

July 29, 1941.

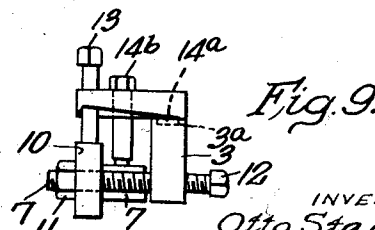
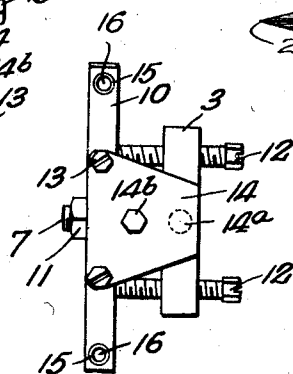
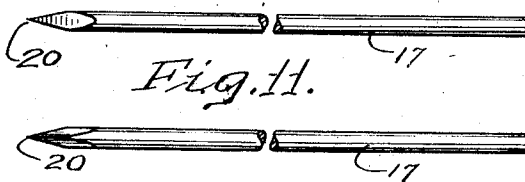
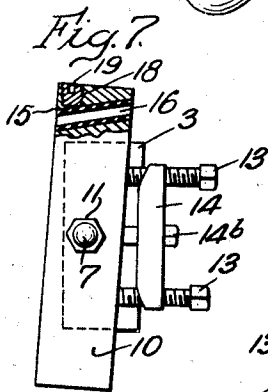
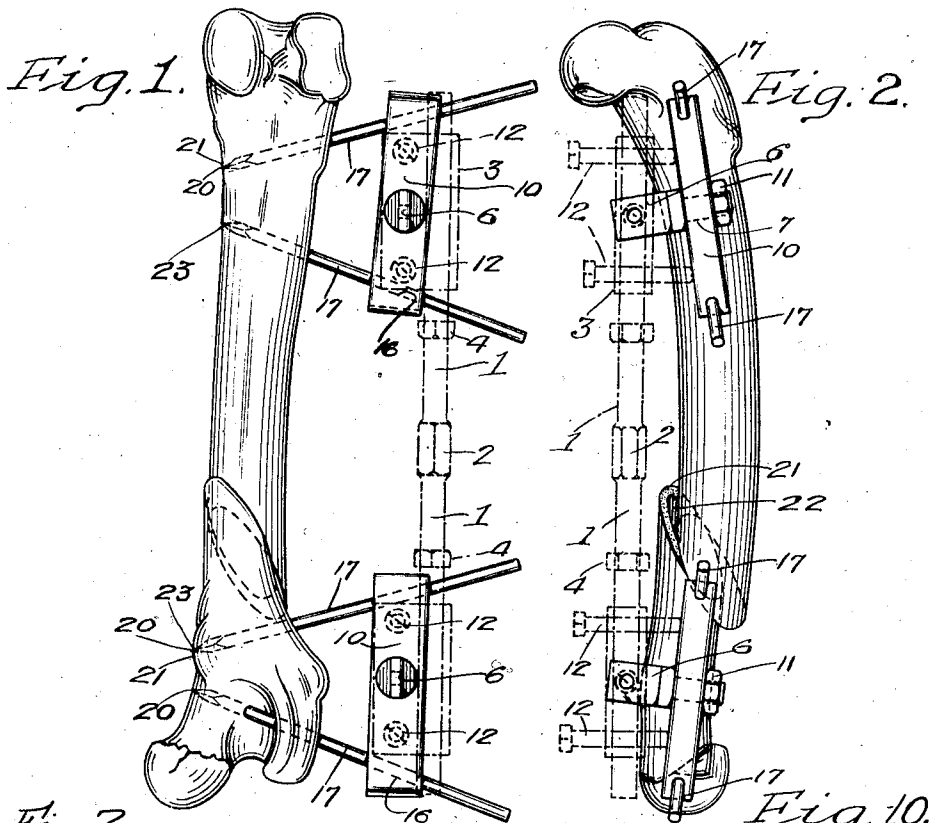
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2,251,209

BONE SPLINT

Filed Feb. 17, 1940

2 Sheets-Sheet 1



WITNESS
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Fig. 8.

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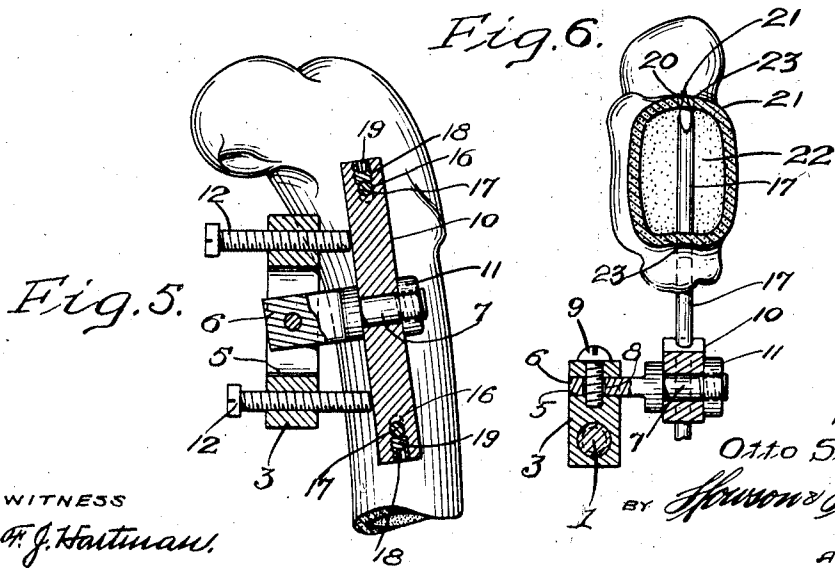
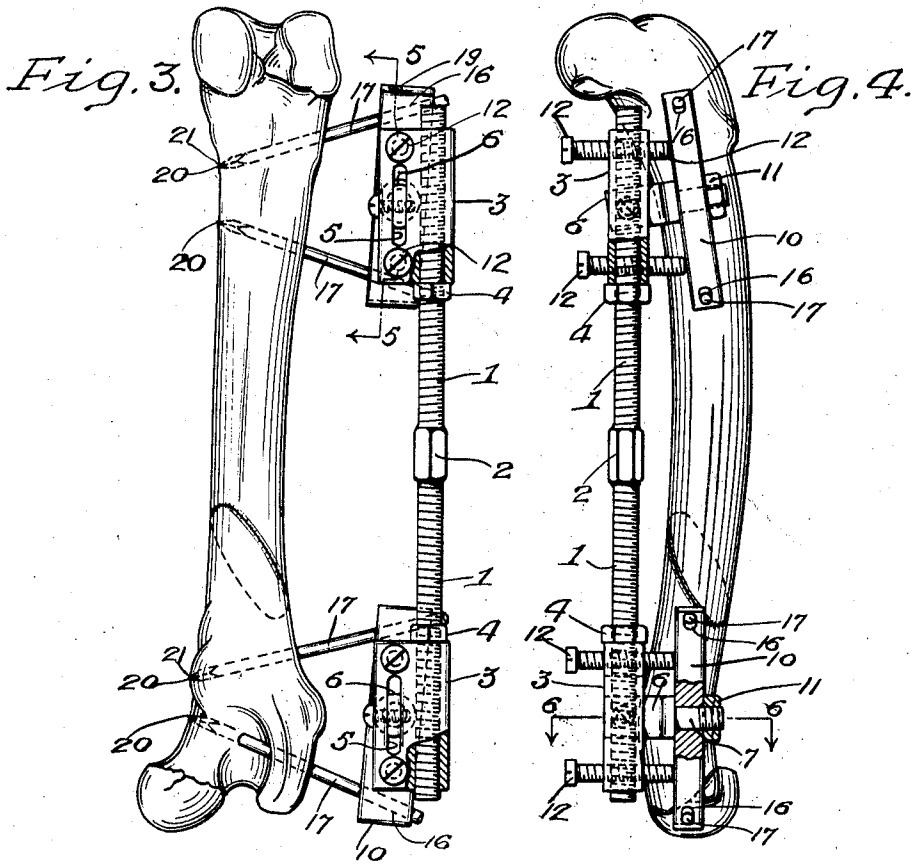
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2,251,209

BONE SPLINT

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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,251,209

BONE SPLINT

Otto Stader, Ardmore, Pa.

Application February 17, 1940, Serial No. 319,529

23 Claims. (Cl. 128—92)

This invention relates to new and useful improvements in devices or apparatus for use in the reduction and fixation of bone fractures, and is a continuation-in-part of my application for Letters Patent of the United States, Serial No. 105,432, filed October 13, 1936.

In accordance with present practices, the reduction and fixation of bone fractures actually comprises two separate and distinct operations, namely, that of first reducing or "setting" the fracture, and then effecting fixation by maintaining the reduction in place by means of a rigid splint, plaster cast, or the like. These splints and casts are usually applied in such manner that one or more of the joints adjacent the fracture are likewise held in one set or fixed position during healing or knitting of the fracture and prevents normal articulation which renders the patient less ambulatory, if not immobile, and tends toward muscle atrophy or shrinkage due to inactivity—all of which contribute to the discomfort of the patient and require prolonged hospitalization, care and expense in the treatment of bone fractures. Other disadvantages and objectionable features incident to present day treatment of fractures of various kinds will be brought up and discussed from time to time hereinafter.

With the foregoing in mind the principal object of the present invention is to provide a combined bone fracture reduction and fixation device or apparatus of the counter-skeletal traction type permitting, in most instances, normal articulation adjacent the fracture.

Another object of the invention is to provide a bone fracture reduction and fixation device of the character set forth which is not only operative to effect relative longitudinal, angular or rotary manipulation and adjustment of one or more fragments of the fractured bone independently of one another to accomplish proper reduction of such fracture, but is also operative to insure positive locked fixation of the fragments after such reduction or "setting" thereof.

Another object of the invention is to provide a device or apparatus of the stated type which is novelly constructed and arranged so that use thereof will greatly reduce the ordinary relatively long periods of hospitalization or confinement heretofore incident to the reduction and fixation of bone fractures and enable the subject to become ambulatory within considerably shorter periods of time.

Another object of the invention is to provide a device of the character set forth which is

novelly constructed and arranged to prevent tissue-break-down and irritation of the adjacent bone structure due to bio-chemical reactions which take place during periods of application of the device to a patient.

A further and equally important object of the invention is to provide a device of the character stated which not only is not painful or uncomfortable to the patient, due to its relatively light weight and comparatively small size, but which can be applied laterally along but one side or surface of the bone outwardly of the surface of the limb or other portion of the body through which such bone extends.

These and other objects of the invention and the features and details of the construction, arrangement and use or application thereof are set forth hereinafter and shown in the accompanying drawings, in which:

Fig. 1 is a front elevation view of certain parts of a device made in accordance with this invention illustrating the same secured to a fractured bone which is shown in its anterior-posterior relation.

Fig. 2 is a view in side elevation of the disclosure in Fig. 1.

Fig. 3 is a view similar to Fig. 1 showing the complete device applied to the bone and its relation thereto after reduction and fixation of the fracture therein.

Fig. 4 is a view in side elevation of the disclosure of Fig. 3.

Fig. 5 is an enlarged view in section taken on line 5—5, Fig. 3.

Fig. 6 is an enlarged view in section taken on line 6—6, Fig. 4.

Fig. 7 is an enlarged detached view in front elevation of a pin assembly illustrating one form of positive control and locking element therefor, said figure being partly in section to illustrate certain features of the mounting and support of the pins.

Figs. 8 and 9 are respectively plan and end elevation views of the disclosure of Fig. 7; and

Figs. 10 and 11 are views in elevation illustrating the pins adapted to penetrate the bone structure to secure the device to the fractured bone to enable proper reduction and fixation of the fracture sections thereof.

Referring now particularly to the drawings, the device or apparatus contemplated by the present invention comprises a supporting structure including a reversely threaded spindle or bar 1 having a nut-like portion 2 at or adjacent its midpoint for effecting rotation of said spindle

or bar 1 by any suitable means such as a wrench or the like and blocks or members 3 which are threaded on opposite end portions of the spindle 1 as shown, so that rotation of said spindle 1 in one direction will cause said blocks 3 to approach one another while rotation of the spindle 1 in the opposite direction will cause the blocks 3 to relatively separate. The blocks 3 may be positively locked upon the spindle 1 longitudinally thereof in the desired predetermined relatively spaced relation with respect to each other by means of lock nuts or the like 4 threaded thereon.

As best shown in Figs. 5 and 6 of the drawings, each of the blocks 3 of the supporting structure is slotted as indicated at 5 to receive the lug or like portion 6 of a spindle 7 and this lug portion 6 is provided with a suitably located aperture 8 therein through which freely extends a retaining screw or the like 9 threaded into the blocks 3 and arranged so that said spindle 7 may pivot within the slot 5 up said screw 9 for adjustment relative to said blocks 3 in a plane parallel to the axis of the spindle 1. A bracket or holder 10 is pivotally or rotatably mounted at or adjacent its midpoint upon each spindle 7 for rotation in a plane at right angles to the plane of rotation of said spindle 7 and a nut or like securing means 11 is provided for retaining said brackets 10 upon the spindles 7.

A pair of screws 12 are threaded in each block 3 at opposite sides of the slot 5 therein and spindle 7 and these screws 12 extend in the direction of the brackets 10 and engage the adjacent faces thereof thereby making it possible, by adjustment of the screws 12, to effect positive mechanical adjustment of said brackets 10 and spindles 7 about the screws or pins 9 after which the said screws 12 may be tightened to securely lock the said brackets 10 and spindles 7 in the positions to which respectively adjusted thereby.

In addition to the foregoing, and referring to Figs. 7 to 9 of the drawings, adjustment and locking of the brackets 10 in adjusted position upon their spindles 7 is effected positively and mechanically by means of screws 13 threaded in a plate 14 and engaging the top outer surface of the brackets 10 at opposite sides of the axes of rotation thereof as shown. The plates 14 bridge the space between these brackets 10 and the blocks 3 and are pivotally connected to the latter by means of lugs 14a which rotatably engage sockets or recesses 3a formed in the upper face of said blocks 3, the said plates 14 being securely held in the aforementioned position by means of bolts 14b which threadably engage the underlying spindles 7.

As shown, each of the brackets 10 is provided with angularly extending bores 16, each of which is arranged to receive a pin or other bone penetrating element 17 and these angularly disposed bores 16 are arranged with respect to each other so that the bone-engaging extremities of elements 17 converge in the direction of each other and form an acute angle therebetween. The brackets 10 are each tapped inwardly from opposite ends thereof as indicated at 18 to receive set screws or the like 19 by means of which the pins 17 may be locked in any axial position within said supporting brackets 10.

The pins 17 previously mentioned are provided with sharply tapered points or ends as indicated at 20 to facilitate penetration of the bone which is accomplished by forcing said pins into the bone at an angle to the axis thereof preferably at a point in the fractured fragments between

such fracture and the adjacent joint in the limb. The pins 17 may be forced into the bone with comparatively easy effort due to the sharp point or ends 20 thereof by merely applying pressure axially of said pins and at the same time rotating the same in alternately opposite directions in the manner of a hand drill. The pins 17 should entirely penetrate the adjacent wall portion of the cortex or shell 21 of the bone structure, as well as the medullary canal 22 therein and have their ends 20 firmly imbedded in and just slightly penetrating through the opposite wall portion of the cortex or shell as at 23 in the relationship shown in Fig. 6 of the drawings, although no injury or impairment of the results obtained will occur should the pins 17 protrude a substantial distance beyond the opposite wall portion of the cortex or shell of such bone.

For strength and rigidity the pins 17 employed are composed generally of metal such as, for example, stainless steel, duraluminum, and the like, and in the course of application and use of my device, I have found that the contact of these metal pins with the tissue, flesh, etc., of the limb or body portion into which inserted causes a bio-chemical reaction to take place which sets up a galvanic current through the pins 17, the flesh and tissue in which embedded, and the externally connected brackets 10 and their supporting structure.

This galvanic current manifests itself by an ammoniacal odor definitely indicative of tissue (protein) breakdown, causes also irritation of the adjacent bone structure, and attributes generally to the discomfort of the patient.

It is obviously desirable, therefore, to eliminate the occurrence of such a galvanic current and I have found that this may be accomplished by electrically insulating or segregating each pin 17 from the others. This may be done either by constructing the brackets 10 of suitable dielectric material such, as for example, hard rubber, Bakelite, plastic or the like, or by inserting into the pin apertures or bores 16 a sleeve or like structure of such a dielectric material in the manner indicated at 15 in Figure 7 of the drawings. By either of these arrangements each pin 17 is electrically insulated from the other of the pair of pins in the same bracket 10 as well as from the pins in the other bracket and I have found that by either such arrangement the occurrence of a galvanic current is entirely eliminated together with the objectionable manifestations thereof.

In applying the apparatus one pin 17 is forced into a fragment of the bone in the proper angular position and the portion thereof which is allowed to remain projecting outwardly from the surface of the flesh overlying the bone is passed through one of the bores 16 in a bracket 10 which is securely locked thereon by means of the set screw 19. Another pin 17 is then inserted in the other bore 16 of the bracket 10 and it likewise is similarly forced into the bone after which said bracket 10 is locked upon the latter pin 17 by the adjacent set screw 19. Due to engagement of the bone structure by these pins 17 at an acute angle with respect to each other, it is impossible for said pins to be withdrawn from the bone when lateral pull is exerted upon the bracket 10, thus insuring a positive rigid connection between the fractured bone sections and the bracket at the exterior of the body of the patient. Another pin assembly consisting of a pair of pins 17 and a supporting bracket 10 is

similarly secured preferably in a fragment of the fractured bone at the other side of the fracture between the latter and the joint adjacent thereto, and the adjustment and control mechanism constituting in general the supporting structure which includes the spindle 1, blocks 3, spindles 7 and plates 14 is then attached or connected between the brackets 10 by mounting the latter upon said spindles 7 and securing the same thereon by means of nuts 11. With the two pin assemblies penetrating fragments of the fractured bone at opposite sides of the fracture and with the adjustment and control mechanism just described secured to and connected between the brackets 10 of said pin assemblies thus bridging the fracture, it should be particularly observed that the device or apparatus thus assembled is confined wholly between adjacent joints of the limb containing the fractured bone.

In order to effect a proper reduction or "setting" of the fracture, the spindle 1 is preferably first rotated in a proper direction to cause a relative separation of the blocks 3 and the pin assemblies carried thereby for the purpose of effecting an extension or separation of the fragments of the bone until the fractured ends thereof, which are often ragged, are relatively free or floating with respect to one another. When such an extension of the fractured bone has been brought about, the respective fragments thereof may be manipulated into alignment with one another, as for example by rotary adjustment of the brackets 10 and pins carried thereby upon the spindles 7, by adjustment of said brackets 10 and spindles 7 angularly with respect to the blocks 3 by means of the screws 12 and 13 as may be desired and also by varying or adjusting the relative position of one or both blocks 3 circumferentially of the spindle 1. The foregoing adjustments provide in effect a universal movement or connection between the spindle 1 and pin assemblies by means of which the one or more fragments of the fractured bone may be manipulated in any desired plane that may be required or necessary to effect proper alignment thereof. After the several parts just described have been securely locked in their adjusted relation to maintain the fragments of the bone properly aligned the sections of the fractured bone may then be brought into apposition or abutment by rotating the spindle 1 in the opposite direction causing the blocks 3 and said pin assemblies carried thereby to approach one another and as the fractured ends of the bone fragments are brought into proper apposition the lock nuts 4 should be tightened against said blocks 3 to prevent further relative displacement of the blocks thus insuring positive fixation of the reduced or "set" fracture so long as the device or apparatus remains in place.

In certain instances, as for example, where the fracture is at or closely adjacent a joint, it may be found necessary to bridge such joint and securely lock the same against movement due to the lack of sufficient bone structure intermediate such joint and the fracture into which one set or pair of the pins 17 may be forced in which event it will be found necessary to insert said pins 17 in bone structures at the opposite side of the joint from the fractured bone. This type or location of a fraction does not always make this form of application of the device necessary for in many instances it has been found that by mounting the bracket 10 transversely upon the spindle 1 either directly or indirectly, sufficient structure of the fractured bone at or in the joint

may be found to receive the now transversely disposed pins 17 in a bracket so mounted. In this latter instance, of course, adjustment of the bracket will be less flexible than ordinarily and any adjustments, both angular and rotary, necessary to secure proper alignment of the fragments may be accomplished by adjustment of the pin assembly at the other end of the spindle 1 in the manner previously described.

In other instances, it may be found desirable to mount both brackets 10 transversely upon or with respect to the spindle 1 at opposite ends thereof to enable insertion of the sets of pins 17 properly into the fractured bone at opposite sides of the fracture. This arrangement does not, of course, afford the complete universal adjustment of the respective bone fragments provided by the arrangement shown in Figs. 1 to 9 inclusive, but does permit transverse rotary, and in some instances angular, manipulation of the fragments as well as extension and contraction thereof—adjustments sufficient to insure correct reduction and fixation of this type of bone fracture.

From the foregoing description of the invention it will be observed that a novel device or apparatus is provided by means of which the reduction and fixation of bone fractures may be brought about in most instances without interfering with the normal articulation adjacent the fracture. This is an important feature of the invention inasmuch as it not only minimizes nerve-deadening and any tendency toward muscle atrophy shrinkage resulting from inactivity, but also eliminates any impairment of normal blood circulation which might tend to retard healing or knitting of the fracture. In addition, by enabling normal articulation in the usual manner, the patient or subject can become ambulatory after a comparatively short period of time, thus greatly reducing the period of hospitalization or confinement, care, expense and discomfort to the patient usually accompanying the successful treatment of bone fractures. Another equally important feature of the invention resides in the fact that by the use of the device or apparatus herein described accurate reduction of the fracture may be effected and positive fixation thereof insured when once reduced or set without the added annoyance and discomfort of the usual splint or cast. It is not uncommon in present day treatment of fractures to have to reset the fracture as many as three or four times before the fragments are properly held or secured in correct apposition and alignment within a cast or splint of the ordinary type which often fail to securely hold the fragments in position after the first or second reduction due to the lack of any positive connection between reduction and fixation of the fracture which in reality constitutes two separate and distinct operative procedures. This situation is entirely eliminated by the present invention wherein a rigid connection with the bone fragments is provided and reduction and fixation thereof are in effect one and the same operation. A device or apparatus made in accordance with this invention is otherwise desirable, more comfortable and less painful to the patient due to its extremely light weight and novel structural arrangement which enables application of such device within a relatively small space laterally along and adjacent a single side of the limb or portion of the body through which the fractured bone extends and eliminates the weight and cumbersome devices and apparatus which heretofore protruded entirely through such

limb and beyond the other side or surface thereof or completely encased the limb.

Another important advantage of the present invention manifests itself in the treatment of fractures that exhibit a substantial overlapping or overriding of the fractured ends of the bone. In such cases the muscles, blood vessels, nerves, and other soft tissues and structure, shorten or contract substantially, and it is usually most unwise to attempt immediately to bring about complete reduction of the fracture due to the possibility of damage resulting from stretching these soft tissues and structures to the extent required to effect such reduction. However, in the treatment of fractures of this type the device of the present invention can be attached to the fractured fragments of the bone in the manner previously described and then, by daily adjustment of the extension bar or spindle 1, the fragments and soft tissue and structure can be gradually lengthened or stretched over a period of time to their proper length necessary to effect complete reduction of the fracture, and during this step-by-step stretching of the contracted tissues both fragments of the fracture remain fully immobilized and therefore are unable further to damage or tear the soft tissue structures while at the same time minimizing patient discomfort and pain.

The device or apparatus herein described has many further uses and applications and may be effectively employed in bone reconstruction work where for example it is often desired to secure an elongation or extension of a bone that had been previously fractured and shortening resulted, or contracted during healing or knitting thereof. So too, the invention may be used to advantage in bone-grafting work to support the fragments of the bone adjacent the graft and effectively carry any weight applied to such sections across the graft which is thereby relieved from any strain or bearing whatever which may otherwise interfere with successful results of such an operative procedure. Furthermore, the construction and arrangement of the present invention is such as to provide ready access to flesh and muscle wounds necessarily incident to bone grafting surgery and also present in compound bone fractures for the proper treatment and dressing thereof. Such a device is also removed from contact with a wound of the character mentioned which is allowed to remain relatively free for redressing, thus substantially eliminating the heretofore not uncommon infection of such wounds due to continued contact with splints, casts or the like, effecting a fixation of such graft or fracture.

In the drawings and foregoing description of the present invention the pin brackets 10 have been referred to and illustrated as provided with but one pair or set of two of the pin holes, but it will be obvious that these pin brackets 10 may be provided with a greater number of such pin holes suitably arranged therein. The device or apparatus herein described may be applied in many different ways and methods which must be determined by the practitioner or surgeon depending upon the location and type of fracture to be treated, although where the nature and location of the fracture permits, the methods of application and treatment herein set forth should preferably be followed, and while certain specific embodiments of the invention have been set forth for purposes of description, it is not intended that said invention shall be limited thereto, but

that changes and modifications may be made and incorporated therein within the scope of the annexed claims.

I claim:

1. In an ambulatory bone fracture reduction splint of the character described, a bracket, means adapted to rigidly connect at least one fragment of a fractured bone to said bracket, a second bracket, means adapted to rigidly connect said second bracket to bone structure at the opposite side of the fracture from the first mentioned means, a supporting structure bridging the fracture between said first and second brackets to support the same in predetermined relatively spaced relation with respect to each other, said supporting structure being adjustable at will to effect relative longitudinal movement of the brackets and relative separation and appositioning of the bone fragments connected respectively thereto, connections between the supporting structure and at least one of said brackets providing for adjustment of the latter with respect to the supporting structure to effect relative manipulation of said bone fragments while relatively separated to insure correct reduction of the fracture when the fragments are appositioned, and means mechanically operative positively to actuate said bracket relative to said supporting structure and for securing a relative permanent fixation of the bracket in the position to which adjusted.

2. In an ambulatory bone fracture reduction splint of the character described, a bracket, means adapted rigidly to connect at least one fragment of a fractured bone to said bracket, a second bracket, means adapted rigidly to connect said second bracket to bone structure at the opposite side of the fracture from the first mentioned means, elements pivotally supporting said brackets, a supporting structure bridging the fracture between said elements and including members pivotally supporting the elements in predetermined relatively spaced relation with respect to each other, said members being adjustable at will to effect relative longitudinal movement of the elements and brackets and relative separation and appositioning of the bone fragments connected respectively thereto, and means mechanically operative positively to actuate said brackets relative to said elements and the elements and brackets relative to said members, said last-mentioned means being constructed and arranged to provide positive adjustment of the brackets with respect to the supporting structure for effecting relative manipulation of said bone fragments while separated to insure correct reduction of the fracture when the fragments are brought into apposition.

3. In an ambulatory bone fracture reduction splint of the character described, a bracket, means adapted rigidly to connect at least one fragment of a fractured bone to said bracket, a second bracket, means adapted rigidly to connect said second bracket to bone structure at the opposite side of the fracture from the first mentioned means, pivotally supporting said brackets, a supporting structure bridging the fracture between said elements and including members pivotally supporting the elements in predetermined relatively spaced relation with respect to each other, said members being adjustable at will to effect relative longitudinal movement of the elements and brackets and relative separation and appositioning of the bone fragments connected respectively thereto, means mechanically

operative positively to actuate said brackets relative to said elements and the elements and brackets relative to said members, said last mentioned means being constructed and arranged to provide positive adjustment of the brackets with respect to the supporting structure for effecting relative manipulation of said bone fragments while relatively separated to insure correct reduction of the fracture when the fragments are brought into apposition and for positively locking the several parts of the structure in the positions to which adjusted and thereby effect relatively permanent fixation of the reduced fracture during healing thereof.

4. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including a member adjustably mounted thereon, a spindle pivotally carried by the member of said supporting structure, a bracket pivoted on said spindle and arranged for location laterally adjacent one side of the fracture, means carried by said bracket arranged to provide a rigid connection between the same and the bone structure adjacent thereto, and means for effecting positive adjustment of the bracket and spindle with respect to each other and the member of the supporting structure to effect positive manipulation of the bone structure connected to said bracket.

5. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including members adjustably carried thereby, a spindle pivotally carried by each member of said supporting structure, a bracket pivoted on each of said spindles and arranged for location laterally adjacent respectively opposite sides of the fractures, means carried by each of said brackets arranged to provide a rigid connection between the same and the bone structure adjacent thereto, and means for effecting positive independent adjustment of each bracket and spindle with respect to each other and the supporting structure to effect positive manipulation of the bone structure connected to said brackets.

6. An ambulatory bone fracture splint comprising a rigid support arranged to bridge a bone fracture and to extend in close proximity to and lengthwise of the bone, means constructed and arranged to provide relatively permanent adjustable connections between the support and the bone fragments laterally adjacent thereto at opposite sides of the fracture, and means operable mechanically to effect positive lateral-medial and anterior-posterior manipulation of said bone fragments relative to each other and the support to reduce the fracture and for making secure the connections between the support and the adjacent bone structure in the position to which adjusted to effect a relatively permanent fixation of the reduced fracture, said support and connections having such rigidity and strength and being confined substantially within the limits of the length of the fractured bone so as to permit of the elimination of plaster and like casts and the retention of articular freedom and normal free use of the limb throughout the union of the bone fracture therein.

7. An ambulatory bone fracture reduction splint comprising a pair of brackets, means for connecting each bracket to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, a supporting structure for bridging the fracture and connecting said brackets including extensible means and connections between the latter and the brackets

constructed and arranged to permit of adjustment of said brackets with respect to said supporting structure, and means mechanically operative positively and independently to adjust each bracket relative to the supporting structure and for securing relative permanent fixation of each bracket in the position to which adjusted.

8. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including a member adjustably mounted thereon, a spindle pivotally carried by the member of said supporting structure, a bracket pivoted on said spindle and arranged for location laterally adjacent one side of the fracture, means carried by said bracket arranged to provide a rigid connection between the same and the bone structure adjacent thereto, means carried by said member of the supporting structure and engaging the bracket operative to effect positive adjustment thereof and its spindle relative to the member, and mechanism pivotally supported by said member including elements operable to effect positive adjustment of the bracket upon its spindle.

9. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including members adjustably carried thereby, a spindle pivotally carried by each member of said supporting structure, a bracket pivoted on each of said spindles and arranged for location laterally adjacent respectively opposite sides of the fractures, means carried by each of said brackets arranged to provide a rigid connection between the same and the bone structure adjacent thereto, means carried by each of said members of the supporting structure and engaging the brackets operative to effect positive adjustment thereof and their spindles relative to the member, and mechanisms pivotally supported by each of said members including elements operable to effect positive adjustment of each bracket upon its spindle.

10. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including a member adjustably mounted thereon, a spindle pivotally carried by the member of said supporting structure, a bracket pivoted on said spindle and arranged for location laterally adjacent one side of the fracture, means carried by said bracket arranged to provide a rigid connection between the same and the bone structure adjacent thereto, said means comprising a pair of spaced skeletal pins, means electrically insulating each pin from the other, and means for effecting positive adjustment of the bracket and spindle with respect to each other and the member of the supporting structure to effect positive manipulation of the bone structure connected to said bracket.

11. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including members adjustably carried thereby, a spindle pivotally carried by each member of said supporting structure, a bracket pivoted on each of said spindles and arranged for location laterally adjacent respectively opposite sides of the fractures, means carried by each of said brackets arranged to provide a rigid connection between the same and the bone structure adjacent thereto, said means comprising a pair of spaced skeletal pins, means electrically insulating each pin from the others, and means for effecting positive independent adjustment of each bracket and spindle with respect to each other and the supporting structure to effect positive

manipulation of the bone structure connected to said brackets.

12. In an ambulatory fracture splint, a pair of metal skeletal pins having pointed ends for insertion into a bone fragment, a rigid metal bracket mounting the pins therein and arranged to hold the same in rigid relation with respect to each other, and means electrically insulating said pins from each other.

13. In an ambulatory fracture splint, a pair of metal skeletal pins having pointed ends for insertion into a bone fragment, a rigid bracket mounting the pins therein and arranged to hold the same in rigid relation with respect to each other, said bracket being composed of dielectric material to electrically insulate said pins from each other.

14. In an ambulatory bone fracture reduction splint, a supporting structure to externally bridge a fracture including a member adjustably mounted thereon, a spindle pivotally carried by the member of said supporting structure, a bracket pivoted on said spindle and arranged for location laterally adjacent one side of the fracture, means carried by said bracket arranged to provide a rigid connection between the same and the bone structure adjacent thereto, said means comprising a pair of spaced skeletal pins, means electrically insulating each pin from the other, means carried by said member of the supporting structure and engaging the bracket operative to effect positive adjustment thereof and its spindle relative to the member, and mechanism pivotally supported by said member including elements operable to effect positive adjustment of the bracket upon its spindle.

15. An ambulatory bone fracture splint comprising a structure including a rigid longitudinally adjustable support arranged to bridge a bone fracture and to extend in close proximity to and lengthwise of the bone, means for locking said support in the position to which longitudinally adjusted, a pair of base members, means for connecting each base member to a bone fragment at opposite sides of the fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, and means for providing a rigid connection between each of said base members and said rigid support to effect a relatively permanent fixation of the fractured bone fragments, the structure having such rigidity and strength as to permit of the elimination of plaster and like casts and being confined substantially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

16. An ambulatory bone fracture splint comprising a structure including a rigid longitudinally adjustable support arranged to bridge a bone fracture and to extend in close proximity to and lengthwise of the bone, means for locking said support in the position to which longitudinally adjusted, a pair of base members, means for connecting each base member to a bone fragment at opposite sides of the fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, means providing connections between each of said base members and said rigid support constructed and arranged to permit of the varied positioning of the support and base members with respect to each other, and means for making rigid said connections to effect a relatively permanent fixation of the fractured bone fragments, the structure having such rigidity and

strength as to permit of the elimination of plaster and like casts and being defined substantially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

17. An ambulatory bone fracture splint comprising a rigid support arranged to bridge a bone fracture and to extend in close proximity to and lengthwise of the bone, a pair of base members, means for connecting each of said base members respectively to the bone fragments laterally adjacent thereto at opposite sides of the fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, means for connecting the base members to said support constructed and arranged to permit of the varied positioning of said base members and support with respect to each other, means electrically insulating the skeletal pins associated with each base member from the pins associated with the other base member and means for making rigid said connections to effect a relatively permanent fixation of the fractured bone fragments, the structure having such rigidity and strength as to permit of the elimination of plaster and like casts and being confined substantially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

18. An ambulatory bone fracture splint comprising a rigid support arranged to bridge a bone fracture and to extend in close proximity to and lengthwise of the bone, a pair of base members, means for connecting each of said base members respectively to the bone fragments laterally adjacent thereto at opposite sides of the fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, means for connecting the base members to said support constructed and arranged to permit of the varied positioning of said base members and support with respect to each other, means electrically insulating the skeletal pins associated with each base member from the pins associated with the other base member and means operable mechanically for making secure the said connections to effect a relatively permanent fixation of the fractured bone fragments, the structure having such rigidity and strength as to permit of the elimination of plaster and like casts and being confined substantially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

19. An ambulatory bone fracture splint comprising a structure including a pair of base members, means for connecting each base member to a bone fragment at opposite sides of the fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, means for effecting relative movement of said base members toward and away from each other comprising a rigid element arranged to bridge the fracture and to extend in close proximity to and lengthwise of the bone, connections between said rigid element and said base members providing for the adjustment of the base members and rigid element with respect to each other, and means for making rigid the said connections between said rigid element and base members to effect a relatively permanent fixation of the fractured bone fragments, the structure having such rigidity and strength as to permit of the elimination of plaster and like casts and being confined substan-

tially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

20. In an ambulatory bone fracture splint, a pair of base members, means for connecting each base member to a bone fragment at opposite sides of the fracture, comprising a pair of skeletal pins spaced to hold the fragment rigid, a rigid support connecting said pair of base members, and means electrically insulating the respective pairs of skeletal pins from each other.

21. An ambulatory bone fracture splint comprising a structure including a pair of base members, means for connecting each base member to a bone fragment at opposite sides of a bone fracture comprising a pair of skeletal pins spaced to hold the fragment rigid, a rigid support for said base members arranged to bridge the fracture and to extend in relatively close proximity to and substantially lengthwise of the bone, and means for providing a rigid connection between each of said base members and said rigid support to effect a relatively permanent fixation of the fractured bone fragments, the said rigid support being constructed and arranged to enable the last mentioned means to be variously spaced from each other lengthwise of said rigid

support substantially according to the spacing of said base members from each other, and the said structure having such rigidity and strength as to permit of the elimination of plaster and like casts and being confined substantially within the limits of the length of the fractured bone to afford articular freedom and use of the limb throughout the union of the fractured bone therein.

22. In an ambulatory bone fracture splint, a rigid base member having a pair of apertures extending therein, a metal skeletal pin mounted in each of said apertures, and a dielectric sleeve member embracing each of said skeletal pins and disposed between the latter and the rigid base member to electrically insulate said pins from each other.

23. In an ambulatory bone fracture splint, a rigid base member having a pair of apertures extending therein, a metal skeletal pin mounted in each of said apertures, a dielectric sleeve member embracing each of said skeletal pins and disposed between the latter and the rigid base member to electrically insulate said pins from each other, and means for securing said skeletal pins and sleeves in the apertures of the said base member.

OTTO STADER.