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AMBULATORY SPLINT AND TRACTION DEVICE

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2 Sheets-Sheet 2

FIG. 3.

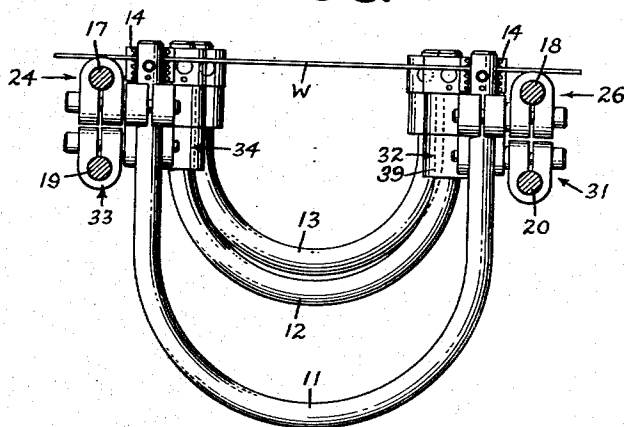


FIG. 4.

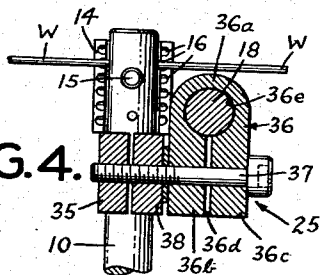


FIG. 5.

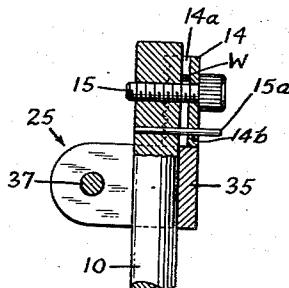
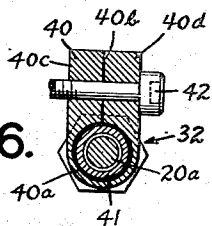


FIG. 6.



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AMBULATORY SPLINT AND TRACTION
DEVICE

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5 Claims. (Cl. 128—84)

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This invention relates to orthopedic devices and it relates particularly to improvements in ambulatory splints, bone lengthening and fracture reducing devices and splints for receiving or transferring fractured or lengthened limbs from fracture reducing and bone lengthening apparatus.

Heretofore, the traction apparatuses used for reducing fractures or for surgically lengthening limbs have used bone pins to penetrate and support fractured or separated portions of a bone during the reduction of the fracture or during the bone lengthening operation. Such pins, due to their comparative rigidity, lend themselves to ready transfer to an ambulatory splint. However, the diameter of such pins requires that holes of substantial diameter must be drilled through the bone sections with the result that healing of the bone requires a substantial period of time after the pins are withdrawn.

Tensioned wires, such as Kirschner wires, are superior to the pins to the extent that they may be used with less damage to the bone. However, such wires have not been used when the limb is to be transferred to an ambulatory splint because of the difficulty in maintaining the required high tension on the wires during the transfer procedure.

The present invention relates to an improved type of splint which may be used with fracture reducing and bone lengthening apparatus utilizing tensioned wires. The improved splint is constructed and arranged to receive the fractured or lengthened limb from the apparatus without loss of tension on the wires. The new splint can be adjusted and made rigid to serve as an ambulatory splint, and, if desired, it can include adjusting mechanism to render it useful as a bone lengthening and fracture reducing apparatus.

More particularly, the apparatus includes a plurality of yoke members each of which is provided with a pair of arcuate wire gripping and tensioning jaws adapted to receive a portion of a tensioned wire passing through the fractured or lengthened limb. As the jaws are closed to grip the already tensioned wire, the portions of the wire within the jaws are bent thereby exerting increased tension on the wire and gripping it tightly on opposite sides of the limb to maintain tension when the wire is released from the fracture reducing or bone lengthening apparatus.

The yoke members may be maintained in spaced relation by pairs of rigid rods interposed between each pair of yoke members. Each end

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of a rod is connected to a yoke by means of a pair of pivotally connected split sleeves which are slidable on the rod and an arm of the yoke to permit suitable positioning of the rod relative to the yoke. The two split sleeves of each connecting member are connected by means of a screw, which, when loosened, permits pivoting movement of the sleeves and sliding movement relative to the yoke and the rod. When the screws are tightened, the sleeves are clamped securely to the rod and the yoke and are fixed relative to each other. In this way, each yoke may be anchored rigidly to a pair or to two pairs of spacing rods by tightening only one screw for each split sleeve connection. This arrangement for clamping or locking the yokes and rods in fixed relation greatly simplifies the adjustment of the splint, either when used as a transfer splint or an ambulatory splint.

The yokes preferably are made of rod stock of suitable metal, for example, aluminum alloy, stainless steel or the like, of circular cross-section. By using such a circular rod, the split sleeves engaging the yokes can be adjusted lengthwise and angularly around the arms of the yokes to permit almost universal adjustment of the yokes relative to the spacing rods, thereby greatly facilitating the adjustment of the splint.

The splint can also be provided with mechanism permitting controlled traction to be applied to the limb for reducing fractures or lengthening limbs.

For a better understanding of the present invention, reference may be had to the accompanying drawings, in which:

Fig. 1 is a plan view of a typical splint embodying the present invention, partly broken away;

Fig. 2 is a view in side elevation of the splint shown partly in section to disclose details thereof;

Fig. 3 is a view in section taken on line 3—3 of Fig. 2;

Fig. 4 is a view in section taken on line 4—4 of Fig. 1;

Fig. 5 is a view in section taken on line 5—5 of Fig. 1;

Fig. 6 is a view in section taken on line 6—6 of Fig. 2;

The form of splint described hereinafter may be of a type including four yoke members 10, 11, 12 and 13 of graduated sizes although more or fewer than four of such yokes may be used, if desired. The yokes 10 to 13 are formed of circular rod stock such as stainless steel rod, alu-

minum alloy rod or the like. The yokes, as shown in Fig. 3, are substantially U-shaped, but their shape may be varied, if desired.

The upper end of each arm of a yoke, for example, the yoke 10, is provided with a means for gripping a highly tensioned wire W of the Kirschner wire type. This means may consist of an arcuate clamping plate or jaw 14 having an inner concave surface 14a generally complementary to the arcuate surface of the arm of the yoke. The clamping plate or jaw 14 may be adjusted toward the yoke by means of a socket head screw 15 adapted to be turned by a suitable wrench, such as an Allen wrench, to bring the arcuate plate into tight engagement with the portion of the wire W interposed between the jaw or plate 14 and the yoke arm. Rotation of the jaw 14 around the screw 15 is prevented by means of a guide pin 15a fixed to the arm of the yoke and slidably received in a hole 14b in the jaw 14, as shown in Figure 5. It will be seen by an inspection of Fig. 1 that if the opposite ends of a wire W are gripped tightly and the wire is subjected to tension, tightening of the screw 15 will cause the wire to bend or flex around the arm of the yoke and will subject the wire to even greater tension because, in effect, the action of the clamping plate or jaw 14 is to lengthen the wire.

In order to avoid bending the wire too sharply as it passes from beneath the edge of the clamping plate or jaw 14, the inner edges of the jaw may be provided with a series of notches 16 (Fig. 4) which allow the wire to bend on a more gradual curve. These notches also serve to position the wire against movement axially of the arms of the yoke.

By utilizing the four yokes as shown in Figs. 1 and 2, four wires may be gripped, two wires passing through the bone portion on one side of the fracture or cut and the other two passing through the other bone portion on the other side of the fracture or cut.

To enable the bone portions to be fixed relative to each other, the several yokes 10, 11, 12 and 13 are maintained in spaced relation by means of pairs of spacing rods 17 and 18 interposed between the yokes 10 and 11, rods 19 and 20 interposed between the yokes 11 and 12 and rods 21 and 22 interposed between the yokes 12 and 13. Each rod is connected at one end to a corresponding yoke by means of the universally adjustable connecting devices 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33 and 34. The connecting devices 23 to 31 and 33 are identical in construction as may also be the connecting devices 32 and 34, if desired. The connecting device 25, for example, may consist of a pair of generally U-shaped split sleeves 35 and 36 which are the same in construction. As best shown in Figs. 4 and 5, the sleeve 36 has a rounded base portion 36a and a pair of spaced apart parallel arms 36b and 36c. These arms are separated by a slot 36d which communicates at its inner end with a circular opening 36e in which the rod 18 is received slidably. The sleeve 35 is similar in construction and has an opening 35a receiving the arm of the yoke 10 (Fig. 2). The two sleeves are connected by means of a socket head screw 37 which serves as a pivot for connecting the two sleeves 35 and 36 and also as a clamping means, when tightened, for squeezing the arms of the split sleeves 35 and 36 together to clamp them tightly around the yoke arm and the rod 18, respectively. A corrugated washer 38 or the like may be positioned between the sleeves to

prevent relative movement of the two split sleeves 35 and 36, when the screw 37 is tightened.

When the screw 37 is loosened, the split sleeves 35 and 36 may be rocked about the axis of the screw 37 and can slide along the yoke 10 and the rod 18, respectively, into any desired position to permit adjustment of the yoke relative to the rod, to vary the inclination of the yokes relative to each other and to vary the spacing between them.

The connecting devices 32 and 34 preferably are used to adjust the spacing between the yokes 11 and 12 and are alike. The device 32 (Figs. 1, 2 and 6) includes a split sleeve 39 similar to the sleeve 35 described. The connected split sleeve 40 differs in that it has an enlarged passage or bore 40a therein for receiving rotatably an internally threaded bushing 41. The bushing has flanges 41a, 41b at its opposite ends to prevent endwise movement of the bushing in the sleeve. The flange 41a is noncircular permitting rotation of the sleeve with a wrench. The slot 40b between the arms of the split sleeve 37 is of such width that the arms 40c and 40d of the sleeve can be squeezed tightly together without clamping the bushing 41 against rotation. The bushing is rotatable even when the connecting screw 42 extending through the sleeves 39 and 40 is tightened sufficiently to hold them rigid with respect to each other.

The threaded bushing 41 receives the threaded end section 20a on the rod 20 so that the spacing between the pair of yokes 10 and 11 and the pair of yokes 12 and 13 may be varied by rotating the bushing 41 when all the yokes are rigidly clamped in position. The rod 19 is connected to the yoke 12 by a connecting and adjusting coupling 34, like the coupling 32 described above so that it too may be adjusted to position the several sets of yokes.

The provision of the adjustable couplings 32 and 34 and the threaded end portions on the rods 19 and 20 renders the apparatus useful for bone-lengthening operations. Thus, with the yokes and wires in position with respect to the bone, and the yokes locked in position, the bone may be severed in the usual way and the bushings 41 then rotated to separate the pairs of yokes 10 and 11 further from the pair of yokes 12 and 13. The severed sections of the bone slide relatively endwise without altering their alignment during adjustment of the spacing of the yokes.

Similarly, the apparatus can be used for reducing fractures and as a traction or ambulatory splint.

It will be understood that the apparatus is susceptible to change in its dimensions, the materials from which it is made may be selected according to requirements, and the shape and design of the parts may be altered without departing from the invention. The form of the invention disclosed herein therefore should be considered as illustrative and not as limiting the scope of the invention.

I claim:

1. An ambulatory splint and bone lengthening device comprising a first pair of U-shaped yokes, a second pair of U-shaped yokes, each of said yokes having a pair of substantially parallel arms connected by an arcuate base, means at the outer end of each arm for gripping a bone-penetrating member, a first pair of rods connecting the first pair of yokes, a second pair of rods connecting the second pair of yokes, first connecting means joining each end of a rod to a yoke, said first connecting means including a pair of split sleeves normally slidable on the yoke and a rod, and a

connecting and clamping screw passing through and joining said split sleeves, a third pair of rods connecting one yoke of the first pair to one yoke of the second pair, each of said third pair of rods having a threaded end portion, second connecting means including split sleeves and a connecting and clamping screw connecting one end of each rod of the third pair to said one yoke of said first pair, other connecting means between the opposite ends of the third pair of rods and said one yoke of the second pair, each of said connecting means including a first split sleeve slidable on an arm of the last-mentioned yoke, a second split sleeve connected by a clamping screw to said first split sleeve, said second split sleeve having a bore therethrough, an internally threaded bushing mounted in said bore for rotation and receiving the threaded end of one of said third pair of rods, and means on said second sleeve and bushing retaining the latter against relative axial movement.

2. An ambulatory splint and bone lengthening device comprising a first pair of U-shaped yokes, a second pair of U-shaped yokes, each of said yokes having a pair of substantially parallel arms connected by an arcuate base, means at the outer end of each arm for gripping a bone-penetrating member, means connecting said yokes of each pair for angular adjustment and to vary spacing between said yokes of each pair, a pair of rods connecting one yoke of the first pair to one yoke of the second pair, each of said pair of rods having a threaded end portion, first connecting means including split sleeves and a connecting and clamping screw connecting one end of each rod to said one yoke of said first pair of yokes, other connecting means between the opposite end of each of the last-mentioned rods and said one yoke of the second pair of yokes including a first split sleeve slidable on each arm of the last-mentioned yoke, a second split sleeve connected by a clamping screw to said first split sleeve, said second split sleeve having a bore therethrough, an internally threaded bushing mounted in said bore for rotation and receiving the threaded end of a rod, and means on said second sleeve and bushing retaining the latter against relative axial movement.

3. An ambulatory splint comprising a pair of U-shaped yokes having substantially parallel arms of circular cross-section, means on each of said yokes to grip and tension a wire, a pair of spacing rods of circular cross-section interposed between the pair of yokes, each of said rods having a threaded portion at one end and an opposite unthreaded end, internally threaded bushings screwed on said threaded portions, a split sleeve mounted for sliding and rotary movement on each arm of said yokes, a split sleeve mounted for sliding and rotary movement on the unthreaded end of each of said spacing rods, another pair of split sleeves receiving said bushings rotatably and screw means connecting said split sleeves on the unthreaded ends of the rods with split sleeves on one of said yokes and the split sleeves receiving the bushings with the split sleeves on

the other yoke to connect them for swivelling movement and to lock them against swivelling movement.

4. An ambulatory splint comprising a pair of U-shaped yokes having substantially parallel arms of circular cross-section, means on each of said yokes to grip and tension a wire comprising: clamping plates having a concave surface substantially complementary to a portion of the cross-section of said arms of said yokes, wires passing between said arms and clamping plates of each said yokes, set screws passing through each of said plates and threaded into said arms to draw said plates and arms together and to thereby exert tension on said wires, a pair of spacing rods of circular cross-section interposed between the pair of yokes, each of said rods having a threaded portion at one end and an opposite unthreaded end, internally threaded bushings screwed on said threaded portions, a split sleeve mounted for sliding and rotary movement on each arm of said yokes, a split sleeve mounted for sliding and rotary movement on the unthreaded end of each of said spacing rods, another pair of split sleeves receiving said bushings rotatably and screw means connecting said split sleeves on the unthreaded ends of the rods with split sleeves on one of said yokes and the split sleeves receiving the bushings with the split sleeves on the other yoke to connect them for swivelling movement and to lock them against swivelling movement.

5. A yoke for an ambulatory splint comprising a U-shaped yoke having a pair of substantially parallel arms of circular cross-section, clamping plates each having a concave surface substantially complementary to the curvature of said arms of said yoke to receive a wire between said plates and said arms, screws extending through each of said plates and arms to draw said plates toward said arms and to exert tension on said wire, guide pins on each of said arms engaging in said plates and holding them against relative rotation when said arms and plates are drawn together and notches in the edges of said plates guiding and positioning said wire and preventing sharp bending of said wire when said plates and arms are drawn together.

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