June 11, 1940. R. W. WILCOX 2,204,266

FRACTURE REDUCTION APPARATUS

Filed Feb. 20, 1937 2 Sheets-Sheet 1

Fig. 1.

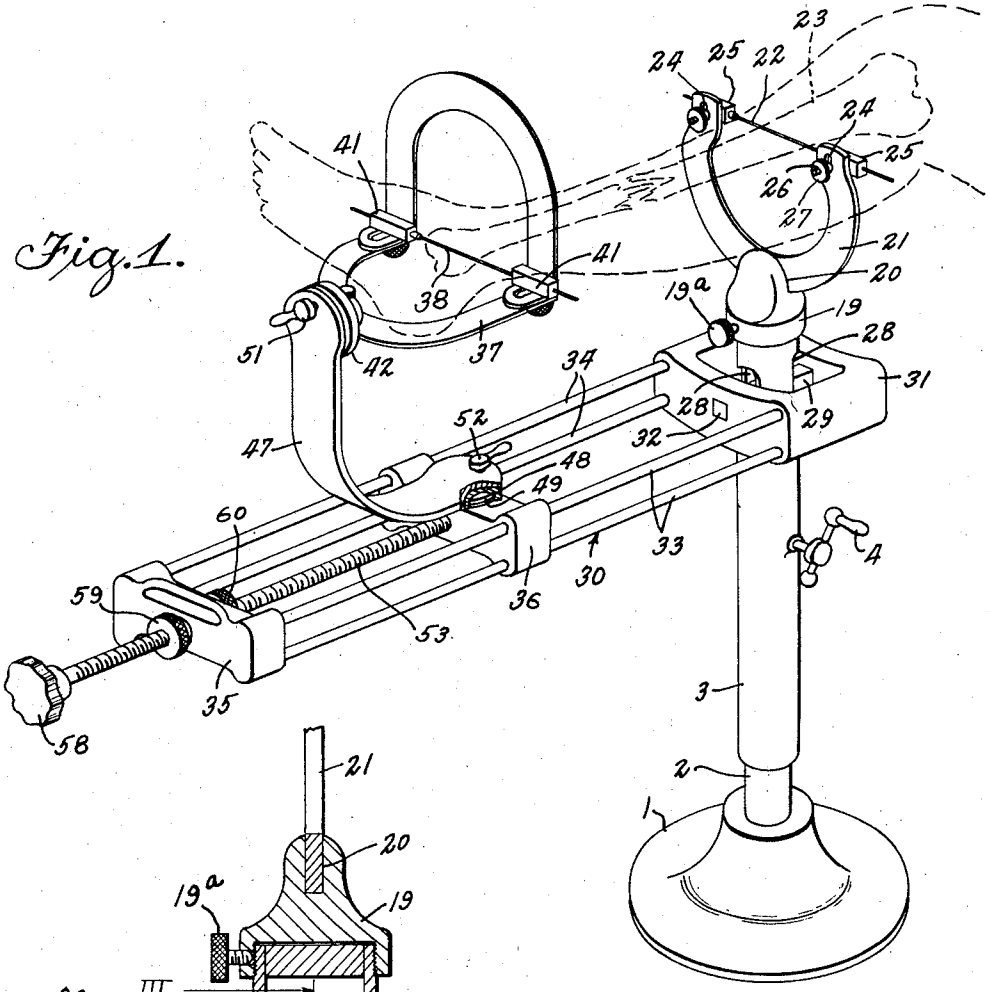
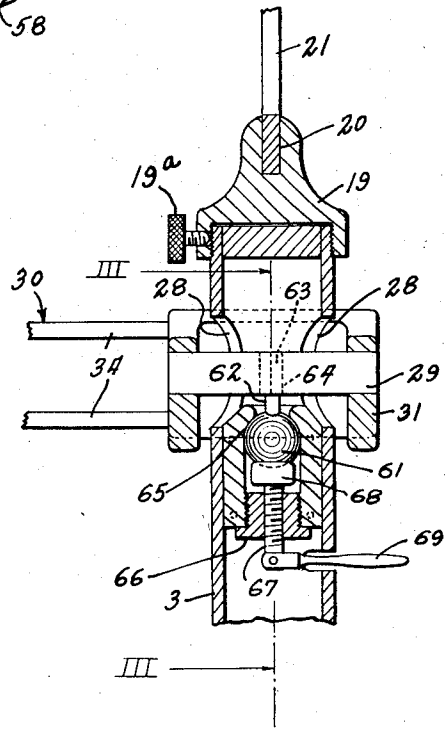


Fig. 2.



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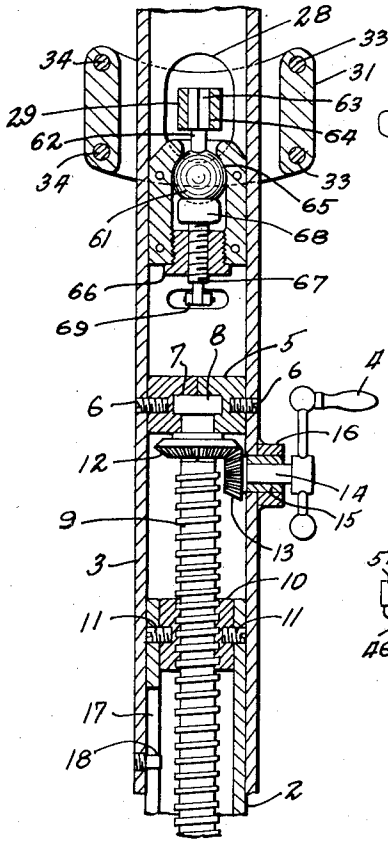
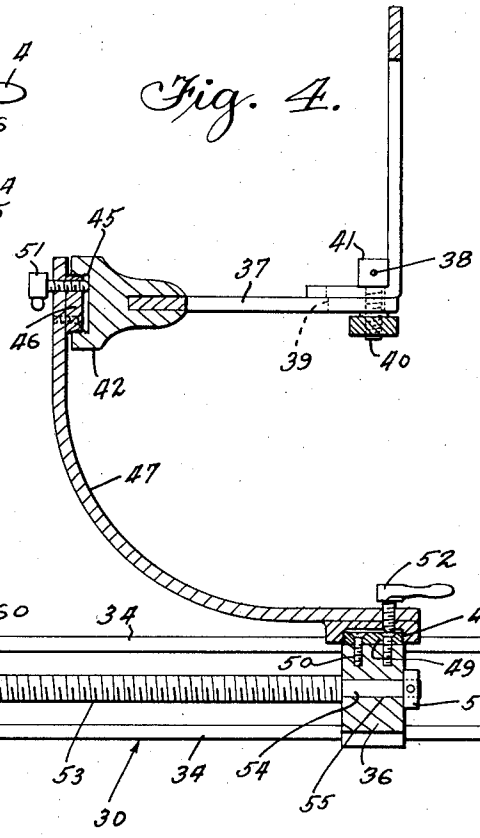


Fig. 3.

Fig. 4.



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Patented June 11, 1940

2,204,266

UNITED STATES PATENT OFFICE

2,204,266

FRACTURE REDUCTION APPARATUS

Robert W. Wilcox, Long Beach, Calif.

Application February 20, 1937, Serial No. 126,853

5 Claims. (Cl. 128—84)

My invention relates to fracture reduction apparatus, and has particular reference to a simple device for obtaining any desired value of traction and motion of the bone fragments in any desired direction by a single manipulation of a universally mounted traction element.

In fracture reduction apparatus it is the common practice to employ wires or pins projected through the bone fragments for the purpose of obtaining traction thereon and by which the bone fragments may be manipulated to reduce the fracture and to align the bone fragments accurately prior to the application of a cast or splint to the break.

Fracture reduction apparatus heretofore employed the wire or pin method of aligning the bone fragments and were complicated and cumbersome in that it was necessary for the surgeon to manipulate a plurality of adjustable devices, certain of them to obtain traction, others of them to obtain rotation of the bone fragments above the normal and anatomical axis, and others to obtain lateral correction, and frequently the making of one adjustment threw the other parts of the device out of line, requiring a multiplicity of readjustments of the various parts during the reduction operation.

It is an object of my invention, therefore, to provide a fracture reduction apparatus which is simple in construction and which, once the pins have been properly located in the bone fragments and secured in stirrups or horseshoe brackets, the manipulation of the bone fragments in making the reduction may be accomplished in a simple and rapid manner by the manipulation of a single adjusting or moving device.

Another object of the invention is to provide a fracture reduction apparatus of the character set forth, in which the proximal fragment is secured by wire or pin to a stationary stirrup or support, and in which the distal fragment is secured by pinning the stirrup to a movable support, which movable support is secured upon a universal joint relative to the stationary support at such distance from the axis of the proximal fragment pin that a simple movement of the movable support will produce both the traction effect and any vertical, lateral or rotational adjustment which may be needed to align the bone fragments.

Another object of the invention is to provide a stand or stationary support for the pin employed in the proximal fragment and a movable support for the distal fragment, the movable support being mounted upon a lever structure secured by a universal mounting to the stand at such distance below the proximal fragment that movement of the outer end of the lever in any direction is permitted to accomplish traction, lateral adjustment, vertical adjustment or rotational adjustment by the single manipulation of the lever structure.

Another object of the invention is to provide a structure of the character set forth in the preceding paragraph, wherein the lever when moved to obtain the desired reduction may be locked in place and constitute a splint by which the bone fragments are held in proper alignment during the application of permanent splints or casts.

Another object of the invention is to provide a device of the character set forth, wherein the mounting of the wire carrying stirrups and the construction of the manipulating lever is such as to permit substantially unobstructed view of the bone fragments and the fracture by fluoroscope of X-ray during the reducing operation.

Another object of the invention is to provide a device of the character set forth, wherein the movable stirrup is so mounted upon the lever as to be adjustable toward and away from the stationary stirrup, not only in a direction to produce traction, but also in a direction to produce compression.

Other objects and advantages will be apparent from a study of the following specifications, read in connection with the accompanying drawings, wherein

Fig. 1 is a perspective view of a fracture reduction apparatus constructed in accordance with my invention;

Fig. 2 is a vertical sectional view, taken through the junction of the lever structure with the stand or standard upon which the stationary stirrup is mounted, and illustrating the locking apparatus employed;

Fig. 3 is a vertical sectional view, taken through the stand or standard supporting the stationary stirrup, and illustrating the manner in which the stationary stirrup and the associated lever may be raised and lowered; and

Fig. 4 is a detail vertical sectional view through the movable stirrup and outer end of the lever structure, illustrating the adjustable mounting of the movable stirrup upon the lever structure.

Referring to the drawings, I have illustrated my fracture reduction apparatus as comprising a suitable standard or supporting structure which may include a base 1 from which rises a station-

ary tubular support 2 upon which is telescopically assembled a tubular carriage 3 adapted to be raised and lowered upon the support 2 by the manipulation of a vertical adjustment handle 4. The tubular carriage is preferably provided, near its upper end, with a split bearing block 5, (see Fig. 3) held in place therein by means of suitable screws 6 and having a recess 7 therein engaging the head 8 of an adjustment screw or screw-jack 9. The screw-jack extends longitudinally through the vertical supporting tubing 2 and engages in a threaded nut 10 secured as by screws 11 in the upper end of the support tube 2. The screw-jack 9 may be rotated in any suitable manner, as by providing a miter gear 12 near its upper end engageable with a miter gear 13 secured upon and rotatable with a shaft 14 upon which the handle 4 is mounted, the shaft 14 being rotatably mounted in a bushing 15 secured within a laterally extending boss 16 formed upon and secured to the tubular carriage 3. The tubular support 2 is preferably provided with a vertically extending slot 17 within which may slide a guide pin 18 secured to the tubular carriage 3 to thus prevent rotational movement between the tubular support 2 and the tubular carriage 3.

It will therefore be observed that by the manipulation of the vertical adjustment handle 4 the carriage 3 may be raised or lowered to any desired height above the floor upon which the base 1 may rest.

Upon the extreme upper end of the tubular carriage 3 I mount a head 19 which is provided with a slot 20 extending laterally therethrough to receive a rigid horseshoe or stirrup member 21 which constitutes the stationary support for a wire or pin 22 passed through the proximal bone fragment 23. While the detail of the construction of the stirrup 21 is not material, I prefer that the stirrup be made of a ribbon of rigid metal bent into a U or horseshoe shape, the body of which is substantially circular in shape and the outer ends of the legs of which are provided with slots 24 by which wire traction blocks 25 may be adjustably secured. The traction blocks 25 may be of any desired size, shape or construction adapted to grip one end of the wire or pin 22, the blocks 25 on the opposite legs of the stirrup 21 being adapted to hold the opposite ends of the wire 22 and to provide the necessary traction thereon to produce the rigidity in the wire or pin 22. The blocks 25 may be provided with a threaded stud 26 which projects through the slot 24 and may be locked in place upon the stirrup 21 by means of a suitable thumb nut 27.

The head 19 is preferably rotatable about the upper end of the tubular carriage 3 so that the head and the stirrup 21 may be rotated to any desired angle in the preliminary adjustment of the proximal bone fragment, and the head may be held rigidly in such adjusted position by means of a set screw 19a extending through the head 19 and bearing against the upper end of the carriage 3. By making the blocks 25 adjustable in the slots 24 any errors or inaccuracies of the drilling and placing of the wires in the bones may be compensated for so that when the head 19, stirrup 21 and wire 22 are fixed in their preliminary adjustable positions the proximal fragments will be held in the most desirable position for the further reduction of the fracture as hereinafter described.

Immediately below the head 19 a pair of aligned openings 28 are provided in the tubular carriage 3 through which projects a bracket 29 forming the support for a lever structure 30. The lever structure 30 preferably comprises a head member 31 which may be cast of metal or similar material in the shape illustrated in Fig. 1, this head member comprising a substantially rectangular frame surrounding the tubular carriage 3 having a cross bar extending between the front and rear sides of the frame, such cross bar constituting the bracket 29. The cross bar or bracket 29 preferably has a rectangular cross section, indicated at 32, at its point of engagement with the head or frame 31 so that the cross bar or bracket is rigidly secured to the head or frame 31 against relative rotation thereby.

The lever structure also includes rails 33 extending from one end of the head structure 31 and rails 34 extending from the opposite end of the head 31. In the embodiment of my invention illustrated herein, the rails 33 and 34 are each constructed of a pair of parallel rods of a length in excess of the length of any of the human bones, the outer ends of the rods comprising rails 33 and 34 to be engaged in and secured to a cross bar member 35 so that the assembled rails constitute a track along which a cross head 36 may slide toward and away from the carriage 3 and the stationary stirrup 21.

The cross head 36 engages all of the rods comprising the rails 33 and 34 so that this cross head is fixed against lateral movement relative to the rails, while movement of the cross head along the rails is permitted.

The cross head 36 is used as a support for a movable stirrup or horseshoe member 37 which carries and supports the wire or pin 38 employed in the distal fragment of the bone, the stirrup 37 being constructed of a ribbon of rigid metal and having substantially the same shape as the stirrup 21, the outer ends of the legs of which are provided with slots 39 (see Fig. 4) through which projects the stud 40 of the wire traction blocks 41 which engage opposite ends of the wire 38 and by which the wire or pin 38 may be rigidly supported. It will be noted that the blocks 41 are adjustable in the stirrup 37 by means of slots 39 to permit preliminary location of the wire 38 at the desired angle and thus permit of compensation for any inaccuracies in the placing of the wire 38 in the distal fragment of the bone.

The head 42 is provided with an internally threaded socket 45 by which the head may be secured either directly to the cross head 36 or may be secured upon a threaded boss 46 upon an angular bar 47 which is in turn provided with a threaded socket 48 receivable upon a threaded boss 49, secured as by means of screws 50 to the cross head 36. It will also be noted that the stirrup 37 and its head 42 are rotatable about the boss 49 so as to permit placing of the wire 38 either in a horizontal plane or in a vertical plane depending upon the type of fracture or the particular limb which is to be treated.

As will be understood by those skilled in this art, in certain types of practice the stirrup 37 should be arranged vertically, while in other types of fractures the fragments may be manipulated to better advantage if the stirrup 37 is laid in a horizontal position, as is indicated in Fig. 1. The bosses 46 and 49 may therefore be selected of the same size, so as to adapt either of them to receive the head 42. Suitable locking screws 51 and 52 may be provided for the purpose of locking the head 42 or the bar 47 in any

desired adjusted position. It will be noted from an inspection of Fig. 1 that the location of the stirrup 37 is such that the wire 38 is in direct alignment with the wire 22. That is, these wires lie in the anatomical axis of the bone upon which the operation is being made. When the stirrup 37 is mounted upon the angular bar 47 a rotational movement of the stirrup in a vertical plane may be readily accomplished to rotate the distal fragment of the bone about the anatomical axis until the fragments are in a desired preliminary rotational relation as will be determined by the surgeon. Then the stirrup 37 may be locked in this adjusted position prior to the actual reduction operation. Also, if it is found upon a preliminary inspection of the fracture that an axial displacement of the bone fragment has occurred, they may be brought into preliminary alignment by rotation of the bar 47 around the cross head 36.

To adapt the instrument for the manipulation of fractures of various bone lengths, the cross head 36 may be slid toward or away from the carriage 3 until a preliminary length or distance between the position of the wires 22 and 38 is provided, at which time the cross head 36 may be substantially fixed upon the lever structure 30 preparatory to the actual reduction operation. The movement of the cross head 36 is preferably controlled by an elongated screw 53 which is rotatably fixed upon the cross head 36, as by extending a reduced section 54 of the screw 53 through a bore 55 in the cross head 36 and providing a lock nut, collar or similar device 56 upon the projecting end of the screw 53. The screw 53 is threaded substantially throughout its length, the outer end of the screw 53 passing through an inverted bore 57 in the cross bar 35 so that the screw has relatively free movement through the cross bar 35. The outer end of the screw 53 is provided with a suitable handle 58 by which the screw may be rotated and a pair of threaded lock nut members 59 and 60 are provided thereon, one on each side of the cross bar 35. Thus by loosening the links 59 and 60 the cross head 36 may be freely slid along the rails 33, 34 in making the preliminary length adjustment and the lock nuts may then be tightened so that turning movement of the screw 58 will be required for further movement of the cross head either toward or away from the tubular carriage 3. For example, if, after the preliminary adjustment is made and the limb is inserted between the stirrups 21—37 and the wires or pins 22—38 are engaged in their traction blocks and it is found that further small adjustment is required, such adjustment may be readily made by manipulation of the handle 58 on the screw 53. Also it may be found that some preliminary traction should be made between the bone fragments which may be readily accomplished by turning the screw 53 which, by reason of its threaded engagement with the nut 59, will permit the insertion of great forces tending to draw the bone fragments against the contractile effect of the muscles.

All of the adjustments herein referred to are preliminary adjustments, that is preliminary setting of the stirrups in the desired angular relation and at the desired distance apart for the engagement of the pins or wire 22—38 prior to the actual manipulation of the bone fragments in reducing the fracture. The actual reduction operation is then performed by the single manipulation of the lever structure 30. The lever structure 30 is secured to the carriage 3 by a connection which permits universal movement relative to the carriage 3; for example, by means of a ball and socket joint illustrated particularly in Figs. 2 and 3 as comprising a ball member 61, having a stem 62 having a squared head 63 extending into a squared socket 64 in the bracket 29 for the head frame 31 of the lever structure 30. The ball 61 is received within a ball seat or socket 65 which is rigidly secured to the tubular carriage 3 immediately below the openings 28 therein. The lower end of the socket member 65 is provided with a bushing 66 through which is threaded a stem 67 carrying a ball-engaging head 68 by which the ball 61 may be clamped immovably against its seat 65 by the manipulation of a clamp handle 69.

It will be found from an inspection of Fig. 1 that the ball and socket mounting of the lever structure 30 is upon an axis which is spaced a considerable distance below the axis of the wire 22 and that lines drawn between the ball and wire 22, wire 22 and wire 38, and wire 38 and the ball, constitutes a triangle so that any raising or lowering of the outer end of the lever structure 30 will either produce compression or traction between the distal and proximal bone fragments necessary to draw these bone fragments away from each other or allow them to move toward each other to properly position the ends of the bone fragments in correct abutting relation with each other while rotation of the outer end of the lever structure 30 will produce a lateral displacement of the wire 38 relative to the wire 22 without changing the distance between the wires and similarly any twisting or rotational movement of the lever structure 30 in a horizontal plane will produce a small rotational movement of the wire 38 relative to the wire 22 with or without an axial displacement of these wires relative to each other.

By moving the outer end of the lever structure in any of these directions, all of the manipulation of the bone fragments may be accomplished necessary to the accurate reduction of the fracture and all of these movements are accomplished by the simple manipulation or swinging of the outer end of the lever structure by up-down, sideways, twisting or rotational movement, or swinging the outer end of the lever through an arc which may be compounded of any two or more of the movements.

In using my fracture reduction apparatus the patient is disposed upon a table or other suitable support and the fracture reducing apparatus is drawn adjacent to the support. The injured limb is drilled to receive the wires or pins 22 and 38 and the proximal fragment with its pin 22 disposed in the stirrup 21, the carriage 3 being elevated or lowered until the desired level is attained for the proximal fragment. The distal fragment and its pin 38 is then disposed in the stirrup 37 and the stirrup and its cross head 36 are preliminarily moved and adjusted to obtain the desired preliminary adjustment of the axial alignment and rotational alignment of the bone fragments.

In making this preliminary adjustment the necessary traction may be obtained either by operating the handle 58 on the screw 53, or the lock nut 59—60 may be backed off relative to the cross head 35 and slid by hand to the desired position. However it must be noted that in making this preliminary adjustment the lever structure 30 should be disposed upon a horizontal plane or may be slightly elevated to extend at

an upward angle relative to the horizontal so that after the preliminary adjustments are made a downward movement of the lever structure **30** will produce additional traction necessary to properly align and engage the fractured ends of the bone fragments. With the preliminary adjustments made as noted the surgeon then operates the handle **69** to release the ball **61** and manipulates the single element necessary to properly reduce the fracture, namely, the lever structure **30**. By employing the wires **22** and **38** no obstruction is encountered to the use of the X-ray tube either below or at either side of the fractured limb and during the manipulation of the lever structure **30** the surgeon may, with a fluoroscope, watch the movement of the bones and dispose them in proper alignment, proper axial rotational relation, to insure that the reduced fracture secures the most desirable alignment of the bone fragments.

It sometimes happens that after the necessary traction is produced and the alignment of the bone fragments has been made, that the bone fragments will lie slightly separated, in which event, by loosening the lock nut **59** and tightening the lock nut **60** a compressive force may be produced upon the limb, forcing the distal fragment into snug relation with the proximal fragment.

While I have shown and described the preferred embodiment of my invention, I do not wish to be limited to any of the details of construction shown herein, except as defined in the appended claims.

I claim:

1. In a fracture reduction apparatus, a standard, a carriage mounted upon said standard for vertical movement relative thereto, a stirrup secured on the upper end of said carriage for engaging and supporting a wire through the proximal fragment of a bone, a lever structure, a ball and socket joint coupling one end of said lever structure to said carriage at a predetermined distance below said stirrup for universal movement relative to said carriage and said stirrup, a second stirrup adapted to engage a wire extending through the distal bone fragment, means mounting said second stirrup upon said lever structure in spaced relation to said first named stirrup, whereby manipulation of the outer end of said lever will produce movement of said bone fragments toward and away from each other, and lateral displacement of said bone fragments in any direction relative to each other.

2. In a fracture reduction apparatus, a standard, a carriage mounted upon said standard for vertical movement relative thereto, a stirrup secured on the upper end of said carriage for engaging and supporting a wire through the proximal fragment of a bone, a lever structure, a ball and socket joint coupling one end of said lever structure to said carriage at a predetermined distance below said stirrup for universal movement relative to said carriage and said stirrup, a second stirrup adapted to engage a wire extending through the distal bone fragment, means mounting said second stirrup upon said lever structure in spaced relation to said first named stirrup, whereby manipulation of the outer end of said lever will produce movement of said bone fragments toward and away from each other, and lateral displacement of said bone fragments in any direction relative to each other, and means for locking said ball and socket joint against movement in any position to which said lever structure is moved.

3. In a fracture reduction apparatus, a standard, a carriage mounted upon said standard for vertical movement relative thereto, a stirrup secured on the upper end of said carriage for engaging and supporting a wire through the proximal fragment of a bone, a lever structure, a ball and socket joint coupling one end of said lever structure to said carriage at a predetermined distance below said stirrup for universal movement relative to said carriage and said stirrup, a second stirrup adapted to engage a wire extending through the distal bone fragment, means slidably mounting said second stirrup upon said lever structure for movement toward and away from said first named stirrup, screw means engaging said lever structure and said mounting means for positively moving said second stirrup toward and away from said first stirrup.

4. In a fracture reduction apparatus, a standard, a carriage mounted upon said standard for vertical movement relative thereto, a stirrup secured on the upper end of said carriage for engaging and supporting a wire through the proximal fragment of a bone, a lever structure, a ball and socket joint coupling one end of said lever structure to said carriage at a predetermined distance below said stirrup for universal movement relative to said carriage and said stirrup, a second stirrup adapted to engage a wire extending through the distal bone fragment, means slidably mounting said second stirrup upon said lever structure for movement toward and away from said first named stirrup, a screw secured to said mounting means for movement therewith and extending longitudinally of said lever structure, means on said lever structure for receiving said screw for sliding movement longitudinally of said lever structure, threaded means engaging said screw abutting said lever structure whereby rotational movement of said screw will positively move said second stirrup toward and away from said first named stirrup.

5. In a fracture reduction apparatus, stirrup means for engaging a wire passed through a proximal bone fragment, said stirrup means, mounted upon a carriage, said carriage carrying a lever structure pivoted for universal movement upon an axis below said stirrup means, said lever structure comprising a head including said pivot means, a pair of spaced parallel rail structures extending longitudinally therefrom, and a cross bar interconnecting said rail structures at the outer end of said lever structure, a second stirrup means for engaging a wire passed through a distal bone fragment, means for mounting said second stirrup upon said rails for sliding movement therealong, a screw secured to said mounting means and extending through a bore in said cross bar and slidable therethrough, lock nuts threadedly engaging said screw on opposite sides of said cross bar, whereby rotation of said screw positively moves said mounting means along said rails.

ROBERT W. WILCOX.