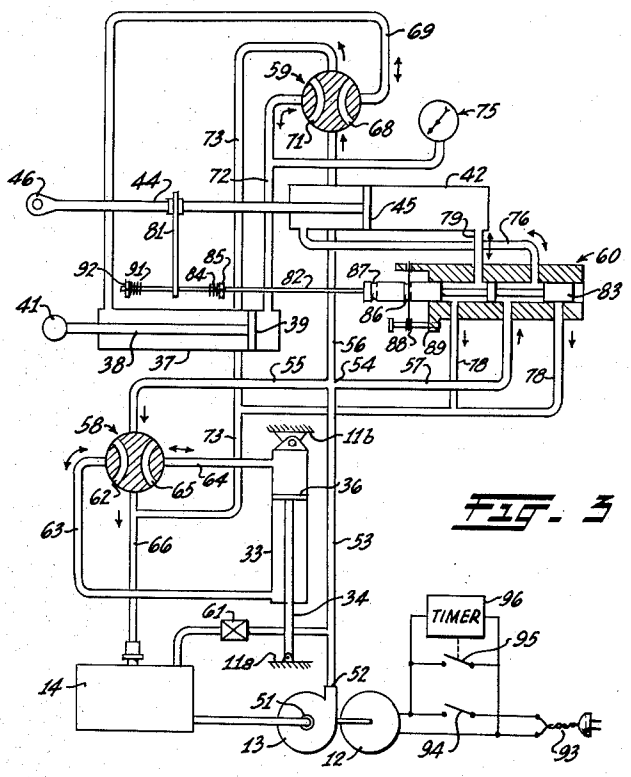



FIG. 3

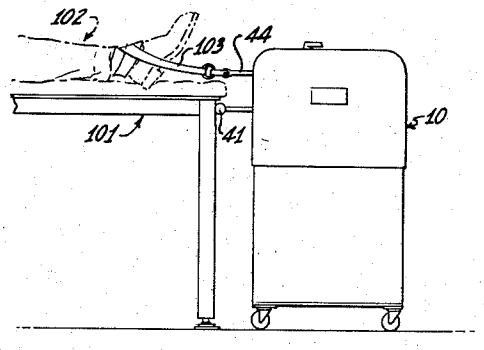


FIG. 4

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# HYDRAULIC INTERMITTENT TRACTION DEVICE

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8 Claims. (Cl. 128—75)

This invention relates to therapeutic traction machines and more particularly to an intermittent traction machine operated by hydraulic apparatus.

The particular machine disclosed in this application has been designed for the therapeutic manipulation of diseased or affected joints, tendons, ligaments, or the like. In such treatment, the affected part of the body is placed in traction. The tension is then rhythmically increased and decreased to exercise and relax the body muscles.

Many devices have been designed for such purposes but none of them has been fully satisfactory. For example, there are therapeutic couches on which the patient lies while undergoing treatment, the table being fitted with suitable harness or other devices adapted to fit the patient. Apparatus of this character is quite costly, removing it from the resources of the average practitioner and restricting it more or less to hospital use. In addition to being costly, such apparatus cannot easily be moved or stored when not in use.

On the other hand, several small, relatively portable devices have been designed for this purpose. However, due to the lightness and smallness of these devices it has not been possible to achieve the smoothness of operation and versatility of use possible with the large machines. These portable machines all employ some sort of motor connected through mechanical linkages to the traction harness which has the disadvantage that it is almost impossible to obtain smooth, steady increases and decreases in tension. Instead, the wear of the mechanical parts and the play between such parts causes at least slight jerks in operation. These jerks when transmitted to a body member under tension can in many cases cause such discomfort that the treatment is more harmful than helpful.

It is a primary object of this invention to provide a portable machine for applying intermittent traction to a patient in which the traction is varied smoothly and at a constant rate. More particularly, this object is accomplished by the use of hydraulic pressure applied directly to the traction harness to vary the tension thereon.

A further object of the invention is to provide a portable machine for applying intermittent traction wherein hydraulic pressure is used to adjust the desired amount of tension on the traction harness, and in which the tension is measured by a hydraulic gauge rather than by a spring gauge interposed between the machine and traction harness as heretofore done.

Yet another object is to provide a machine as set forth above in which the height of the operating parts may be easily adjusted and by the same hydraulic means used for applying traction.

Still another object is to provide a portable traction machine as set forth above in which all of the controls are grouped together for easy manipulation by an operator.

Other objects and advantages will become apparent in the course of the following detailed description.

In the drawings forming a part of this application, and in which like parts are designated by like reference numerals throughout the same.

FIG. 1 is a sectional view, taken on line 1—1 of FIG. 2, illustrating a front view of an intermittent traction apparatus constructed in accordance with the invention, with parts shown in elevaion.



FIG. 2 is a sectional view, taken on line 2—2 of FIG. 1, illustrating a side view of the apparatus.

FIG. 3 is a generally schematic illustration of the hydraulic connections of the apparatus.

FIG. 4 illustrates the use of the apparatus with a patient.

Referring now to the drawings wherein is shown a preferred embodiment of the invention, the traction apparatus, generally indicated by the reference numeral 10 comprises a frame 11 having a base portion 11*a* and an upper portion 11*b* telescopically connected together for vertical movement of the upper frame portion.

The base portion 11*a* of the frame is generally rectangular and supports a motor 12 and pump 13 combination and a fluid reservoir 14 thereon. Casters 16 attached to the base portion permit the apparatus to be easily moved to any desired point of use. Two upstanding tubing members 17 and 18 are rigidly secured to the base portion 11*a*, and are supported thereon by angle iron members 19.

The upper frame portion 11*b* comprises two tubing members 21 and 22 telescopically received in tubing members 17 and 18 for vertical movement therein. A frame tubing member 23 extends from front to back of the apparatus, being welded at its rear end to the upper end of tubing member 22 and being rigidly connected at its front end to tubing member 21 by a bearing block 24. A generally rectangular strap iron frame 26 is secured to frame tubing 23 and supports the upper cover 27 which depends downwardly telescopically around the lower cover 28 which is secured to the base portion of the base. A vertically extending frame bracket 29, welded or otherwise rigidly secured to frame tubing 23, supports at its upper end the control panel 30 for the apparatus. The lower end of bracket 29 has rigidly secured thereto the upper half of a split cylinder bracket 31.

Rigid links 32, also connected at their upper ends to bracket 29, are connected at their lower ends to the elevating cylinder 33. The elevating cylinder rod 34, secured to elevating cylinder piston 36 for movement therewith is connected at its lower end to the base portion 11*a* of the frame.

Bumper cylinder 37, rigidly gripped in split bracket 31, has a rod 38 secured to the bumper cylinder piston 39 for movement therewith. The bumper rod 38 extends through bearing block 24 and the upper cover 27 and has a bumper member 41 on the outer end thereof for engagement with a hospital table, bed, or the like.

Traction cylinder 42 is rigidly secured to frame tubing member 23 by brackets 29 and 43. The traction rod 44, connected to traction cylinder piston 45 for movement therewith, extends out through the upper cover 27 and is provided with an eye 46 at its outer end for connection of a traction harness thereto. The bumper rod 38 and traction rod 44 are parallel to one another and each passes through the vertical centerline of the machine.

Turning now to FIG. 3, the intake 51 of pump 13 is fluidly connected to reservoir 14 and the pump discharge 52 is connected by a flexible hose 53 to connector 54 and by conduits 55, 56 and 57 to the four-way valves 58, 59 and 60. The discharge side of pump 13 is also connected through relief valve 61 to the reservoir 14.

The four-way valve 58 is a manually operable, rotating plug valve mounted on control panel 30. When the plug is rotated 45° in a counterclockwise direction from that shown in FIG. 3, valve passage 62 will connect pump pressure through conduit 63 to the lower end of elevating cylinder 33. At the same time, the upper end of the cylinder will be connected by conduit 64, valve passage 65 and flexible hose 66 to the reservoir 14. Pump pressure will then move the piston 36 upwardly in cylinder

33 causing the upper frame portion 11*b* to lower itself relative to the base portion.

Rotating the valve plug 45° in a counterclockwise direction from the position shown in FIG. 3 will reverse the cylinder end connections, placing pump pressure in the upper end of cylinder 33 causing the upper frame portion to be raised. When the valve is in its intermediate position, as illustrated, all fluid flow to and from both ends of cylinder 33 is shut off, preventing any vertical movement of the piston in the cylinder so that the upper frame portion remains at the height to which it has been adjusted.

The four-way valve 59 is similarly manually operable and is also mounted on control panel 30. When valve 59 is rotated 45° in a clockwise direction, valve passage 68 connects pump pressure through conduit 69 to the left end of bumper cylinder 37 while valve passage 71 connects the right end of the bumper cylinder through conduits 72, 73 and 66 to reservoir 14. With this position of valve 59 the bumper piston 39 and bumper rod will be moved to the right relative to the frame to which bumper cylinder 37 is mounted. A pressure gauge 75 is fluidly connected to the right end of bumper cylinder 37.

The four-way valve 60 is a spool-type valve, and may be, for example, similar to a Douglas Aircraft hydraulic control valve #4267956. When valve 60 is in the position shown, pump pressure is communicated through conduits 57 and 76 to the left end of traction cylinder 42, and the right end of the traction cylinder communicates through conduit 79, valve 60, conduits 78, 73 and 66 to the reservoir 14. This pump pressure in the traction cylinder causes the piston 45 and rod 44 to move to the right.

As traction rod 44 moves to the right, the reversing plate 81 secured thereto rides freely along reversing rod 82, which is secured to spool 83 of valve 60, until plate 81 engages one end of spring 84, fixed at its other end by adjustment nut 85 to reversing rod 82. Spool 83 has two detents 86 and 87 spaced axially along the spool to receive the legs of hairpin shaped spring 88. The upper ends of spring 88 are secured against movement axially of valve 60 by bracket 89. Thus, when the spring legs are in one of the spool detents 86 or 87, the force of the spring against the spool will prevent axial movement of the spool.

As the traction rod continues to move to the right, the reversing plate 81 builds up pressure against spring 84 until there is sufficient force to cam the legs of spring 88 out of detent 86. The spring force of spring 84 then snaps the spool to the right so that the fluid connections to the ends of the traction cylinder 42 are abruptly reversed. The spool is held in this position by the pressure of the legs of hairpin spring 88 in detent 87.

With a reversal of fluid connections to traction cylinder 42, the piston 45 and rod 44 will now move to the left, until the reversing plate engages spring 91, secured by adjustment nut 92 to the reversing rod. Continued movement of rod 44 builds up pressure in spring 91 eventually causing spring 88 to be connected out of spool detent 87 so that the spool snaps back to the illustrated position.

Nuts 85 and 92 can be adjusted on reversing rod 82 to vary the length of stroke in either direction as desired. The electric motor 12 is provided with a line cord 93 adapted to be plugged into a suitable receptacle. A manually operable switch 94 is provided for manual control of motor operation. In addition, an automatic switch 95 controlled by timer 96 is provided. When the timer 96 is set by the operator, switch 95 is moved to closed position, and the timer starts into operation. At the end of the desired time, the timer moves switch 95 to open position to disconnect the motor 12 and the timer 96.

In operation of the apparatus the traction device is wheeled up to a hospital bed 101, the line cord 93 is plugged into a power source and switch 94 or 95 is closed. Motor 12 is energized to drive pump 13. When hydaulic pressure in line 53 exceeds the setting of relief valve 61, the pump discharge may flow therethrough back into reservoir 14. The elevating valve 58 is now manipulated to adjust the height of the upper frame portion so that the bumper and traction rods are at a desired height relative to the bed and patient 102. Bumper valve 59 is preferably manipulated so that the bumper rod moves into the bumper cylinder 37. The motor is then turned off and the machine is pushed by the operator over to the bed 101 until the bumper 41 engages the bed.

The traction harness 103 is fitted onto the patient and is secured to the eye 46 of the traction rod 44. Clock 96 is set to the desired length of treatment, closing switch 95 and starting up the motor and pump. The traction rod will automatically reciprocate as long as pump 13 is in operation. The operator will now manipulate the bumper control valve 58 so that pressure is exerted on the bumper piston and rod to push the entire machine 10 away from the bed, causing tension to be applied to the traction harness 102. The pressure gauge 75 will measure the hydraulic pressure in the right end of bumper cylinder 37 which, when valve 59 is closed, will be a direct measure of the tension in the traction harness. The dial of gauge 75 will be suitably calibrated in pounds of tension so that the operator can tell immediately how much tension is being applied to the patient.

When the maximum tension is at a desired amount, valve 59 is left closed, as illustrated in FIG. 3, and the traction rod will reciprocate as long as pump 13 is activated. When the time of treatment is up, the clock 96 will open switch 95 to turn off the motor and pump.

Very significant advantages are obtained by the use of a hydraulically operated traction rod. When the body is subjected to intermittent traction it is highly desirable that the traction tension be built up as smoothly and uniformly as possible. Any sudden jerk or change in tension will cause discomfort, running from relatively mild to quite severe, in the patient. In the present invention the fluid pressure against the traction piston produced by pump 13 will be uniformly constant over the entire length of the stroke, causing the piston and traction rod to move at a uniform rate throughout the stroke. The use of hydraulic force also eliminates any jerky motion which usually exists when mechanical power transmitting means, such as cams, levers, gears, etc., are used between the power source and a traction harness.

In addition to producing the greatest degree of comfort possible to the patient, the use of hydraulic operation makes the machine much more convenient for the operator to use. All of the controls can be easily located on the top surface of the machine in close adjacency to one another since the hydraulic lines and electric power lines can be extended between the valves and switches in the control panel and the devices operated thereby without the difficulties that would be encountered if mechanical elements were used for operation. With the present machine the operator can control the following operations at the control panel: he can turn the machine on or off manually, or set such operation for automatic timing; he can adjust the height of the bumper and traction rods; he can adjust the tension in the traction harness by operating the bumper rod; and he can note the exact tension in the traction harness at any time.

When not in use, the machine can be moved easily and stored in a small space. The minimum number of moving parts in the device greatly simplifies the maintenance of the machine and also eliminates much of the mechanical noise which would otherwise be disturbing to a patient.

It is to be realized that the apparatus herein shown and described is a preferred embodiment of the invention and that various changes may be made in the shape, size

and arrangement of parts without departing from the spirit of the invention or the scope of the attached claims.

Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. An exercise device adapted to be used with an exercise table comprising a traction cylinder, a piston disposed in said cylinder for reciprocating movement therein, a piston rod secured to said piston for movement therewith, means on said piston for securing an exercise harness thereto, a fluid pump, means fluidly connecting the discharge of said pump to one end of said traction cylinder and fluidly connecting the other end of said cylinder to the intake of said pump whereby pump pressure will cause movement of said piston and rod, means for periodically reversing the fluid connection of said pump to said cylinder to reverse the direction of said piston and rod, and means for holding said traction cylinder at a desired distance from said exercise table comprising a cylinder member and a piston member disposed in said cylinder member for reciprocating movement therein, one of said cylinder and piston members being engageable with said exercise table, means mounting the other of said cylinder and piston members in fixed relation to said traction cylinder, means reversibly fluidly connecting said pump discharge to one end of said cylinder member and reversibly fluidly connecting the other end of said cylinder member to said pump intake, and means for shutting off fluid flow to and from both ends of said cylinder member.

2. A traction device comprising: a frame adapted to rest on a floor surface; a traction cylinder mounted on said frame, a piston disposed in said cylinder for reciprocating movement therein, a piston rod secured to said piston for movement therewith, means on said piston rod for securing a traction harness thereto; a fluid pump; means fluidly connecting the discharge of said pump to one end of said cylinder and fluidly connecting the other end of said cylinder to the intake side of said pump whereby pump pressure will cause movement of said piston and rod; means responsive to a predetermined amount of said piston and rod movement for reversing the fluid connection of said cylinder to said pump to reverse the direction of movement of said piston and rod; bumper means mounted on said frame for engaging a traction table to hold said frame a desired distance from said table, said bumper means comprising a cylinder mounted on said frame, a piston mounted in said bumper cylinder for reciprocating movement therein; a bumper rod connected at one end to said bumper piston and adapted to engage said traction table at its other end; means reversibly fluidly connecting said pump discharge to one end of said bumper cylinder and reversibly fluidly connecting the other end of said bumper cylinder to said pump intake, and means for shutting off fluid flow to and from both ends of said bumper cylinder.

3. A traction device as set forth in claim 2 wherein said bumper rod extends through one end of said bumper cylinder and further including a pressure gauge connected to the other end of said bumper cylinder.

4. A traction device as set forth in claim 2 wherein said frame comprises a base portion and an upper portion telescopically connected to each other, and wherein said bumper and traction cylinders are mounted to said upper frame portion, an elevating cylinder mounted on one of said frame portions, a piston mounted for reciprocating movement in said elevating cylinder, a piston rod connected to said piston and the other frame portion, means reversibly fluidly connecting said pump discharge to one end of said elevating cylinder and reversibly fluidly connecting the other end of said elevating cylinder to said pump intake, and means for shutting off fluid flow to and from both ends of said elevating cylinder.

5. A traction device comprising: a frame adapted to rest on a floor surface; a traction cylinder mounted on said frame, a piston disposed in said cylinder for reciprocating movement therein, a piston rod secured to said piston for movement therewith, means on said piston rod for securing a traction harness thereto; a fluid reservoir disposed on said frame; a fluid pump having its intake fluidly connected to said reservoir; means including a four-way valve for fluidly connecting the discharge of said pump to one end of said cylinder and for fluidly connecting the other end of said cylinder to said reservoir when said valve is in a first position and for reversing the fluid connections to the ends of said cylinder when said valve is in a second position; means responsive to a predetermined amount of movement of said piston and rod in each direction for moving said valve from one position to the other to reverse the direction of movement of said piston and rod; bumper means mounted on said frame for engaging a traction table to hold said frame a desired distance from said table, said bumper means comprising a cylinder mounted on said frame, a piston mounted in said bumper cylinder for reciprocating movement therein, a bumper rod connected at one end to said bumper piston and adapted to engage said traction table at its other end; means including a second manually-operable four-way valve for fluidly connecting said pump discharge to one end of said bumper cylinder and for fluidly connecting the other end of said bumper cylinder to said reservoir when said second valve is in a first position and for reversing the fluid connections to the ends of said bumper cylinder when said second valve is in a second position, said second valve having a third position shutting off fluid flow to and from both ends of said bumper cylinder; and wherein said traction and bumper rods are parallel to each other.

6. A traction device as set forth in claim 5 wherein said bumper rod extends through one end of said bumper cylinder and further including a pressure gauge connected to the other end of said bumper cylinder.

7. A traction device as set forth in claim 5 wherein said frame comprises a base portion and an upper portion telescopically connected to each other, and wherein said bumper and traction cylinders are mounted to said upper frame portion, a generally vertically disposed elevating cylinder mounted on one of said frame portions, a piston mounted for reciprocating movement in said elevating cylinder, a piston rod connected to said piston and the other frame portion, means including a third manually-operable four-way valve for fluidly connecting said pump discharge to one end of said elevating cylinder and for fluidly connecting the other end of said elevating cylinder to said reservoir when said third valve is in a first position and for reversing the fluid connections to the ends of said elevating cylinder when said third valve is in a second position, said third valve having a third position shutting off fluid flow to and from both ends of said elevating cylinder.

8. A traction device as set forth in claim 7 wherein said bumper rod extends through one end of said bumper cylinder and further including a pressure gauge fluidly connected to the other end of said bumper cylinder, a control panel mounted on the upper part of said frame and wherein said second and third valve and said pressure gauge are mounted on said control panel in close adjacency to each other.

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