

- [54] **EMERGENCY TRACTION SPLINT**
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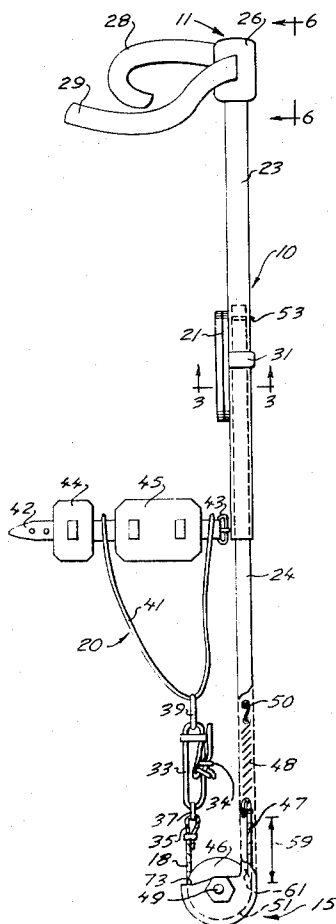
[57] ABSTRACT

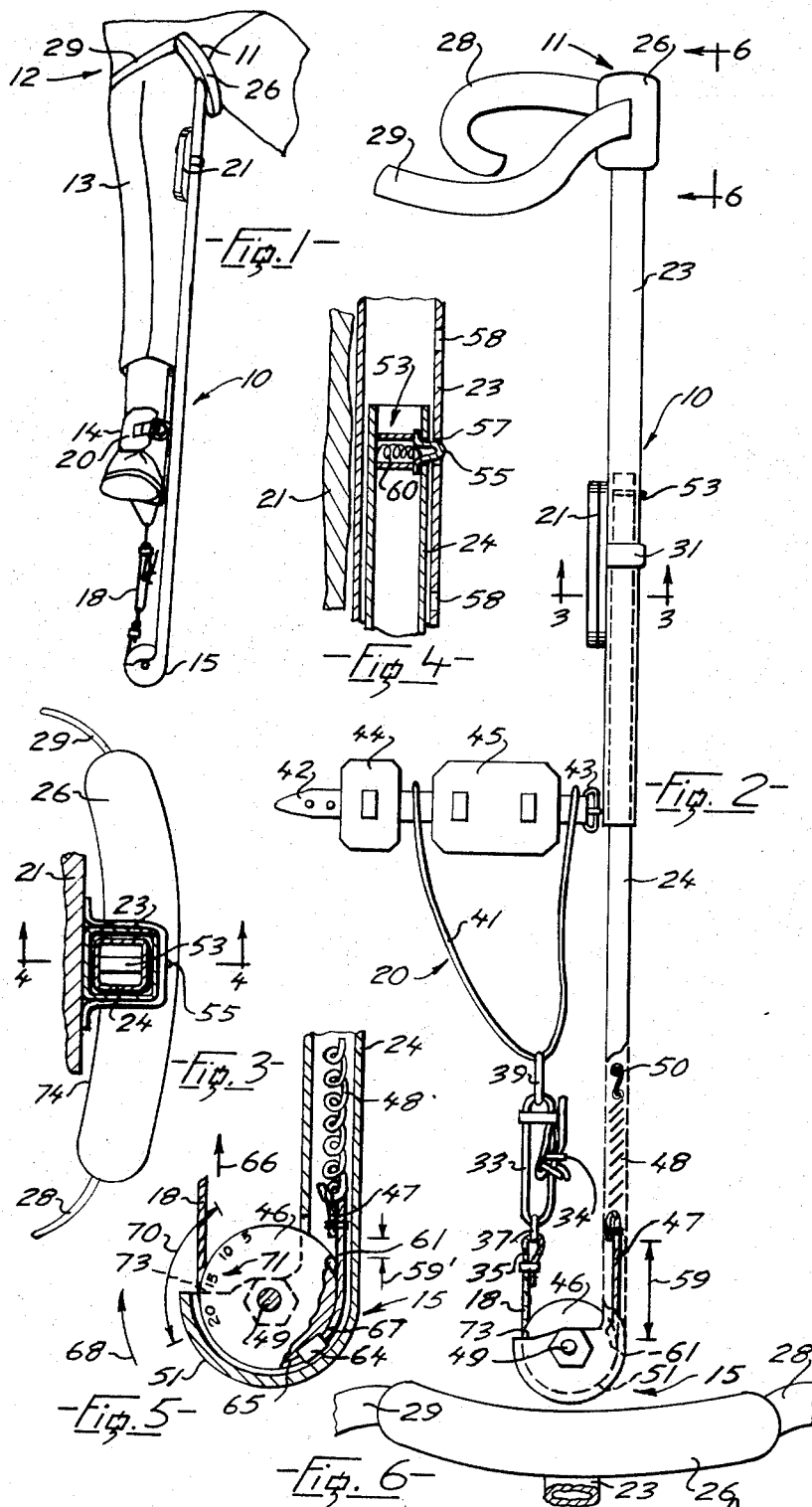
Traction splint to maintain alignment of leg with fractured long bone. Splint has telescoping tubes, upper tube having crotch piece to locate end of splint against perineum, and lower tube, slidable within upper tube for splint length adjustment. Harness to fit around ankle of fractured leg is secured to one end of cable, opposite end of cable secured to spring secured to lower tube. Lower tube has pulley at lower end for cable, so as to reverse tension of spring to apply traction to leg. Cable is engaged with pulley so as to prevent slippage and circumferential graduations on pulley read in conjunction with index indicates traction on leg. Stop means limits rotation of pulley above maximum design traction.

10 Claims, 6 Drawing Figures

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EMERGENCY TRACTION SPLINT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to an emergency splint for primary treatment of a fracture of a long bone in a leg, where traction is indicated as a temporary therapy, — being particularly adapted for treatment of femoral fractures.

2. Prior Art

Splints can be divided into two types; namely firm splints in which alignment is maintained by binding the limb to be treated against a rigid support — these have been known since ancient times — and traction splints in which the limb is maintained in alignment by applying a small tensile force, termed traction, to ends of the limb to overcome contraction forces of the muscles which tend to pull the limb out of alignment.

Traction splints are disclosed in U.S. Pat. 350,526 and 3,477,428 issued respectively to Bunce in 1886, and to Hare in 1969. The devices of these patents tend to be cumbersome and slow to set up, and neither of the traction devices has a positive means to locate the splint at an upper end, or means to indicate magnitude of the traction applied to the leg. Magnitude of the traction applied is difficult to determine, and tends to decrease with time due to lack of positive location of the upper end of the splint. As is well known, if traction drops below a minimum, misalignment of the leg can take place.

SUMMARY OF THE INVENTION

The invention reduces difficulties and disadvantages of the splints known to the inventor by providing a light weight splint that is easily adjusted to a wide range of leg lengths for either leg, has a positive anchor or location means at an upper end, and also gives an indication of the magnitude of traction applied.

One embodiment of the invention includes telescoping upper and lower tubes, the upper tube having an anchor adapted to fit against, and be held in, the crotch, the lower tube having a pulley. Complementary means cooperating with the tubes permit axial sliding of the tubes for length adjustment, while preventing relative rotation, and releasable locking means lock the tubes together when at a desired length. A flexible tension link, for example a cable, has an outer end secured to a harness adapted to engage the ankle of the fractured leg, and an opposite end of the cable secured to a resiliently extensible member attached to the lower tube. Measuring means are provided to give an indication of magnitude of traction applied to the fractured leg, one such means being circumferential graduations on the pulley to be read in conjunction with an index. Engaging means lock the cable to the pulley for positive drive between the cable and the pulley, and stop means provided on the cable restricts rotation of the pulley to a maximum of one revolution.

A detailed description following, related to drawings, gives exemplification of apparatus according to the invention which, however, is capable of expression in means other than those particularly described and illustrated.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective of a traction splint according to the invention in engagement with a fractured limb,

FIG. 2 is a fragmented front elevation of the traction splint, with portions removed to show interior construction,

FIG. 3 is a simplified fragmented detail section on 3—3 of FIG. 2,

FIG. 4 is a simplified fragmented section 4—4 of FIG. 3,

FIG. 5 is a detail of a lower portion of the splint, with portions removed,

FIG. 6 is a fragmented side elevation on 6—6 of FIG. 2.

DETAILED DISCLOSURE

FIG. 1

A traction splint 10 according to the invention has an upper end 11 held adjacent the crotch of a patient 12. The patient has a fractured right leg 13, having an ankle 14, the fracture being of the femur, tibia, and/or fibula. A lower end 15 of the splint extends below the ankle 14, the leg 13 being held in traction by a flexible tension link, here exemplified as a cable 18, extending under tension from the lower end 15. A harness 20 is secured to an outer end of the cable 18 and fits comfortably around the ankle 14 to apply traction from the cable 18 to the leg 13. A knee pad 21, held between the knee cap and the splint 10, cushions the leg against the splint.

FIGS. 2 through 4

The splint 10 has telescoping upper and lower tubes 23 and 24, cross-sections of the tubes being complementary, in this example square as seen in FIG. 3. Such a cross-section serves as complementary means to prevent rotation of one tube relative to the other whilst permitting relative axial sliding of the tubes so as to permit change in length of the splint. The upper end 11 has a padded crotch piece 26 serving as a positive location means when pressed against the crotch, the piece 26 being generally rectangular in cross-section as seen in FIG. 2, and curved in two planes, as seen in FIGS. 3 and 6. As seen in FIG. 2, straps 28 and 29 extend from the crotch piece 26 to hold it against an upper end of the thigh, see FIG. 1. Ends of the straps are securable by nylon hook tape sold under the trade name Velcro, a registered Trade Mark of Canadian Velcro Ltd. Other releasable straps and strap fastening means can be used, such as a buckle. The knee pad 21 is slidably secured to the upper tube 23 by a strap 31, the strap permitting sliding of the pad along the tube to accommodate different leg lengths.

The harness 20 FIG. 2 has a lower strap 33 and a buckle 34 forming an adjustable loop, the strap 33 passing through a first ring 37 secured in an eye 35 at an outer end of the cable 18. A second ring 39 is looped through the strap 33 and secures an intermediate strap 41 in a general V-shape, outer ends of the strap 41 being threaded on a circumferential strap 42 which has a buckle 43 securing it around the ankle as seen in FIG. 1. Flexible pads 44 and 45 are threaded on the strap 42, the pads being slidable along the strap for adjustment for a comfortable fit around a bare ankle, or if necessary, around a boot.

The cable 18 extends from the lower end 15 of the splint and passes around a pulley 46 journaled on a spindle 49, the spindle being secured in a hood 51 adjacent the end 15. The cable 18 has an inner end 47 secured to one end of a resiliently extensible member,

here exemplified as a tension coil spring 48, an opposite end of the spring being anchored to a pin 50 secured in the inner tube at a position later particularized.

A spring-loaded plunger 53 FIG. 4 serving as a releasable locking means to lock the tubes axially, extends transversely across the inner tube 24. The plunger has a domed cap 55 standing proud of the inner tube 24 so that, when the cap extends through a hole 57 of the outer tube 23, the inner tube is located relative to the outer tube. The hole 57 is one of a series of spaced longitudinally aligned holes severally 58. The holes are pitched at intervals of about two inches, thus providing coarse adjustment for length of the splint. The cap 55 is urged outwards by a compression spring 60, and can be depressed to a lowered position (not shown) in which the inner tube can be slid relative to the outer tube until a different hole 58 is engaged by the cap.

When the spring 48 is fully retracted and there is no slack in the cable, the inner end 47 of the cable is spaced a distance 59 from a point of contact 61 of the cable with the pulley 46. The distance 59 is important and is described with reference to FIG. 5.

FIG. 5, WITH REFERENCES TO FIGS. 1 AND 2

The cable 18 is engaged with the pulley 46 by a sleeve 64 so as to prevent slipping, the sleeve fitting in a recess 65 of a groove 67 of the pulley. When the harness 20 (FIG. 2) is fitted around the ankle 14 and the spring 48 is barely extended (as in FIG. 2), negligible traction is applied to the leg 13 (FIG. 1). To increase traction, the loop of the strap 33 is made smaller or the splint is extended, either of which pulls an outer end of the cable 18 in a direction of an arrow 66, thus rotating the pulley 46 in a direction of an arrow 68. The end 47 of the cable is thus drawn toward the pulley 46, reducing the distance 59 to 59'.

The pulley 46 has graduations generally 71 being typically 5, 10, 15, and 20 pounds, extending circumferentially around a side wall of the pulley over an arc 70, about ninety degrees. The hood 51 has an upper edge 73, shown in broken outline in FIG. 5 and in full outline in FIG. 2. The upper edge serves as an index for reading the graduations 71 to indicate load on the cable 18, the graduations and upper edge 73 serving as measuring means to indicate magnitude of traction applied to the leg. Length and force constant of the spring 48 and position of the pin 50 are selected so as to permit traction within a range of between about 5 pounds and about 20 pounds to be applied to the leg, for about a 90 degree arc of the pulley 46.

Rotation of pulley 46 in the direction of the arrow 68 is limited by interference of the end 47 of the cable with the pulley. Interference above serves as an automatic stop means to prevent overloading and, slightly before the pulley is stopped as above, the upper edge 73 is in register with the 20 pound graduation on the pulley. Care should be taken to ensure that the stop means becomes operative at a traction somewhat above maximum design traction as indicated by the graduations. This is to ensure that there is resiliency in the cable 18 at maximum indicated traction, thus indicating that the measuring means is still operative at maximum indicated traction. This is to reduce possibility of applying an excessive traction which would jam the stop means against the pulley so that the measuring means would indicate a load above the maximum trac-

tion, which indication would not change with further increase in traction applied to the leg.

Clearly the measuring means become inoperative after full scale deflection is reached. A wider range of traction can be attained by increasing the distance 59, thus permitting the pulley to rotate through an arc greater than the arc 70. The arc 70 can extend up to a maximum of 360°, that is the pulley can rotate from a minimum to a maximum load through one complete revolution.

Thus, as can be seen in FIG. 2, the dimension 59 represents extension of the cable 18 due to extension of the spring 48 from a no-load position to a full-load position, and is equal to the arc length 70.

FIGS. 3 AND 6

The crotch piece 26 is padded for comfort, and, as before stated, is generally rectangular in section (FIG. 2). The piece 26 is curved in two planes, and has an inner surface 74 (FIG. 3). The piece 26 curves as shown in FIG. 3, so that the inner surface 74 conforms generally to an inside surface of the right thigh, and as seen in FIG. 6, the piece 26 curves generally upwards to conform to curvature of the perineum.

If the splint is to be used on the left leg, the splint is rotated through one hundred and eighty degrees and the piece 26 is then strapped to the left thigh (not shown) by the straps 28 and 29.

OPERATION

The patient lies on his back on a horizontal surface and the splint 10 is placed between his legs with the inner surface 74 of the crotch piece 26 adjacent an upper end of the fractured leg e.g. the right leg. The crotch piece is pushed up into the crotch until it fits snugly against the tuberosity of the ischium and the perineum. The straps 28 and 29 are then secured around the thigh of the fractured leg, holding the upper end of the splint to the fractured leg. Alignment of the leg is maintained manually and, with slack in the cable 18, the strap 42 is buckled around the ankle 14, enclosing the ankle with the harness 20, the flexible pads 44 and 45 being moved along the strap 42 until a comfortable position is attained. The domed cap 55 of the spring-loaded plunger 53 is depressed and the lower tube 24 is slid relative to the upper tube 23, extending the splint to a length several inches greater than the length of the fractured limb (see FIG. 1), to a position which applies negligible traction to the leg, the cable 18 remaining essentially slack throughout. The knee pad 21 is slid along the splint until it is adjacent the knee. The loop of the strap 33 is tightened until a desired traction is indicated on the pulley 46, as read by sighting perpendicularly onto the upper edge 73, thus avoiding parallax difficulties. The strap 33 serves as a fine adjustment for traction, spacing of holes in the strap 33 for the buckle 34 being less than spacing between adjacent holes 58 in the outer tube 23.

ALTERNATIVE EQUIVALENTS

Alternative means of fine adjustment could be used, e.g. a turnbuckle (not shown) provided between the ring 39 and the eye 35, thus eliminating the strap 33.

The upper edge 73 is used as an index for reading the graduations on the pulley 46. Other indices can be used, such as a pointer or opening in the hood.

The cable 18 is one example of a flexible tension link connecting the spring 48 to the harness 20, which, in combination with the pulley 46, reverses tension of the spring. Other flexible tension links can be used, such as a chain, in which case a graduated sprocket would be substituted for the pulley 46, positive engagement being automatically attained. Clearly, as a limited arc of the pulley is used, a journalled sector of a pulley can be substituted for the pulley. Hereinafter, such devices to reverse tension of the spring are referred to as tension reversing means. If a chain and sprocket were used, means to prevent the chain from leaving the sprocket would be provided, so as to maintain correct calibration of the graduations on the sprocket.

The pulley 46 as shown is limited to rotation through one revolution. If, for full extension of the spring, the pulley were to rotate more than one complete revolution, an additional series of graduations would be provided to indicate an increase in traction about that shown by the graduations for up to one revolution. Other releasable locking means to lock the inner and outer tubes can be used, such as a clamping screw threaded in the outer tube and having an inner end adapted to be screwed against the inner tube.

The pulley 46 is restricted against excessive further rotation beyond full scale deflection by the stop means as illustrated, namely the end 47 of the cable 18. Other stop means can be provided, such as a projection (not shown) on the pulley adapted to interfere with the hood 51 at a traction slightly above maximum indicated traction. All equivalent stop means are thus adjacent the tension reversing means and are adapted to prevent excessive further rotation of the reversing means beyond maximum design traction.

I claim:

1. A traction splint to maintain alignment by traction of a fractured leg of a patient for temporary therapy, the splint having upper and lower ends and including:
 - a. telescoping upper and lower tubes, the tubes being extensible and retractable to permit change in length of the splint, and restricted against relative rotation, the tubes having a releasable locking means to lock the tubes axially,
 - b. a crotch piece at the upper end of the splint to locate the upper end of the splint relative to the crotch, the crotch piece having a strap to hold the upper end of the splint against an upper portion of the leg so that the crotch piece is held against the tuberosity of the ischium and the perineum,
 - c. a flexible tension link having outer and inner ends, the outer end of the link having a harness to fit around the ankle, the inner end of the link having a resiliently extensible member having one end secured thereto, an opposite end of the resiliently extensible member being secured adjacent the lower end of the splint,
 - d. tension reversing means at the lower end of the splint, which means are complementary to and engaged by the flexible tension link so that the flexible tension link is located relative to the tension reversing means to prevent slippage therebetween, the tension reversing means having peripherally spaced graduations and an index adjacent the reversing means for reading the graduations, so that when the crotch piece is held against the upper end of the leg by the strap and is urged against the perineum, tension in the flexible tension link arising

from extension of the resiliently extensible member is reversed by the tension reversing means to apply traction to the leg tending to maintain the leg in alignment, the tension in the flexible tension link being measured by sighting the graduations in combination with the index.

2. A traction splint as claimed in claim 1 wherein
 - i. the upper and lower tubes have complementary square cross sections to prevent rotation of one tube relative to the other whilst maintaining relative axial sliding.
3. A traction splint as defined in claim 1 in which:
 - i. the flexible tension link is a cable,
 - ii. the tension reversing means is a pulley,
 - iii. a sleeve is secured to and adjacent an end of the cable passing over the pulley,
 - iv. the pulley has a groove and a recess adjacent the groove, the recess accepting the sleeve so as to prevent slipping between the pulley and the cable when the cable is in tension.
4. A traction splint as claimed in claim 1 wherein:
 - i. the resiliently extensible member extends within the lower tube.
5. A traction splint as claimed in claim 1 wherein:
 1. a lower strap extends between the ankle harness and the outer end of the link, the lower strap forming an adjustable loop serving as a fine adjustment means to apply tension to the flexible tension link.
6. A traction splint as defined in claim 1, including:
 - e. stop means adjacent the tension reversing means adapted to prevent further excessive rotation of the reversing means beyond maximum design traction, constructed and arranged so that maximum design traction to be applied to the leg is attained at traction less than that at which the reversing means is prevented from further rotation due to the stop means.
7. A traction splint as defined in claim 2 in which the stop means includes:
 - i. an end of the flexible tension link, constructed and arranged so that the end interferes with the pulley and prevents further rotation of the pulley at a traction greater than maximum design traction to be applied to the leg.
8. A traction splint as defined in claim 1 in which the tension reversing means includes:
 - i. a pulley, and the flexible tension link includes:
 - ii. a cable, constructed and arranged so that the cable runs in the groove of the pulley and reverses tension in the flexible tension link arising from extension of the resiliently extensible member.
9. A traction splint as defined in claim 1 in which the releasable locking means includes:
 - i. a spring-loaded plunger extending transversely across the inner tube, the plunger having a domed cap adapted to stand proud of the inner tube,
 - ii. a series of spaced, longitudinally extending, aligned holes in the outer tube, one hole of which is adapted to be engaged by the domed cap at one time, constructed and arranged so that when the cap is urged outwards and engages one hole in the outer tube, the inner tube is locked relative to the outer tube, and when the cap is depressed to a lowered position the inner tube can be slid relative to the outer tube to change length of the splint.
10. A traction splint as defined in claim 1 in which the index includes:
 - i. a hood partially enclosing the tension reversing means,
 - ii. the hood having an upper edge adjacent a portion of the reversing means so as to serve as an index for reading graduations on the tension reversing means.

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