May 27, 1941. A. L. STEARNS 2,243,294

FRACTURE REDUCING DEVICE

Filed Oct. 24, 1938 2 Sheets-Sheet 1

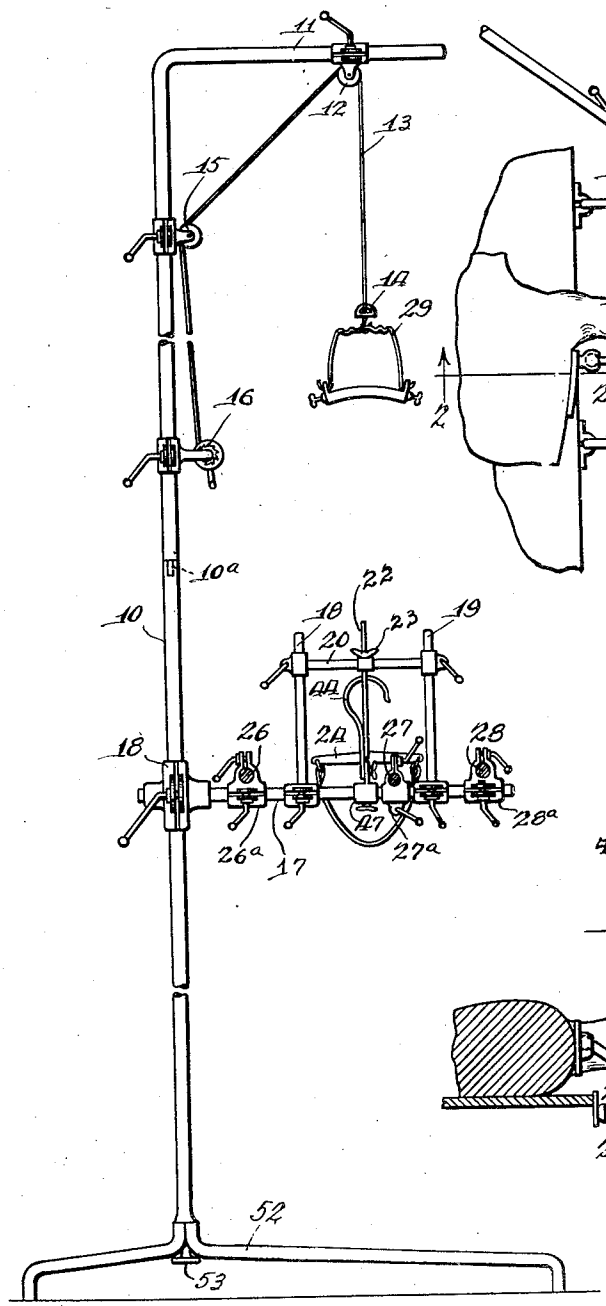

Fig. 1.

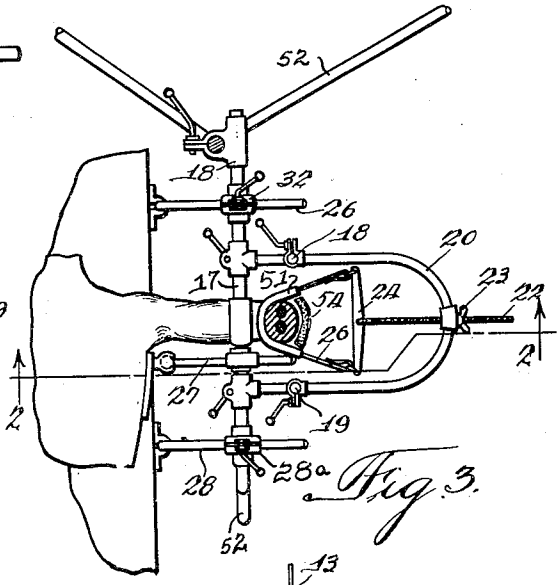

Fig. 3.

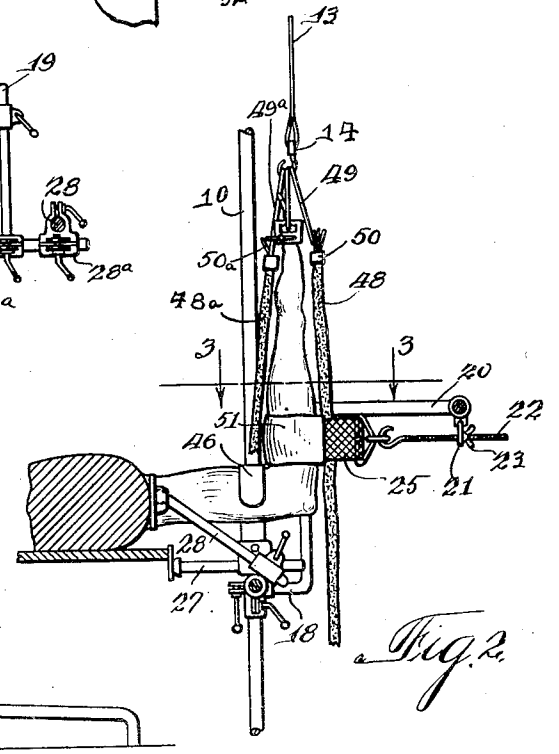

Fig. 2.

Inventor
Alexander L. Stearns.
By Amos, Thies, Ober & Mecklenburg.
Attys.

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FRACTURE REDUCING DEVICE

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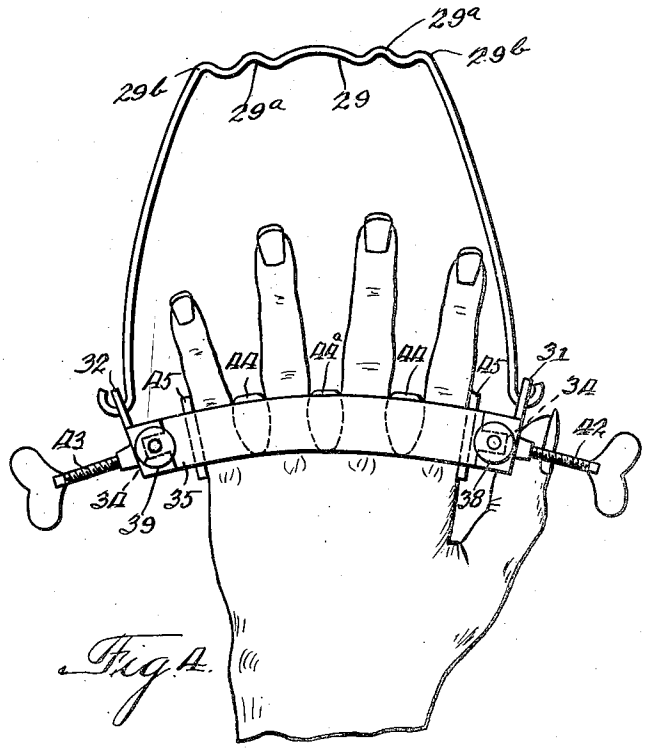

Fig. 4.

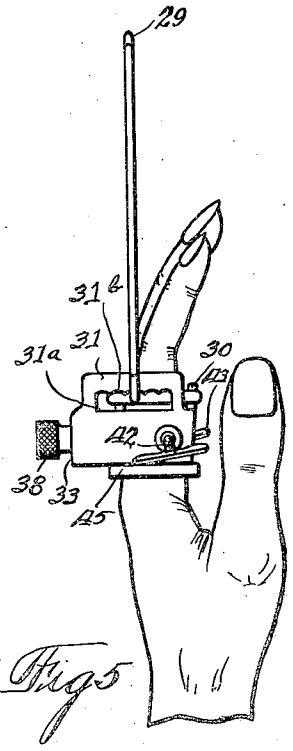

Fig. 5

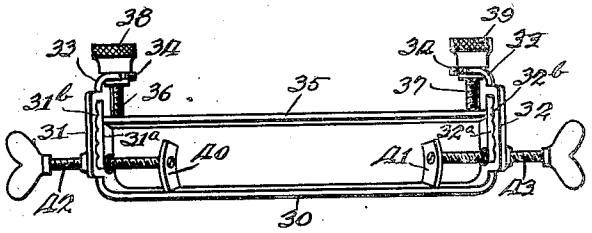

Fig. 6.

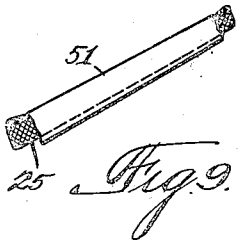

Fig. 9.

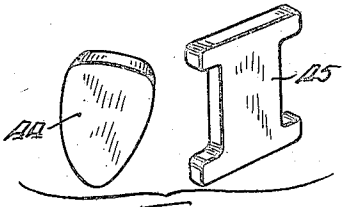

Fig. 7.

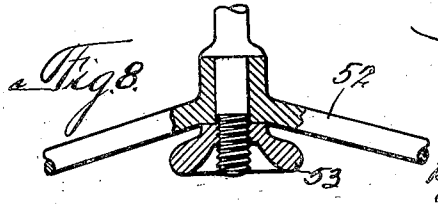

Fig. 8.

Inventor
Alexander L. Stearns
By: Arms, Thies, Oles & Mecklenburg.
Attys.

Patented May 27, 1941

2,243,294

UNITED STATES PATENT OFFICE

2,243,294

FRACTURE REDUCING DEVICE

Alexander L. Stearns, Chicago, Ill.

Application October 24, 1938, Serial No. 236,641

8 Claims. (Cl. 128—84)

This invention relates to surgical appliances and more particularly to a fracture reducing apparatus for the application of controlled traction and countertraction to the extremities of the human body.

The application of traction and countertraction to bodily extremities for the purpose of reducing fractures and for the general treatment of nerves and muscles has long been recognized by the medical world as desirable. This method of treatment is particularly important in the reduction of fractures where controlled application of traction to the broken member for comparatively long periods of time is essential in order to permit the broken portions to be manipulated into proper alignment and be permanently affixed in suitable splints or plaster casts which hold the fractured parts in place until the bones have knitted.

In the reduction of fractures it has been usual to require one or more assistants who aid in the application of traction and attempt to maintain immobility of the affected parts as well as can be done with the usual fracture reducing devices. This immobility is essential so that the operator may bandage and fixedly encase the broken member after it has been manipulated into the proper alignment. The encasement ordinarily consists of a soft, wet plaster bandage mould applied to the affected parts and molded thereto. About this a circular bandage is wrapped and the plaster allowed to dry. The result is a firm cast of sufficient rigidity to effectively prevent motion of the opposed parts, ensuring retention of the proper alignment of the bones during the knitting process.

The devices previously employed in the reduction of fractures lacked versatility and permitted the setting of only one fracture at a time. It is an object of this invention to provide a versatile apparatus whereby one may set fractures of either the upper arm or the forearm separately, or, if the case so requires, both may be set at the same time without loss of control, degree of tension, or of the flexibilty of operation which is so necessary in the proper reduction of fractures.

As shown and described herein, this invention is considered as applied to the arms of a human. However, it is of course applicable to any anatomical structure wherein proximal and distal bone segments, having their adjacent ends interengaged to articulate, require the controlled application of traction and countertraction. Nor is the utility of this device limited to the uses shown as it may be applied to other medical uses, as will readily be apparent to one skilled in the art.

It is well known that, in the reduction of fractures, control of the relative angular positions of the upper arm and forearm, together with control of the relative placement of the ulna and radius of the lower arm is of extreme importance. It is therefore an object of this device to provide a fracture reducing apparatus wherein the amount of traction and angle of application may be under the control of a single operator to thereby retain the affected portion in the physical apposition most conducive to a prompt knitting of the fractured bones. Thus, in a fracture of the radius, particularly an oblique fracture, it is important that the main muscles connected to the radius be relaxed, and to that end this apparatus permits the angular placement of the injured parts so as to relax said muscles as much as is possible during the manipulating operation.

Previous fracture reducing devices employ methods for gripping or slidably clamping the hand in order to provide traction to the forearm or arm. These methods, because of the inherent structural limitations of such devices, ordinarily impede the circulation of blood to the finger tips. This is not only painful to the patient, but is highly undesirable from a physiological standpoint as such impeded circulation soon causes temporary paralysis and partial atrophy of the distal portion of the hand. Also, as the extensor and flexor ligaments lie closely adjacent the phalanges and are readily compressed thereagainst, and as the usual hand-grasping device exerts a strong pressure upon these ligaments pressing them against the phalanges, the tissues and ligaments may thereby be severely bruised and mutilated, retarding the recovery of the use of the injured member and increasing the discomfort to the patient. In addition, these methods of grasping the hand frequently exert considerably more pressure on the hand than is necessary to hold it immobile and consequently cause unnecessary pain and suffering.

The defects in previous methods materially limit the effective time that traction may be applied with prior devices and make virtually impossible the application of traction for a sufficient length of time to totally tire the muscles of that member so as to permit manipulation to secure the proper apposition of the broken parts.

It is, therefore, an object of this invention to provide a hand-grasping apparatus which not only securely engages the hand so as to leave unimpeded the circulation of the blood to the ex-

tremity thereof, and does not compress the tendons against the bones of the hand, but which also regulates the amount of pressure applied to the hand so that it automatically is proportioned to the degree of tension applied. Therefore, only sufficient pressure is applied to retain a secure grip without injury and with minimum discomfort.

A further object of this invention is to provide a self-locking grip wherein the hand of the patient may be grasped by a force which increases as the amount of traction increases and in which the possibility of the hand slipping from the device is reduced to a minimum.

Another object is to provide a combined hand-gripping and traction-applying apparatus whereby the amount of traction applied may be instantly controlled in amount and direction of application by a single operator so that any desired angular relation of the bones being set may be obtained by a single operation and which adjustment will be permanently retained without the necessity for additional manipulation during the encasing of the arm.

A further feature of this invention is the provision of a fracture reducing device requiring a minimum number of parts and manufacturing operations and wherein objectionable and interfering projections and protrusions are avoided and Roentgenogram examination and fluoroscopy of the affected part may readily and repeatedly be made throughout the reducing operation.

With this invention any degree of palmar flexion or extension of the wrist may be attained and retained for any desired period of time with the consequent tension or relaxation of the flexors, as desired. Likewise and simultaneously any degree of ulnar or radial abduction may easily be attained together with any amount of pronation or supination. In addition, any desired angle of flexion or extension of the elbow joint may be assured.

The apparatus lends itself readily to any of the usual methods of operative reduction of fractures and is of particular value when used in conjunction with Kirschner wires or skeletal pins extending through the terminal or other portions of the member wherein the fracture lies.

This device is of particular utility where a compound fracture is involved with the resulting exposure of a large divided area which cannot be covered with a cast or other permanent arm encasing structure. In this event, this device may be used alone as the sole means of placing and keeping the injured member under traction while the patient is hospitalized.

Further objects will be apparent from the specification and the appended claims.

In the drawings,

Fig. 1 is a side elevation of one embodiment of the invention and illustrates the supporting stand and tension-applying and reducing means thereon.

Fig. 2 is a side elevation looking from the right of the embodiment shown in Fig. 1 and illustrates the arm-engaging and traction-applying members as applied to a patient.

Fig. 3 is a top plan view partly in section on line 3—3 of Fig. 2 and shows the application of traction to the upper arm.

Fig. 4 is a side elevation of the hand clamp in position on a patient's hand.

Fig. 5 is a side elevation of the hand clamp illustrated in Fig. 4.

Fig. 6 is a top view of the hand clamp.

Fig. 7 is a perspective view of the compressible finger blocks.

Fig. 8 is a side elevation showing one means by which the standard may be detachably secured to its base.

Fig. 9 is a view of the Cellophane envelope applied over the web strap and which remains in the cast when the strap is withdrawn.

Referring to the drawings, in detail, the embodiment illustrated comprises a vertical standard 10, which may be arranged to telescope or may be provided with a suitable separable threaded union 10a. The upper end of this support may be formed to provide an overhanging arm 11.

A traction applying assembly is suspended from the overhanging arm 11 and supported thereby. The traction assembly comprises a pulley 12 on a suitable bracket slidably adjustable on said arm and provided with a clamp screw to retain such adjustment. From this pulley a cable or cord 13 is suspended, one end of which is provided with a suitable swivel hook 14 for detachable engagement with the bail of a hand-grasping device and which it cooperates in a manner shortly to be described in detail. The opposite end of this cord passes through a similar pulley 15 which is adjustably mounted on the standard as shown and is wound upon a suitable winch 16 of conventional construction and supported on a similar adjustable bracket. This winch is preferably provided with the usual pawl and ratchet means to retain the desired adjustment.

A horizontal bracket 17 is adjustably secured in a split clamp 18 which may be positioned and locked at any desired height along the vertical standard 10 by means of a clamp screw. Mounted upon the arm 17 and adjustable therealong by means of similar split clamps and clamp screws are two outwardly and upwardly extending spaced arms 18 and 19. These arms support a U-shaped frame member 20, each end of which is provided with a split coupling slidably supported upon the respective arms 18 and 19. At the center of this U-shaped frame 20 a hinged lug 21 is provided which supports a hooked traction-applying screw 22, by which traction may be applied when a threaded thumb nut 23 thereon is operated to retract the screw. The hooked portion of the screw 22 engages the center of a yoke 24 provided at each end with suitable detachable clips whereby a webbed strip 25 may be suspended in a loop while secured at both ends to the yoke. This traction-applying assembly is shown in its normal position in Fig. 1 and as applied to a patient's arm in Figs. 2 and 3.

Three spacing braces or supports 26, 27 and 28 are also mounted upon the arm 17 by split clamps 26a, 27a and 28a similar to those previously described so as to be adjustable along the arm 17. The spacing braces may be adjustably extended to bear against the side of the patient or the table upon which he lies so as to brace both the apparatus and the patient during the fracture reducing operation. With the split clamp construction illustrated, the entire apparatus is very easily adjustable to conform to the size of the individual patient to whose arm traction is to be applied.

Referring to the particular hand-grasping device employed, which is illustrated generally as applied to the patient's hand in Figs. 4 and 5

and in top view in Fig. 6, the device comprises a bail 29 preferably of the contour shown, each end of which is provided with a hook to engage with suitable portions of the arcuate hand-grasping frame 30. The frame may be formed of a single elongated strip of metal and, if desired, may have integral therewith upwardly extending slotted portions 31 and 32, each of which is provided with a series of notches or indentations with which the free ends of the bail 29 may selectively engage. The frame also has inturned ends 33 provided with open end slots or notches 34.

A retaining strip 35 of similar arcuate contour is provided in laterally adjustable alignment with the strip 30 and has rearwardly extending threaded members 36 and 37 extending through the slots or notches 34 in the inturned ends 33 of the strip 30.

The threaded members are provided with thumb nuts 38 and 39 which are grooved for operative engagement in the slots to adjustably support the strip 35 as shown. Rotation of the thumb nuts causes the arcuate member 35 to recede from or approach toward the frame member 30 and assume an angular or parallel alignment therewith as desired. Located between the members 30 and 35 are two adjustable members 40 and 41 which are mounted upon the inner ends of thumbscrews 42 and 43, respectively, so as to provide a proper spacing therebetween to receive the hand and to enable the application of tension to the sides of the hand.

With the patient's hand in place within the clamp, but not clamped therein, resilient blocks or inserts 44 and 44*a* of suitable material such as rubber are placed between each of the four fingers and a suitable resilient pad 45 is placed between the sides of the hand and the adjacent longitudinally adjustable members 40 and 41. The block 44*a* is preferably of softer and more resilient material than the rest. The lateral play is then taken up by means of the thumb nuts 38 and 39 which are tightened just enough to bring the member 35 close to the hand and prevent lateral displacement of the inserts. The thumbscrews 42 and 43 are then tightened sufficiently to retain the parts in close engagement.

It will be apparent from the above description that this hand-grasping device engages the fingers by the sides only and that any pressure against the inner or outer sides of the fingers, whereby compression of the ligaments or impedance of blood circulation might result, is avoided. With this device also the more traction applied to the arm the more secure the hold upon the hand becomes. But at no time is the hand grasped with a firmer pressure than is necessary to insure against slippage of the fingers.

When reducing fractures of the forearm only, the webbed strap 25 need not be employed, and the patient's arm is instead held at the elbow against upward movement by means of a suitably padded metal strap or saddle 46 which may independently be secured to the horizontal bracket 17 by means of an adjustable clamp 47, or may be mounted on the split clamp 27*a* if desired. The patient's fingers are then secured in the adjustable hand clamp previously described and traction applied to the arm.

When reducing a fracture of both the radius and ulna, it may be desirable to locate the hook 14 in the center depression of the bail 29 whereby an even traction will be applied to both bones and both will be placed under equal tension so that they may be manipulated back into place. However, when reducing fractures of only one of the bones of the forearm, the greatest amount of traction may be applied to that bone by simply placing the hook 14 in a corresponding notch 29*a* or 29*b* in the bail 29 whereby the entire hand-grasping frame will be tilted to the desired degree so as to apply the greater amount of tension to the fractured bone.

Of course, any number of notches may be formed in the bail 29 whereby any desired angular degree of the hand-grasping frame may be obtained.

As previously stated, in the reduction of fractures it is frequently highly desirable that complete flexibility be provided to permit varying degrees of pronation or supination so that the major muscles connected to the fractured bone may be relaxed as much as possible or to exert tension on the injured parts to draw them into apposition. This is accomplished by making the hook 14 so that it may swivel with respect to the cable 13 and permit any desired rotation of the arm to be obtained and retained.

In addition to the two adjustments above described, this invention permits an additional adjustment by the provision of slots 31*a* and 32*a* in the upwardly extending portions 31 and 32 of the frame 30 and formed to provide a series of notches 31*b* and 32*b* whereby the bail 29 may provide acute palmar flexion, acute extension or any intermediate degree of wrist positioning desired by selectively engaging the bail hooks closer in suitable notches. Though five notches are shown provided in each slotted portion, it is apparent that any suitable number may be employed to give the desired flexibility of control.

When traction has tired the muscles sufficiently to permit manipulation of the fractured bones into proper apposition, moist plastic strips 48 and 48*a* of suitable cast-making composition and of any desired length may be suspended from the hook 14 on either or both sides of the fractured member by means of suitable elongated hooks 49 and 49*a* and clips 50 and 50*a*. Being self-supporting, this leaves the operator's hands free to manipulate the arm and mold the plaster strip about the arm. Additional plaster strips may be added if desired and the entire arm then bound with the usual circular gauze or plaster of Paris bandage. When dry, the traction is released and the patient's arm disengaged from the traction-applying apparatus. Thus, immobilization in the exact position where the parts are in perfect apposition is assured.

Throughout the reduction of a fracture of the forearm as described above, the braces 27, 28 and 29 may be employed to space the patient and the table upon which he reclines from the apparatus. However, the braces are of greatest importance in the reduction of fractures of the upper arm or of both the upper and forearm which will now be described in detail.

In reducing fractures of the upper arm or both the upper and forearms, the above described technique is employed with the exception that the metal strap 46 may be discarded and the webbed strap 25 employed to supply the necessary traction upon the upper arm. This strap is first provided with a suitable Cellophane envelope 51, illustrated in Fig. 9, and which is open at each end to permit the webbed strap to extend therethrough. This strap is then placed

about the forearm adjacent the elbow as illustrated in Fig. 2 and traction applied by rotation of the thumb nut **23**. This traction is opposed by the patient with the aid of the bracing arms **26**, **27** and **28** so that tension is applied to the muscles of the upper arm to tire them until the broken portions of the bone may be manipulated into place. Of course, traction may simultaneously be applied to the forearm in the manner previously described, whereby fractures of both upper and forearms may concurrently be reduced and the desired degree of lateral deflection, pronation, and supination may be obtained. At the same time, the forearm may be rotated to provide radial or ulnar abduction or adduction in any degree, all of which may be intimately controlled by the operator.

When the arm has been properly positioned with the bones in apposition, the soft, wet plaster cast mould is suspended adjacent the arm as previously described and may be drawn around the outside of the elbow and under the upper arm to provide a continuous and integral upper and forearm support. Additional bandages may be supplied and molded about the arm securely to encase the parts and rigidly support them in their proper alignment and extended position. In this condition the cast is permitted to thoroughly dry, the traction being maintained until dry.

The Cellophane covering keeps the webbed strap **25** from contact with the plaster, and when the plaster is dry the webbed strap may be detached from the clips connecting it with the yoke **24** and may be withdrawn from the Cellophane envelope which remains in the cast. Of course, suitable splints or arm braces may be employed in place of the plaster cast.

Because of the ready accessibility of the arm during the application of traction with this device and the ease with which all the parts may be sterilized, this apparatus is particularly useful in fracture cases requiring operative incision through the flesh. Also where Kirshner wires or similar direct bone engaging skeletal pins are employed, the device is readily adaptable to use therewith without material alteration.

The braces **26**, **27** and **28** will ordinarily be sufficient to support the apparatus in a firm manner when traction is applied. However, a heavier base than the tri-legged skeletal frame **52** may be provided if desired. An additional flexible characteristic of this apparatus is the provision of an adjustable connection as shown in Fig. 8 wherein the vertical standard **10** is adjustably supported in the base **52** by means of a suitable hand wheel **53**.

Of course other modifications will readily suggest themselves to the operator and the extreme flexibility of the apparatus will permit its use in a variety of novel fashions. It is therefore desired to be limited only by the prior art and the scope of the appended claims.

I claim:

1. A self locking finger-grasping device for the application of traction to a fractured arm comprising a substantially rectangular frame having a central opening for the insertion of the patient's fingers, means for spacing the side wall of said frame to correspond with the thickness of the hand without applying material pressure thereto, resilient blocks for insertion between said fingers and kept from lateral displacement by said frame, auxiliary end walls within said frame to receive the hand therebetween, means for adjusting said auxiliary walls in the plane of the hand to urge said fingers and said blocks into intimate gripping contact, a loosely mounted bail having its ends pivoted on the respective end walls of said frame, and means to enable independent lateral adjustment of each pivotal connection, said means comprising a transverse series of bail-engaging notches or the like in each end of said frame and constructed to enable selective engagement of the ends of said bail in said notches, said bail being constructed to enable the attachment of a flexible traction means at different predetermined points along its length.

2. A fracture reducing apparatus comprising means for supporting and fixing the elbow, a flexible traction means, a finger-gripping means, a bail loosely pivoted on said gripping means substantially in the plane of the hand, means for connecting said traction means at different points on said bail to cause tilting of the gripping device in the plane of the hand, said gripping means being constructed to provide two opposed series of bail-engaging notches or the like transversely of the plane of the hand, and said bail having each end formed to enable selective engagement in any one of the associated notches, all of said connections being free for automatic flexible self alignment of all of said elements relative to any adjustment or combination of adjustments of said bail either in said plane or transversely thereof or as a resultant of both, so that different traction may simultaneously be applied to various predetermined muscles by free self alignment relative to the line of applied traction.

3. In a hand-grasping device for applying traction to a forearm of a patient whereby the degree of flexion and extension of the hand may be controlled, a substantially rectangular hand-enclosing frame having means for clamping the fingers therein, a traction applying bail substantially in the plane of the hand and having its ends loosely hooked into slots in the transverse end walls of said frame, each of said slots having a series of notches therein to enable either or both ends of said bail to be adjusted on said frame transversely of said plane.

4. In a hand-grasping device for applying traction to a forearm of a patient whereby the degree of flexion and extension of the hand may be controlled, a hand-enclosing frame having means for clamping the fingers of a patient therein, and a bail substantially in the plane of the hand with its ends hooked into slots in the end walls of said frame, said slots forming a series of bail engaging notches transversely of said plane for transverse adjustment of said bail, and said bail having a series of notches along its length for selective engagement with a traction means.

5. A fracture reducing apparatus wherein palmar flexion, extension, pronation, supination, radial abduction and ulnar abduction may, in varying combinations be imposed upon the forearm and upper arm of a patient, comprising an upright standard having traction and counter-traction applying means thereon, said traction applying means comprising an axially rotatable hand engaging and traction applying member for the distal portion of said forearm, said member comprising an arcuate hand-grasping frame including an elongated strip of metal for subtending the hand having upwardly and laterally extending slotted end portions, each slot forming a series of notches, and a bail for selective

engagement of its ends in said notches so that the selective positioning of said bail therein imposes a variable angular inclination upon said distal portion simultaneously with the application of traction thereto, said countertraction applying means comprising an arm engaging adjustable tension device on said standard for the application of countertraction to the proximal portion of said forearm and for the simultaneous application of traction to the upper arm, and extensible and retractable spacing arms on said standard to securely position the device from the patient during the fracture reducing operation, whereby simultaneous reduction of both upper arm and forearm may be achieved contemporaneously with the application of independently controlled rotation, extension and flexion of the separate portions of the arm.

6. A fracture reducing apparatus comprising an upright having a horizontal elongated bracket vertically adjustable thereon for positioning adjacent and substantially parallel to an operating table to enable a patient's arm to be extended thereover with the forearm vertical, a pair of brace arms longitudinally adjustable on said bracket and transversely adjustable for engaging said table and spacing said apparatus therefrom, said braces being positionable one on each side of the patient's extended arm, a finger-grasping traction member suspended from an overhanging arm on said upright, a countertraction saddle for engagement over the patient's upper arm adjacent the elbow and longitudinally adjustable on said bracket, an outwardly extending U-shaped frame longitudinally and vertically adjustable on said bracket and extending outwardly around the patient's forearm, an adjustable traction applying member comprising a strap to be applied around the patient's forearm adjacent the elbow, means on said frame for applying traction to said strap, and a countertraction brace arm longitudinally and rotarily adjustable on said bracket and laterally adjustable for engaging the patient's body.

7. A fracture reducing apparatus comprising an upright having a horizontal elongated bracket vertically adjustable thereon for positioning adjacent and substantially parallel to an operating table to enable a patient's arm to be extended thereover with the forearm vertical, means longitudinally and laterally adjustable on said bracket for engaging said table and spacing said apparatus therefrom, a finger-grasping traction applying device suspended from an overhanging arm on said upright, a countertraction saddle for engagement over the patient's upper arm adjacent the elbow and longitudinally adjustable on said bracket, an outwardly extending frame longitudinally and vertically adjustable on said bracket and having traction means thereon for alignment with the patient's arm, countertraction means adjustably mounted on said bracket for engagement with the patient's body, said traction means comprising a yoke, a strap to be applied around the patient's forearm adjacent the elbow and having its ends secured to said yoke, and adjustable means between said yoke and said frame to apply traction to said yoke.

8. A fracture reducing apparatus comprising an upright having a horizontal elongated bracket vertically adjustable thereon for positioning adjacent and substantially parallel to an operating table to enable a patient's arm to be extended thereover with the forearm vertical, means longitudinally and laterally adjustable on said bracket for engaging said table and spacing said apparatus therefrom, a finger-grasping device suspended from an overhanging arm on said upright, an outwardly extending frame longitudinally and vertically adjustable on said bracket for aligning the outer end thereof with the patient's arm, traction means adjustably mounted on said outer end of said frame and comprising a loop for engaging around the patient's forearm adjacent the elbow and means for applying traction to said loop, and countertraction means adjustably mounted on said bracket for engagement with the patient's body.

ALEXANDER L. STEARNS.