April 15, 1941. H. H. HAYNES 2,238,869

AMBULATORY SPLINT

Filed March 25, 1938 2 Sheets-Sheet 1

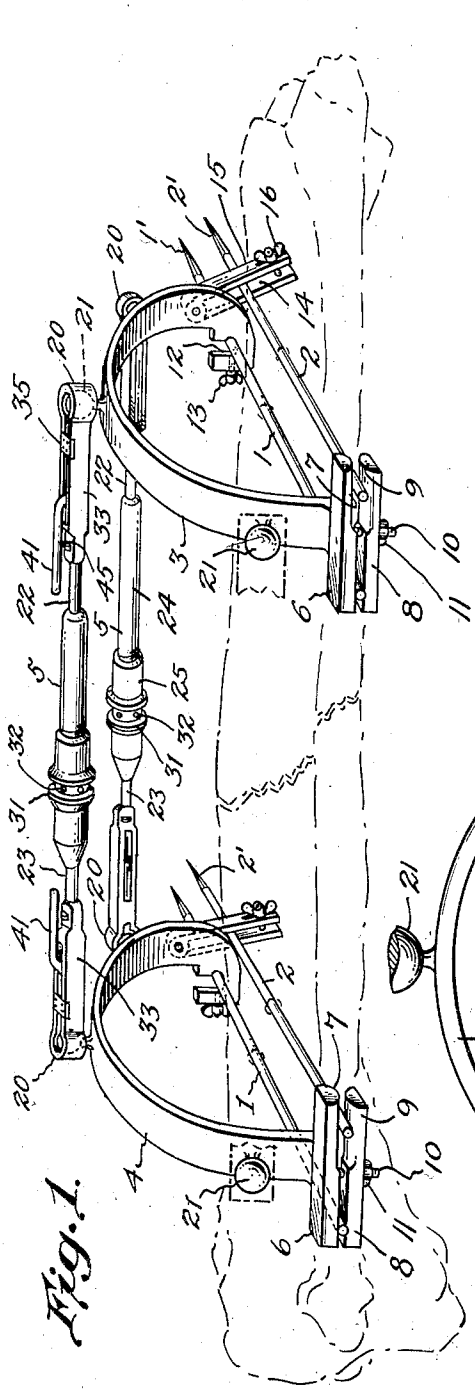

Fig. 1.

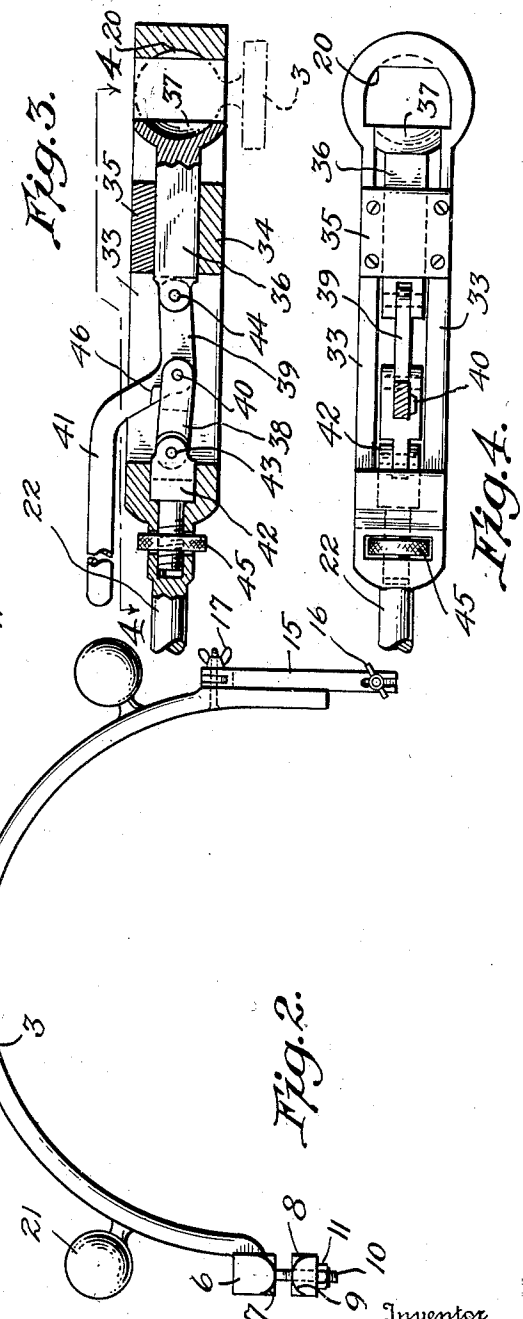

Fig. 2.

Fig. 3.

Fig. 4.

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Fig. 5.

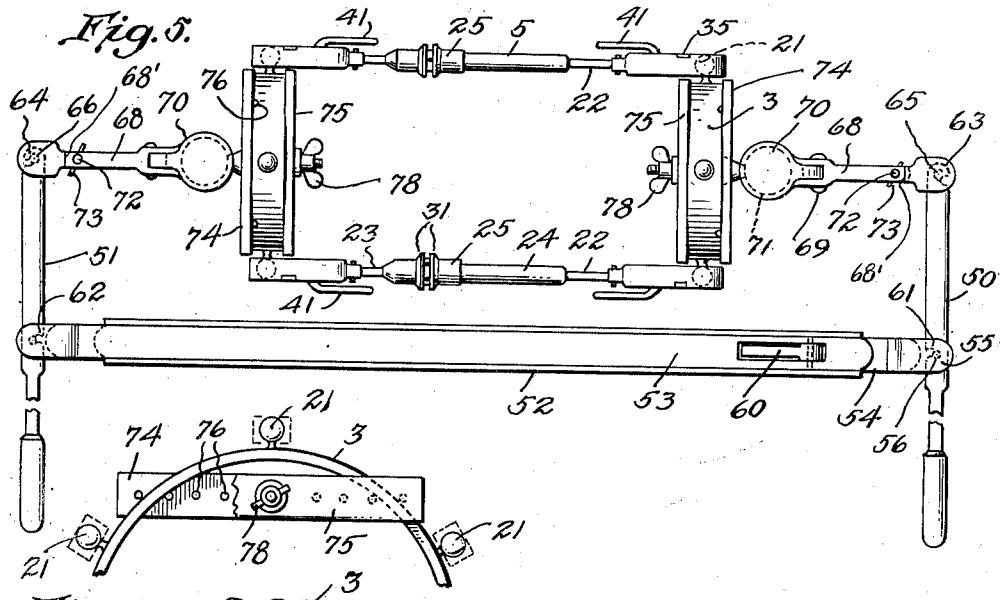

Fig. 6.

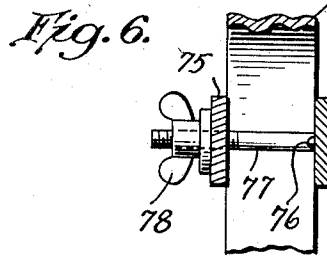

Fig. 7.

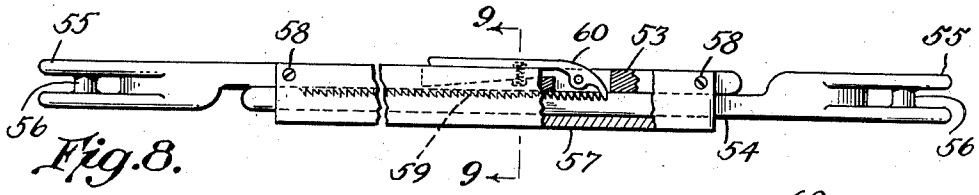

Fig. 8.

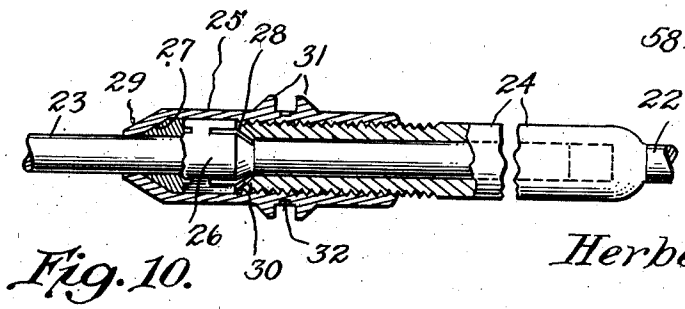

Fig. 10.

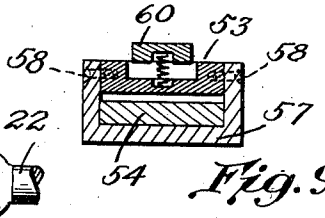

Fig. 9.

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UNITED STATES PATENT OFFICE

2,238,869

AMBULATORY SPLINT

Herbert H. Haynes, Clarksburg, W. Va.

Application March 25, 1938, Serial No. 198,122

17 Claims. (Cl. 128—92)

In the conventional treatment of broken bones it is the practice to manually adjust the bone fragments, secure them in fixed relation by the use of splints and thereafter encase the broken limb in a plaster cast. This method usually requires that the patient be confined to bed for a number of weeks, or at least that the limb be very carefully guarded, not only because the plaster cast is a bulky affair but also because of the danger of disturbing the alignment of the bone fragments if the patient were allowed to move about. Moreover, the use of a plaster cast precludes treatment of any flesh wounds which may have occurred adjacent the fracture, and the cast itself quite often is a cause of serious injury to the fleshy part of the limb which it encases.

Various attempts have been made to provide splints of the skeletal attachment type, which will leave exposed for local treatment any adjacent flesh wounds which may have accompanied the fracture. Such prior devices however have been more or less cumbersome and in many instances required the additional use of a plaster cast, and for various other reasons have proved objectionable.

The present invention is directed generally to an ambulatory fracture apparatus, and particularly to the skeletal control of bone fragments during extension, reduction and fixation of a fracture.

More particularly, it is an object of the invention to provide a light but strong mechanism, for attachment to the bone fragments of a broken arm or leg, which may be manipulated to bring the bone segments into alignment and to rotate the segments axially so that the bone may be accurately set.

Another object of the invention consists in providing an ambulatory splint which, while of relatively small measurements so as to permit the placing of ordinary clothing over the limb, is nevertheless strong and durable in operation.

A further object of the invention resides in the provision of means for quickly and readily locking the mechanism so as to securely hold the bone segments in proper position after once being adjusted.

Another object of the invention consists in the use of pairs of pins or wires which are forced through the bone fragments and serve to provide the desired attachment for the mechanism; the pins of each pair being arranged at an inclination whereby lateral movement of the mechanism secured to the pins, is prevented.

A still further object of the invention resides in the provision of an ambulatory fracture apparatus which not only eliminates the use of a plaster cast but also leaves the limb entirely exposed for treatment such as massage and the like.

Various other objects and advantages of the invention will be apparent to those skilled in the art, from the following description when taken in connection with the accompanying drawings, in which,

Figure 1 is a perspective view of the novel fracture apparatus in operative position, the bone to which the apparatus is attached being indicated in dotted outline, and one of the clamping bars being broken away for the sake of clearness.

Figure 2 is an end view of one of the yokes.

Figure 3 is a fragmentary sectional view through an end of one of the clamping bars.

Figure 4 is a sectional view taken on line 4—4 of Figure 3.

Figure 5 is a plan view of a tool which may be used in conjunction with the fracture apparatus in the skeletal control of the bone fragments prior to fixation, etc.

Figure 6 is a fragmentary end view of one of the yokes, with one of the clamping members of the tool attached thereto.

Figure 7 is a side elevational view of one of the grips of the tool secured to one of the yokes.

Figure 8 is an elevational view, partly in section, of the base bar of the tool.

Figure 9 is a sectional view taken on line 9—9, of Figure 8, and

Figure 10 is an enlarged sectional view through the adjustable portion of one of the clamping bars of the fracture apparatus.

Referring to the drawings in greater detail, Figures 1, 2, 3, 4 and 10 relate to the ambulatory fracture apparatus per se, while Figures 5 to 9 inclusive relate to the tool for use in conjunction with the fracture apparatus. The description immediately following will be directed to the fracture apparatus.

The means for connecting the apparatus to the bone fragments comprises pairs of pins 1 and 2. These pins may be formed of stainless steel or the like, and are preferably of angular cross section at the tapered pointed ends 1', 2' to facilitate boring through the bone fragments. This transfixion may be accomplished manually or by any preferred drilling mechanism, but it is essential that the pins of each pair be arranged at an inclination to each other so as to prevent

longitudinal movement of the pins with respect to the bone, after the pins have been clamped to the main apparatus, as will now be described.

The primary elements of the fracture apparatus, aside from the pins 1 and 2, consist of two yoke or base members 3 and 4, and clamping bars 5 for rigidly holding the yokes in the relative positions to which they have been adjusted in the extension and reduction of the limb being operated upon. The yokes 3—4 are identical in construction and a description of one of them will suffice.

Each yoke is formed of a strong metal band of light weight and is more or less semi-circular in shape, being of such curvature as to accommodate itself to the limb being treated and yet being sufficiently close thereto to permit the application of ordinary clothing thereover. One leg of the yoke is formed with a rigid clamping plate extending laterally therefrom, as indicated by numeral 6. Approximately one-half of the underside of the plate 6 is a flat surface, while the remaining portion thereof is preferably rounded transversely, as indicated by numeral 7. Cooperating with plate 6 is a plate 8, provided with a flat upper surface at one end and a rounded surface 9 at the opposite end; these surfaces being opposed to the corresponding surfaces on the clamping plate 6.

As will be observed by viewing Figure 1, the pin 1 has one of its ends clamped between the flat surfaces of members 6 and 8, while the pin 2 has a corresponding end clamped between the rounded surfaces 7 and 9. The clamping action is provided by means of a bolt 10 extending downwardly from the upper plate 6 and through an opening in the lower plate 8. A nut 11 is threaded onto the free end of the bolt. The flat portions of the plates 6 and 8 grip the pin 1, the pin being in the plane of the clamp surfaces. The curved surfaces 7 and 9 grip pin 2, and by reason of the curvature of these surfaces the proper gripping action occurs even though the pin 2 may be at a different angle to the horizontal (Figure 1) than the pin 1. This arrangement permits the proper clamping of a pair of pins, without undue strain on the pins or bone fragments, even though the pins may not make the same angle to the horizontal.

The opposite end of each of the yokes is provided with a seat 12 for pin 1 and a set screw 13 for clamping the pin in position in its seat. Pivotally mounted on the same end of the yoke is a clamping member for pin 2. This member comprises the pivotally connected plates 14 and 15, the latter being slotted to receive the free end of a clamping bolt 16 mounted on plate 14. By reason of this separate clamping member for pin 2 it will be apparent that it may be connected to the yoke regardless of the fact that its angle of transfixion in a vertical plane (Figure 1) may be somewhat different from that of pin 1. After pin 2 is clamped between plates 14 and 15 its position relative to the yoke is fixed by means of a wing-nut 17 which locks the clamp against movement about its pivot on the yoke.

Assuming that the two yokes have been connected to the pairs of pins in the bone fragments and that the fragments have been brought into proper alignment by manual operation of the yokes, or through the instrumentality of the tool to be later described, it is essential that the yokes be firmly connected to each other in their adjusted position so as to provide the necessary fixation of the bone fragments. To this end, the clamping bars 5 are provided. These bars, of which there are three, are formed with socket members 20 on their opposite ends for cooperation with corresponding ball members 21 on the yokes 3 and 4.

The bars 5 are of course longitudinally adjustable to accommodate them to different spacing of the yokes or different angular positions thereof. In the particular embodiment illustrated, each bar is composed of two aligned rods 22 and 23; the rod 22 being formed with an enlarged cylindrical portion 24 for the reception of an end of the rod 23. The cylindrical portion 24 is externally threaded, as shown in Figure 10, for cooperation with an internally threaded sleeve 25. Within the sleeve 25 is a gripping element 26 slidably mounted on rod 23. The element has tapered or conical ends 27 and 28 for cooperation respectively with a tapered end 29 on sleeve 25 and a flared end 30 on cylinder 24. The tapered ends 27 and 28 are slotted to form gripping fingers, and when the sleeve 25 is rotated these fingers will be forced into gripping relation with respect to the rod 23. The sleeve 25 can be rotated by any desired means, but there is preferably provided spaced ribs 31, between which are recesses 32 for the reception of a wrench.

As heretofore stated, each bar 5 is provided with end sockets 20, for engagement with cooperating ball members 21 on the yokes 34. These sockets are formed in enlargements of the rods 22—23, and consist of generally semi-circular portions having their ends connected to the rod by parallel plates 33. These plates are connected at their lower edges by an integral web member 34 (Figure 3), and at their upper edges by a detachable plate 35. The plate 35 serves to confine a slidably mounted bar 36 between the guide plates 33 and web 34, and this bar is provided on its outer end with a cup-shaped clamping member 37 for cooperation with socket 20, in clamping a ball member 21. The bar 36 is reciprocated by means of a toggle comprising levers 38 and 39, pivotally connected at 40. The lever 39 is provided with an operating handle 41. The opposite ends of the levers 38 and 39 are pivotally connected to a shackle bolt 42 and bar 36 as indicated by numerals 43 and 44, respectively. The shackle bolt 42 is slidably mounted in a recess in the rod 22 or 23, and a nut 45 is threaded on the shackle bolt to provide a preliminary adjustment for clamp 37, so that operation of the toggle will produce the necessary pressure when moved to operative position. The handle 41 is provided with a stop 46 as is usual in this type of toggle joint.

With this type of clamp it will be apparent that the clamping bars 5 may be quickly installed after being adjusted to the proper length by manipulation of sleeve 25.

Having described the fracture apparatus insofar as it relates to the skeletal attachment of the yokes and the securing of the yokes in adjusted positions for the duration of fixation of the bone fragments, I shall now describe the preferred tool for operation on the yokes, to provide the necessary traction for overcoming contraction of the muscles and to bring the bone fragments into proper end to end relation.

This tool comprises a pair of levers 50—51 (Figure 5) pivotally connected to a spacer bar generally indicated by numeral 52, and means for connecting the operative ends of the levers to the yokes 3 and 4.

The spacer bar 52 comprises two plates 53 and 54 mounted in overlapping relation and provided with yokes 55 at their outer ends. These yokes are formed with bearing members 56 for the levers 50—51. The plate 53 has a channel member 57 detachably connected thereto by screws 58, to provide a guideway for the slidably-mounted plate 54, and the latter is formed with ratchet teeth 59 for cooperation with a spring-pressed pawl 60 pivotally mounted on the plate 53. By this arrangement it will be observed that the spacer bar may be elongated or shortened to correspond with the spacing of yokes 3 and 4, and thus provide the best leverage action for levers 50—51.

The levers 50—51 are preferably formed with transverse slots 61 and 62 respectively, to provide detachable connections with the bearings 56, and with slots or hooks 63 and 64 at their outer ends for detachable engagement with bearing members 65 and 66 provided on the links which connect the levers with the yokes 3 and 4.

The connection between the yokes and levers is shown in detail in Figure 7, and comprises a pair of members 67 and 68 pivotally connected at 69, and provided with complementary cup-shaped clamping elements 70—70. The parts 70—70 constitute a socket for the gripping of a ball 71 connected to yoke 3 and 4. These parts are secured in their clamping position on ball 71, by a bolt 72 connected to arm 68 and passing through arm 67, and a wing-nut 73 threaded on the outer end of the bolt. It will be understood of course that the members 70 are intended to tightly grip the ball 71, so that the necessary movements may be transmitted to the bone fragments. Axial movements of the yokes may be permitted by reason of the swivel connection 68' in member 68, although the swivel may be placed at any point between the lever and yoke.

The ball 71 may be secured to the yokes 3, 4, by any desired means. In the specific form illustrated, clamp plates 74 and 75 are arranged on opposite sides of the yoke, and clamped thereto by bolt 77 and nut 78. One of the plates may be provided with a series of pins 76, for interlocking engagement with the yoke. The ball 71 is carried by the outer plate 74.

The operation of the various parts of the apparatus has been described in connection with the description of the structural details and need be repeated only in a general way.

The bone fragments having been transfixed by the pairs of pins 1 and 2, with the pins arranged at an angle to each other as indicated in Figure 1, the yoke members 3 and 4 are clamped to the pins. For this purpose the clamping plates 6 and 8 are passed over the base ends of the pins and the nut 11 tightened up until the pins are securely clamped. The opposite end of pin 1 is seated in the seat 12 and the screw 13 rotated to clamping position. The position of pin 1 controls the angular position of the yoke 3 or 4 due to the fact that it is clamped between the plain faces of the plates 6 and 8. The other pin may lie in a different plane from pin 1, but due to the curved surfaces 7 and 9 and the separately adjustable clamp 14—15 it may be securely gripped without placing any undue strain upon any of the parts of the apparatus or the bone fragment.

The yoke members having been secured in position, the reduction of the fracture and angulation of the fragments, etc., may be accomplished by manual operation of the yokes 3 and 4, but due to the force ordinarily required to overcome the spasticity of the muscles, it is preferable to employ the tool disclosed in Figure 5. For this purpose the plates 74 and 75 are clamped on the yokes and the extensions of levers 50—51 are connected to the balls 71 of the plates 74. To secure the most efficient leverage the levers 50—51 are then moved outwardly into parallel relationship, this being permitted by the extensibility of the spacer bar 52. The levers 50—51 may then be operated to reduce the fracture, and the swivel connections 68' permit independent axial movement of the yokes to bring the ends of the bone fragments into proper mating relationship. The fluoroscope will of course be used to determine the final setting of the bone. Thereafter the clamping bars 5 are adjusted to the proper length and quickly clamped to the yokes by snapping down the toggle joints 41. Immobilization of the bone fragments is now completed and the tool 50—51 and clamping plates 74—75 are removed.

The fracture apparatus, as thus applied, leaves the soft parts of the limb completely exposed for any desired treatment of flesh wounds which may have been caused at the time of the fracture. The use of the inclined pins and the clamps secured to the ends thereof provide a firm and durable connection of the yokes to the bone fragments; while the bars 5 insure the desired fixation of the parts for an indefinite period. Moreover, the rather snug fit of the yokes 3 and 4 and related parts, to the limb, permit of the application of ordinary clothing. It will be apparent therefore that in many instances of fractures of the upper extremities the patient may be allowed to continue his daily routine during the healing of the injured limb. For this reason the splint has been referred to as an ambulatory splint. By this term is meant a splint which will permit the patient to continue substantially normal use of the affected part, but is in no sense intended to limit the specification and claims to a splint for a leg. Moreover the term ambulatory splint as here used is intended to exclude splints which are employed in conjunction with plaster casts and which would therefore prevent substantially normal use of the affected part.

Obviously the particular apparatus shown and described, may be changed and modified in numerous respects without departing from the invention, and such changes and modifications are intended to be included within the scope of the appended claims.

I claim:

1. An ambulatory splint comprising a pair of yoke members, means for skeletally attaching said members to a human limb, a plurality of bars securing said yokes in fixed relative positions, and lever-actuated clamping members securing the bars to the yokes.

2. An ambulatory splint comprising a pair of yoke members, means for skeletally attaching said members to a human limb, a plurality of extensible clamping bars securing said yokes in fixed relative positions, clamping members connecting the bars to the yokes, and toggle levers for operating said clamping members.

3. An ambulatory splint comprising a pair of substantially semi-circular yoke members, means for skeletally attaching said members to a human limb, a plurality of clamping bars securing said yokes in fixed relative positions, and quick-acting clamping members on the ends of said bars for gripping the yokes.

4. In an ambulatory splint a substantially semi-circular yoke member adapted to partly encircle a human limb, means on the yoke for clamping a pair of skeletal pins, and a series of joint-forming balls spaced about the yoke.

5. An ambulatory splint comprising a pair of separate yoke members, means on each yoke for clamping the opposite ends of a pair of skeletal pins, and means for securing said yokes in fixed relative positions, said means including a plurality of balls spaced about each yoke, and a plurality of clamping bars having sockets on their ends cooperating with the balls.

6. An ambulatory splint including a pair of separate and independent yoke members, means for skeletally attaching said members to a human limb, a series of spaced balls on each yoke, an equal number of bars for locking the yokes in fixed relative positions, and quick-acting clamps on each end of each bar gripping the respective balls.

7. In an ambulatory splint fracture apparatus including a pair of separate and independent yoke members, means for skeletally attaching said members to a human limb, a series of spaced balls on each yoke, an equal number of extensible bars for locking the yokes in fixed relative positions, and clamps on each end of each bar gripping the respective ball.

8. In a splint a substantially semi-circular yoke member adapted to partly encircle a human limb, means on the ends of the yoke for clamping a skeletal pin, and additional means on the ends of the yoke to clamp a second skeletal pin, said additional means being constructed and arranged to clamp the second pin either in or out of the plane of the first pin.

9. In an ambulatory splint a substantially semi-circular yoke member adapted to partly encircle a human limb, a clamping bar integrally formed on one end of the yoke, a clamping plate cooperating with said bar, the clamping bar and plate provided with corresponding flat clamping surfaces at one end and curved clamping surfaces at the other end.

10. In an ambulatory splint a substantially semi-circular yoke member adapted to partly encircle a human limb, a seat for a skeletal pin on one end of said yoke, means for locking said pin in its seat, and means pivotally connected to the same end of the yoke for clamping a second skeletal pin.

11. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, extensible means connecting the base members, and ball and socket connections between the respective ends of the extending means and the base members.

12. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, an extensible rod connecting the base members, ball and socket connections between the respective ends of the rod and the base members, and means locking the ball and socket connections against movement.

13. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, extensible rods connecting the base members, ball and socket connections between the respective ends of the rods and the base members, and means locking the ball and socket connections against movement.

14. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, extensible means connecting the base members, and a ball and socket joint connecting each end of the extensible means to a base member, parts of each of said joints being separable to permit the attachment and detachment of the extensible means to and from the base members.

15. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, extensible means connecting the base members, a ball and socket joint connecting each end of the extensible means to a base member, the ball and socket of each joint being separable to permit the attachment and detachment of the extensible means to and from the base members, and means locking the elements of each ball and socket joint against relative movement.

16. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, an extensible rod connecting the base members, a ball and socket joint connecting each end of the rod to a base member, the ball and socket of each joint being separable to permit the attachment and detachment of the rod to and from the base members, and a clamp locking the elements of each ball and socket joint against relative movement.

17. An ambulatory splint comprising a pair of base members, means for connecting each base member to a bone fragment, said means comprising a pair of skeletal pins spaced to hold the fragment rigid, means supporting said base members in spaced relationship, and a ball and socket connection between each base member and the supporting means, the base members being adjustable toward or from each other.

HERBERT H. HAYNES.