

[54] **APPARATUS FOR APPLYING THERAPUTIC TRACTION IN PROGRESSIVE INTERMITTENT INCREASE OF MAGNITUDE**

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[58] Field of Search **128/75, 84; 254/172, 173**

[56] **References Cited**
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[57]

ABSTRACT

Apparatus for applying therapeutic traction to a patient in which a solenoid energized simultaneously with the energization of an intermittently operated traction motor actuates a ratchet wheel fixed to a device that controls the magnitude of applied traction to increase intermittently and automatically the magnitude of applied traction for each cycle over a preselected period of time until a maximum magnitude of applied traction is reached.

10 Claims, 12 Drawing Figures

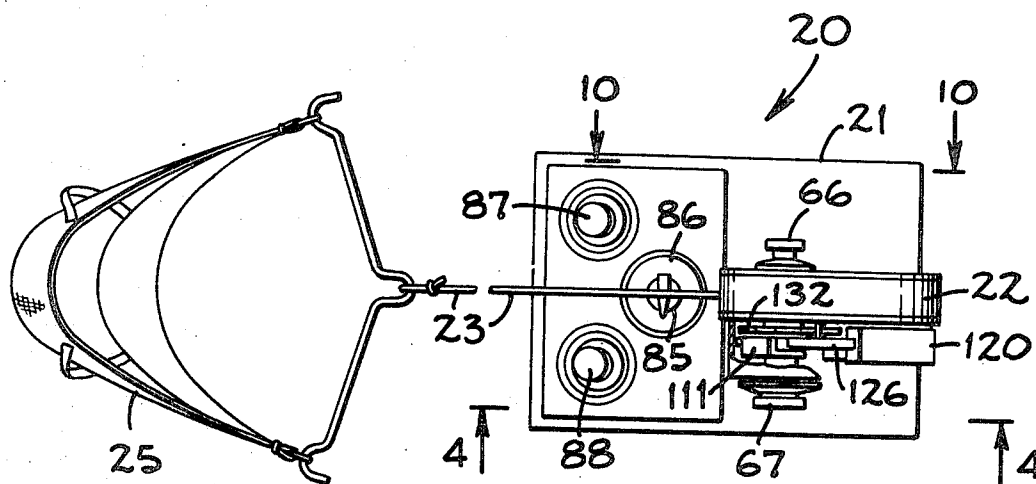


Fig-7

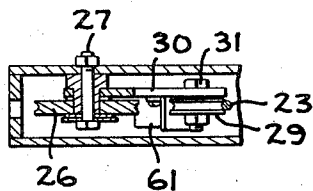
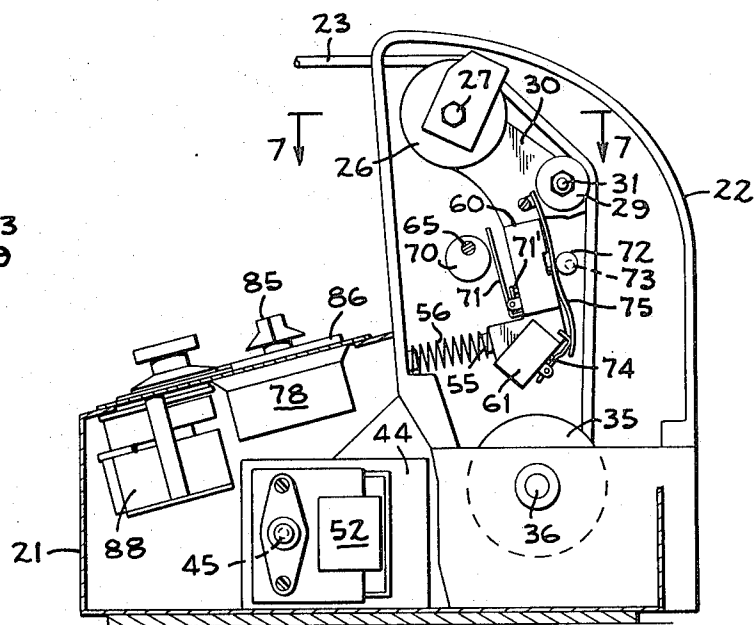


Fig-4

Fig-6

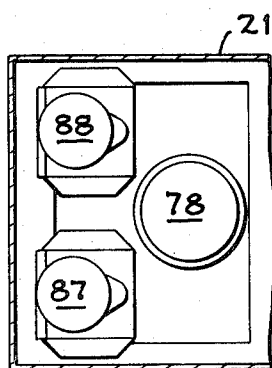
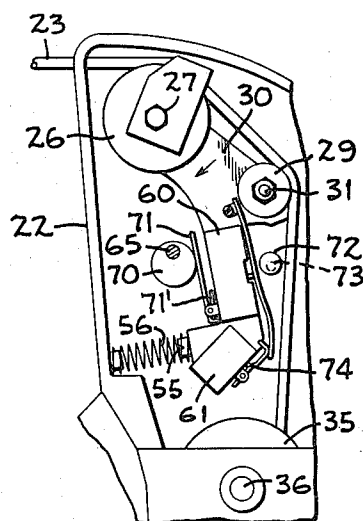


Fig-8



APPARATUS FOR APPLYING THERAPUTIC TRACTION IN PROGRESSIVE INTERMITTENT INCREASE OF MAGNITUDE

BACKGROUND OF THE INVENTION

The present invention relates in general to apparatus for applying therapeutic traction and more particularly to apparatus for applying intermittently therapeutic traction over a preselected time period.

Heretofore, apparatus such as the "Tru Trac" traction machine manufactured by Tru-Eze Manufacturing Company, Inc. of Burbank, California, applied intermittently over a preselected period of time a preset magnitude of applied traction. During each intermittent cycle, the same magnitude of traction was applied, unless an operator manually changed the maximum traction dial. If an incremental increase of magnitude of applied traction was desired over a preset time period, an operator had to adjust the maximum traction dial manually and during various time intervals over the preselected time period. The foregoing is disclosed in U. S. Pat. No. 3,168,094, issued to R. W. Siltamaki on Feb. 2, 1965, for Traction Therapy Apparatus.

SUMMARY OF THE INVENTION

Apparatus for applying therapeutic traction in which the magnitude of the applied traction increases intermittently and automatically for each cycle for a preselected period of time until a maximum magnitude of applied traction is reached.

By virtue of the progressively increased intermittent traction achieved by the present invention, a patient receives gradual stretch and accommodation at each level of resistance. In turn, the patient tends to have less pain from traction and enables the therapist to apply a greater amount of pull to attain better results.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevation view of the apparatus of the present invention for applying therapeutic traction, broken away to illustrate mechanism for increasing intermittently and automatically the applied traction.

FIG. 2 is a fragmentary side elevation view of the apparatus shown in FIG. 1, broken away to illustrate the mechanism for increasing intermittently and automatically the applied traction.

FIG. 3 is a plan view of the apparatus shown in FIGS. 1 and 2.

FIG. 4 is an enlarged vertical sectional view taken along line 4—4 of FIG. 1.

FIG. 5 is an enlarged horizontal sectional view taken along lines 5—5 of FIG. 2.

FIG. 6 is a rear view of the timer panel for the apparatus shown in FIGS. 1—5, taken along line 6—6 of FIG. 2.

FIG. 7 is a fragmentary sectional view taken along line 7—7 of FIG. 4.

FIG. 8 is a fragmentary view similar to FIG. 4.

FIG. 9 is an enlarged vertical sectional view taken along line 9—9 of FIG. 2.

FIG. 10 is a fragmentary vertical sectional view taken along line 10—10 of FIG. 1.

FIG. 11 is a schematic diagram of the electrical system employed in the apparatus of the present invention.

FIG. 12 is a fragmentary exploded view of the mechanism for increasing intermittently and automatically the applied traction.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Illustrated in FIGS. 1—3 is the apparatus 20 of the present invention for applying therapeutic traction intermittently in progressive increases of magnitude. The apparatus 20 comprises a suitable support structure 21 which is mounted on a wall or the like. Projecting outwardly from the upper, front portion of the support structure 21 is a suitable housing 22. An opening is provided in the bottom wall of the housing 22 for the advancement of a cable 23. At the distal end of the cable 23 is secured a suitable hanger and harness 25 (FIG. 1) for attachment to the body of a patient. The cable 23 is tensioned for transmitting a traction force to the body of a patient through the harness 25.

The cable 23 is trained around a grooved idler sheave 26 (FIGS. 4 and 8) that is supported for rotation by a bolt 27. A nut secures the bolt 27 to the housing 22. In addition thereto, the cable 23 is also trained about a grooved idler sheave 29, which is supported for rotation by an arm 30 through a bolt 31. At its proximal end, the cable 23 is trained around a windlass pulley 35 and is anchored thereto with several turns thereof wrapped about the body portion of the windlass pulley 35. The pulley 35 is fixed to a shaft 36 for rotation therewith, which shaft 36 is journaled for rotation by the housing 22 through suitable bushings.

For imparting rotation to the shaft 36, a larger sprocket 40 (FIGS. 5, 9 and 10) is fixed to the shaft 36. An endless chain 41 is wound around the sprocket 41 and a smaller sprocket 42. Fixed to the sprocket 42 for imparting rotation thereto is a shaft 43. The shaft 43 is carried and rotated by the output side of a gear speed reduction unit 44. The input side of the gear speed reduction unit 44 is connected to a drive shaft 45 of a drive motor arrangement 50 (FIG. 5).

The drive motor arrangement 50 includes a traction motor 51 and reversing motor 52. The armatures of the motors 51 and 52 are mounted in and fixed to the horizontal drive shaft 45 that is connected to the input side of the gear reduction unit 44. Thus, the operation of the traction motor 51 rotates the shaft 45 in a direction to apply tension to the harness 25 through the cable 23 and the operation of the reversing motor 52 rotates the shaft 45 in an opposite direction to reduce the application of traction on the harness 25 through the cable 23. The motors 51 and 52 are alternately energized.

For controlling the successive application of traction forces on the harness 25 through the cable 23, the duration and frequency thereof, a lever arm 30 (FIGS. 4 and 8) at one end thereof is mounted for pivotal movement about the bolt 27. The other end of the lever arm 30 has a depending cylindrical boss 55. A compressive spring 56 at one end thereof engages the cylindrical boss 55 to urge the lever arm 30 to rotate in counterclockwise direction as viewed in FIGS. 4 and 8. At the other end thereof, the compressive spring 56 seats on a boss that is fixed to the housing 22.

As the windlass pulley 35 winds in the cable 23, a tension is created on the cable 23 from the resistance of the harness 25 attached to the body of a patient. The reaction of the cable 23 tends to straighten the bight thereof extending between the pulley 35 and the sheave

26 by causing the sheave 29 and the lever arm 30 to rotate in the clockwise direction about the bolt 27 as viewed in FIGS. 4 and 8 against the urgency of the compression spring 56.

Mounted on the lever arm 30 for movement therewith is a double throw snap switch 60 which moves between two positions in response to the pivotal movement of the lever arm 30. The distal end of the lever arm 30 carries a normally closed single throw switch 61.

Below the lever arm 30 a shaft 65 (FIGS. 1, 3, 4, 8, 9 and 12) is journaled to the housing 22 for rotation. At each end of the shaft 65 are fixed knobs 66 and 67 for manual rotation (FIGS. 1, 3, 9 and 12). Each knob has a radial index which is registered or aligned with indicia on a semicircular dial to indicate the extent or magnitude of maximum traction to be exerted on the harness 25. Fixed to the shaft 65 within the housing 22 is an eccentric disc 70 (FIGS. 4, 8 and 12). Rotation of the knobs 66 and 67 will rotate the eccentric disc 70 with the shaft 65 so that the location of the perimeter of the eccentric disc can be varied.

The switch 60 extends at right angles to the axis of the shaft 65. Movement of the lever arm 30 in response to the increase of tension on the cable 23 brings a lever 71 of the switch 60 into engagement with the eccentric disc 70 (FIG. 8). The extent in which the lever arm 30 must be rotated to cause the lever arm 71 to engage the peripheral wall of the eccentric disc 70 determines when the switch 60 will be actuated to the position shown in dotted line in FIG. 11 from the full line position shown in FIG. 11 by the actuating of a plunger 71'. It is apparent that varying the position of the peripheral wall of the eccentric disc 70 controls the extent of the pivotal movement of the lever arm 30 about the bolt 27 against the urgency of the compression spring 56 to cause the lever arm 71 to engage the eccentric disc 70 to actuate the switch 60 to the dotted line position from the full line position shown in FIG. 11.

In a similar manner, an eccentric 72 (FIGS. 4 and 8) is affixed to a shaft 73 that is journaled for rotation by the housing 22. A second plunger 74 is employed for actuating the switch 61, which is actuated by engagement with an actuating leaf spring 75 that is carried by the arm 30. When the leaf spring 75 engages the peripheral surface of the eccentric 72, the switch 61 snaps back to its full line position (FIG. 11). The switch 61 is normally closed. When the distal end of the leaf spring 75 contacts the peripheral wall of the eccentric 72, the leaf spring 75 actuates the plunger 74 to open the switch 61.

When the cable 23 is attached to the body of a patient through the harness 25, the traction motor 51 is energized to wind up the cable 23 about the windlass pulley 35. When the tension on the cable 23 reaches a predetermined magnitude, the drive motor arrangement 50 is stopped and held against reverse rotation for a predetermined dwell time. At the end of the dwell time, the traction motor 51 remains deenergized and the reversing motor 52 is energized to reverse the direction of rotation of the windlass pulley 35 and thereby reduces the tension on the cable 23.

When the cable 23 reaches a slack condition, the reversing motor is deenergized and remains deenergized for a second dwell period of time. At the end of the second dwell period, the traction motor 51 is again energized and the reversing motor 52 remains deenergized.

This begins a new cycle of operation. All of the foregoing operations are repeated in sequence over a period of time, set by a master time switch 78.

The total elapsed time for a treatment is determined by the master time switch 78 (FIGS. 4, 6, 10 and 11) which includes a single throw switch operated by clock work to be closed when the clock work is started at the beginning of the total treatment time period and to open at the end of the total treatment time period. The switch 78 is adjusted by a handle 85 moved with reference to a dial 86 (FIG. 1).

The length of the holding dwell which occurs at the end of each traction period during each cycle is determined by an automatic reset timing device 87 (FIGS. 1 and 11). The elapsed time for the rest dwell at the end of the traction release period is determined by a timing device 88 (FIGS. 1 and 11). The timing device 87 includes a switch 90 and a timing device 88 includes a switch 91. In addition thereto, the timing device 87 includes a manually operated knob and an index dial.

When the harness 25 is on the body of a patient, the master time knob is actuated to set the time of treatment. The switch 78 is closed to complete a circuit through the switch 60, which is in the full line position shown in FIG. 11. Current now flows through the test timer 88. After the rest dwell period, the switch 91 is actuated to complete the energizing circuit for the traction motor 51.

As the cable 23 is tensioned above the windlass pulley 35, the lever arm 30 pivots about the bolt 27 against the urgency of the spring 56. This action continues until the plunger 74 is actuated by the lever arm 71 engaging the peripheral wall of the eccentric disc 70. Thereupon, the switch 60 is actuated to the dotted line position shown in FIG. 11. Now, the holding dwell period commences and the reset timer 87 is operated. At the end of the holding dwell period, the reset timer 87 operates to complete an energizing circuit for the reversing motor 52.

The motor 52 reverses the direction of rotation of the windlass pulley 35 and the cable 23 slackens. The compression spring 56 urges the arm 30 in the counterclockwise direction as viewed in FIGS. 4 and 8. This action continues until the plunger 74 is actuated by the leaf spring 75 to cause the switch 60 to snap back to the full line position shown in FIG. 11. The plunger 74 is engaged by the peripheral wall of the eccentric disc 70 during the aforesaid counterclockwise movement of the lever arm 30. Now, the succeeding cycle of operation begins with the operation of the rest dwell timer 88. The above cycles are repeated until the time set on the master timer 78 has expired. The switch 61 insures that regardless of when the elapsed time set by the timer 78 expires, the apparatus 20 will nevertheless complete the cycle then in operation. To ensure rapid stopping of the motors when operating current is discontinued, rectifying means 100 are provided.

The foregoing operation and parts are described in detail in the patent to Siltamaki, U.S. Pat. No. 3,168,094, issued on Feb. 2, 1965, for Traction Therapy Apparatus.

According to the present invention, the tension on the cable 23 is increased for each cycle of operation during the entire period of time the master timer 78 is in operation. The maximum application of tension does not exceed, however, the setting for maximum tension by the knob 67. Thus, during the period of treatment

for a patient the application of force through the cable 23 is increased automatically, intermittently and progressively for each cycle of operation.

Toward this end, a ratchet wheel 110 (FIGS. 2 and 12) is fixed to the shaft 65 for imparting intermittent rotation thereto. Mounted on the ratchet wheel 110 is a spring loaded blocking member 111 (FIG. 12). A solenoid 120 (FIGS. 1, 2 and 11) is connected in parallel with the traction motor 51 and is mounted on a suitable channel plate of bracket 121 (FIG. 2) adjacent to the ratchet wheel 110. The channel plate 121 is fixed to the housing 22 to be supported thereby.

A spring loaded armature 125 of the solenoid 120 is normally in the extended position. A stepping arm 126 is fixed to the armature 125 for rectilinear movement therewith. The solenoid 120 is energized each time the traction motor 51 is energized. The free end of the stepping lever 126 extends over the teeth of the ratchet wheel 110. When the solenoid 120 is energized, the armature 125 is retracted against the urgency of the spring to move the stepping arm 126 rectilinearly therewith. As a consequence thereof, the stepping arm 126 rotates the ratchet wheel 110 in the clockwise direction as viewed in FIGS. 2 and 12. In the exemplary embodiment, each step of rotation of the ratchet wheel 110 rotates the shaft 65 and adjusts the eccentric disc 70 fixed thereto so that the traction motor 51 is deenergized upon the increase of five pounds of traction force to the harness 25. As previously described, the engagement of the switch lever 71 with the periphery of the eccentric disc 70 controls the application of traction force by controlling the deenergizing of the traction motor 51 in response to the pivotal movement of the arm 30 about the bolt 27, which is controlled by the tension on the cable 23 under the action of the windlass pulley 35.

During the dwell hold time, the traction motor 51 is deenergized and the solenoid 120 is deenergized. The reverse motor 52 is energized after the expiration of the dwell hold time and the solenoid 120 retracts its armature 125 under the urgency of its spring. The stepping arm 126 is now set for engagement with the succeeding tooth of the ratchet wheel.

A locking pawl 130 (FIGS. 2 and 12) engages the teeth of the ratchet wheel 110 to hold the same in its advanced position. The locking pawl 130 is pivotally mounted on the plate 121 and is held in the teeth locking position under the action of a spring 131 to prevent the ratchet wheel 110 from retracting from its advanced position. A release lever 132 pivotally mounted on the mounting plate 121, when actuated, serves to remove the locking pawl 130 out of the path of the teeth of the ratchet wheel 110 against the urgency of the spring 131 to enable the ratchet wheel 110 to return to its initial starting position by manually operating the knob 66 to zero. To set the blocking member 111, the knob 67 is moved axially inward to temporarily remove or unseat the blocking teeth from the ratchet wheel teeth against the urgency of the spring therebetween. Thereupon, the rotation of the knob 67 rotates the blocking member 111 to a selected position. The knob 67 is released and the spring loaded blocking member 111 is resealed against the ratchet wheel 110 with the teeth of blocking member in locking engagement with the teeth of the ratchet wheel, whereby the blocking member 111 rotates with the ratchet wheel 110.

The knob 66 is set to zero and the knob 67 is set for maximum magnitude of traction to be applied in a manner previously described. When the knob 67 is set, the blocking member 111 is positioned over selected teeth of the ratchet wheel 110 to preclude the stepping lever 126 from engaging teeth associated with a traction force in excess with the maximum traction set by the knob 67. A suitable cover is disposed over the ratchet wheel 110 and the solenoid 120.

I claim:

1. Apparatus for applying automatically therapeutic traction in progressive increases comprising:

- a. a harness for attachment to the body of a patient;
- b. a cable connected at its free end to said harness;
- c. tension applying means tensioning said cable for the transmission of traction force through said harness;
- d. drive means operating said tension applying means for the application of tension on said cable;
- e. tension sensing means responsive to the magnitude of tension on said cable and connected to said drive means for stopping the operation of said drive means in response to the tension on said cable reaching a predetermined magnitude; and
- f. control means activated intermittently and connected to said tension sensing means for controlling the operation of said tension sensing means to stop the operation of said drive means in response to the tension on said cable reaching a predetermined increase in magnitude for progressively increasing the tension on said cable through said drive means and through said tension applying means.

2. Apparatus as claimed in claim 1 wherein said drive means operates intermittently in response to the operation of said tension sensing means and wherein said control means is activated intermittently in response to the operation of said drive means and said control means controls intermittently the operation of said tension sensing means to stop the operation of said drive means in response to the tension on said cable reaching predetermined increases in magnitude for increasing the tension on said cable through said drive means and through said tension applying means during each intermittent operation.

3. Apparatus as claimed in claim 1 wherein said drive means operates cyclically in response to the operation of said tension sensing means and wherein said control means is activated cyclically in response to the operation of said drive means and said control means controls cyclically the operation of said tension sensing means to stop the operation of said drive means in response to the tension on said cable reaching predetermined increases in magnitude for increasing the tension on said cable through said drive means and through said tension applying means during each cycle of operation.

4. Apparatus for applying automatically therapeutic traction in progressive increases comprising:

- a. a harness for attachment to the body of a patient;
- b. a cable connected at its free end to said harness;
- c. tension applying means tensioning said cable for the transmission of traction force through said harness;
- d. drive means operating said tension applying means for the application of tension on said cable, said drive means including a traction drive motor;

- e. tension sensing means responsive to the magnitude of tension on said cable and connected to said drive means for stopping the operation of said drive means in response to the tension on said cable reaching a predetermined magnitude, said tension sensing means including a shaft, an eccentric disc fixed to said shaft for rotation therewith, switch means actuated by engagement with said eccentric disc and operative for controlling the energization of said traction drive motor, and means responsive to the tension on said cable for moving said switch means relative to said eccentric disc; and
- f. control means connected to said tension sensing means for controlling the operation of said tension sensing means for progressively increasing the tension applying means, said control means including a ratchet wheel fixed to said shaft for imparting rotation thereto, a solenoid, circuit means for energizing said solenoid in response to the energization of said traction drive motor, and stopping means for advancing said ratchet wheel in response to the energization of said solenoid.

5. Apparatus as claimed in claim 4 wherein said traction drive motor operates intermittently in response to the actuation of said switch means and wherein said ratchet wheel rotates said shaft during each intermittent operation of said traction drive motor to rotate said eccentric disc for requiring an increase in tension on said cable in order for said switch means to be actuated.

6. Apparatus as claimed in claim 4 wherein said traction drive motor operates cyclically in response to the actuation of said switch means and wherein said ratchet wheel rotates said shaft during each cycle of operation of said traction drive motor to rotate said eccentric disc for requiring an increase in tension on said cable in order for said switch means to be actuated.

7. Apparatus as claimed in claim 4 and comprising a ratchet wheel blocking member carried by said ratchet wheel to inhibit the rotation of said ratchet wheel when the desired maximum magnitude of traction has been reached.

8. Apparatus as claimed in claim 6 and comprising a ratchet wheel blocking member carried by said ratchet wheel to inhibit the rotation of said ratchet wheel when the desired maximum magnitude of traction has been reached.

9. Apparatus as claimed in claim 7 wherein said blocking member selectively covers preselected teeth of said ratchet wheel to inhibit said stepping means from rotating said ratchet wheel when the desired maximum magnitude of traction has been reached.

10. Apparatus as claimed in claim 8 wherein said blocking member selectively covers preselected teeth of said ratchet wheel to inhibit said stepping means from rotating said ratchet wheel when the desired maximum magnitude of traction has been reached.

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