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3,216,414

PLATE AND SPLIT NAIL ASSEMBLY FOR USE IN ORTHOPEDIC SURGERY

Filed Sept. 29, 1961

2 Sheets-Sheet 1

FIG 1.

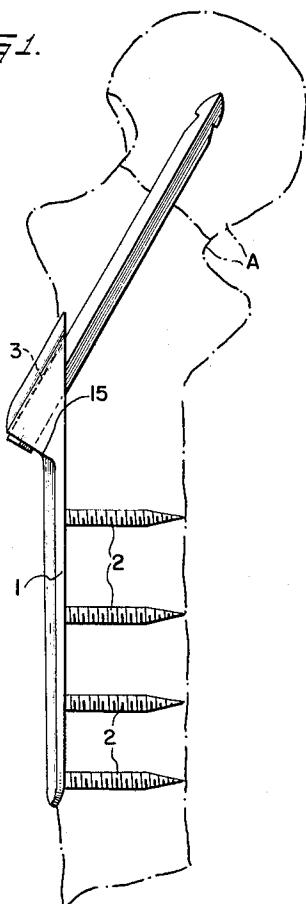


FIG 2.

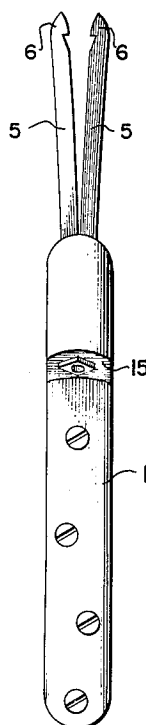


FIG 3.

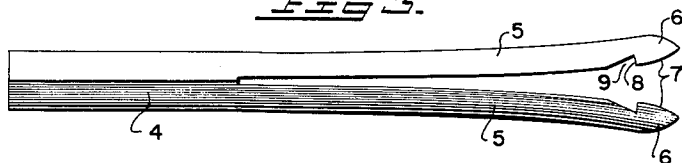
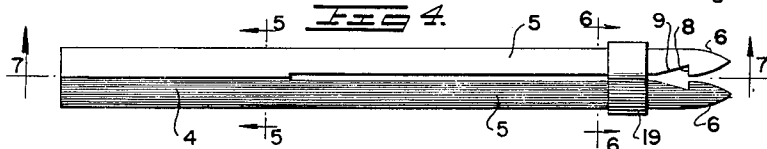


FIG 4.



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FIG 5.

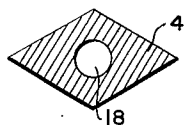


FIG 6.

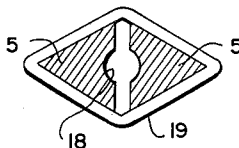


FIG 7.



FIG 8.

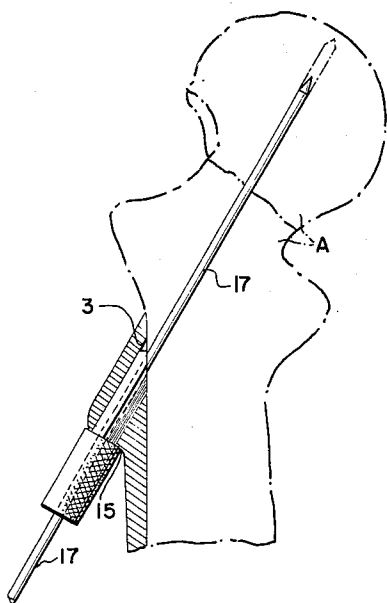


FIG 9.

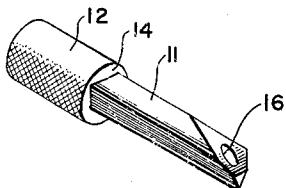
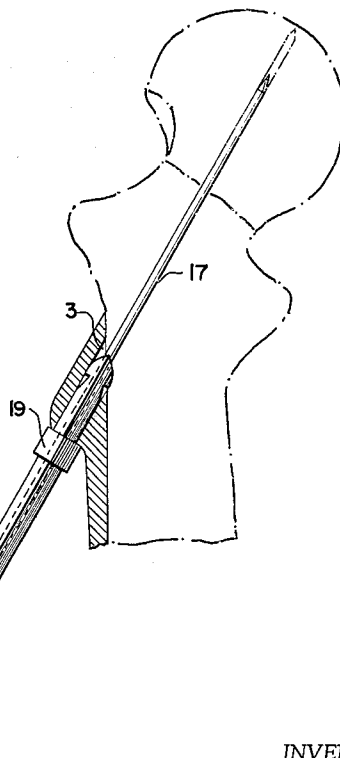


FIG 10.

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3,216,414 PLATE AND SPLIT NAIL ASSEMBLY FOR USE IN ORTHOPEDIC SURGERY

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4 Claims. (Cl. 128—92)

Generally this invention comprehends a novel plate structure for association with a split expanded nail for use in orthopedic surgery involving fractures of the neck of the femur.

More specifically the instant invention uses a plate structure formed with a reinforced area at its upper end, the reinforced area being formed with an angularly arranged guideway for proper association with the femoral shaft to permit the introduction and application of the split nail assembly.

Another object of this invention is the use in hip fracture operations of split nails in which the nail structure is generally diamond shaped in cross section, being of greater dimension horizontally than vertically, the difference in horizontal and vertical measurement being such that the legs of the split nail are substantially triangular after the material is removed by the cutter in the bi-sectioning of the nail extremity.

A further object of the invention is to provide a split nail structure for the purpose specified in which the split nail portions progressively spread outwardly toward their outer terminals, the latter extremities being gradually tapered and having their inner flared faces formed with projections to facilitate their functioning, the entire nail being designed to withstand existing load and torque conditions which may exist when installed.

These and other objects of the invention will more clearly hereinafter appear by reference to the accompanying drawings forming a part of the instant specification and wherein like characters of reference designate corresponding parts throughout the several views, in which:

FIG. 1 is a side elevation of a finished assembly;

FIG. 2 is a front elevation of the assembly of FIG. 1;

FIG. 3 is a top plan of a nail structure;

FIG. 4 is a top plan in which the legs of the nail are clamped together for insertion in the plate guideway;

FIG. 5 is a transverse section on line 5—5 of FIG. 4;

FIG. 6 is a transverse section on line 6—6 of FIG. 4;

FIG. 7 is a longitudinal sectional view on line 7—7 of FIG. 4;

FIG. 8 is a side elevation partly in section showing the guide wire in position in the plate;

FIG. 9 is a side elevation partly in section showing the split nail being introduced on the guide wire; and

FIG. 10 is a perspective view of the wire guide.

In the drawings a suitable plate assembly for attachment to a femur is indicated by reference character 1. This plate assembly is formed with screw openings for the passage of screws 2, the latter being of any suitable number and size according to requirements. The upper end portion of the plate assembly is thickened to provide an appropriate wall structure to accommodate the formation of an angular guide slot 3 of generally diamond shape in cross-section, this slot being disposed at such an angle as to approximate the center of the femur neck A.

The plate described is used in association with a split nail assembly shown in FIGS. 3 to 7, inclusive. The split nail per se may be of any appropriate length and includes a body having solid shank 4 and a split upper portion defining arms 5. The nail body is of generally diamond form in cross-section (see FIGS. 5 and 6), the vertical medial dimension being less than the transverse medial dimension. The difference in the vertical and

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horizontal dimensions is critical in that it provides material for the cut defining the two prongs 5 of the nail, each of which is in cross-section an equilateral triangle, as shown in FIG. 6. In addition the removal of material to form the prongs 5 provides a clearance permitting compression of the prongs to facilitate insertion in the guideway 3 in the head of the plate, as will be more clearly hereinafter explained.

Each of the prongs 5 of the nail is identical throughout its length and each terminates in identical arcuate converging outer faces 6, thus forming a reduced end portion. The inner terminal faces are curved and diverge as at 7 to merge with the outer faces 6 defining a pair of pointed terminals. Inward of the inner diverging terminal faces are vertically extending recesses defined by walls 8 and 9 forming shoulders tending to prevent longitudinal movement of the device when in use. The prongs or arms 5 after being defined by slotting the nail structure are sprung to retain approximately the position of FIG. 3 and are normally retained in this position under tension unless moved to generally abutting position for insertion in the guideway, as shown in FIG. 4, by use of the sliding clamp 19 to be hereinafter described. As the arms pass through the guideway 3 they will gradually spring to open position as shown in FIG. 2, in which position the various parts provide maximum efforts in producing the desired result in supporting the load, in maintaining the parts of the bone structure in proper alignment and association, and resisting relative rotation of the spherical head and neck assembly.

In an operation involving the use of the split nail as aforesaid, certain preliminary steps are essential. In this connection is the provision of the guide wire and its application. The guide wire indicated at 17 in FIGS. 8 and 9 is first inserted in the assembled bone structure and to accomplish this a wire guide shown in FIG. 10 is provided, this wire guide having an end or shank portion 11 and a handle portion or base 12. The handle or base 12 is shown as cylindrical and of greater diameter than the end or shank portion 11 to define a shoulder 14 which when the shank portion 11 is inserted in the guideway 3 of the plate assembly abuts the outer face or wall 15, more clearly shown in FIG. 2. The guide member of FIG. 10 has its shank 11 of substantially the same size and cross-section as the shank 4 of the split nail and is adapted to fit snugly in the guide slot 3 in the head of the plate member. In addition the wire guide of FIG. 10 is formed with an axial bore 16 for the passage of a guide wire 17, these parts being shown assembled in FIG. 8. The insertion of the guide wire 17 in the guide member determines the depth and angle of the split nail travel as when the guide wire 17 is properly inserted and located the guide member of FIG. 10 is removed from the guide slot 3 and the split nail can then be inserted by causing it to travel on the guide wire 17. Normally the guide wire will be inserted until it engages the inner shell face, although this is not necessarily mandatory.

Referring again to the split nail structure, and particularly to FIGS. 3 and 4, it will be noted that this nail embodies two features. In the first place the split nail is formed with an axial bore 18 of a diameter to snugly receive and travel along the guide wire 17. The bore 18 is partly interrupted at the area of the spring arms 5, however, there is sufficient metal to permit the parts to function for the intended purpose. The second feature is the sliding clamp 19 of a size and shape to snugly engage and force the spring arms 5 to their compressed form. After removing the wire guide shown in FIG. 10, the nail with the sliding clamp 19 moved to its forward position, as in FIG. 4, is inserted in the guide slot 3 in the head of the plate with the wire projecting through the

passageway or bore 18 therein. The split nail is driven along the wire guide 17 to its proper position into the spherical head and across the fracture of the neck. The movement of the split nail along the guide wire will result in the sliding clamp 19 engaging the wall 15 of the head of the plate and cause the sliding clamp to travel along the nail for removal from the nail structure. The nail travels freely through the guide slot 3 and is retained against rotational movement due to the diamond shaped formation of the associated parts. The shank 4 of the split nail, while firmly positioned in the guide slot 3 nevertheless will be free for longitudinal movement which is desirable in certain orthopedic surgery involving the parts in question. The split nail, as it travels through the guide slot 3, will gradually take the form shown in FIG. 3, i.e. the arms 5 expanding to the position shown within the marrow canal of the fractured structure.

It is important to note that the inner measurement of the guide slot 3 is such as to permit free axial movement of the nail shank to prevent binding of these parts. In fact one of the important features of this development is the guided, but free axial movement, of the split nail after it is properly positioned to accommodate the inherent movement of the associated parts. It will also be noted that the shoulders tend to restrain any axial displacement of the split nail but still permit essential longitudinal adjustment inherent in such operations.

In use the split nail is driven along its guide wire 17 through the guide slot 3 in the plate and across the fracture and well into the head, the arms 5 of the nail expanding as the compressive forces of the guideway in the head and the compressive forces of the sliding clamp are released by the split nail travel. After the nail is driven to its proper location, the guide wire 17 can be readily removed. When in position the triangular arms of the split nail have their greater thickness generally vertical to resist the vertical forces, the nail being free for longitudinal movement due to the sliding fit with the guide slot 3. The terminal structure of the nail arms insures proper fixation while the torsion and rotation associated with hip motion is positively controlled thus avoiding shortening of the neck or other undesirable conditions.

What I claim is:

1. A nail structure for use in orthopedic surgery comprising an elongated body of diamond form in cross section, said nail structure having one transverse dimension thicker than its other transverse dimension and being formed with an axially extending bore throughout its length, said elongated body being split transversely and medially at one end portion and in a direction normal to the direction of its greater transverse dimension to provide resilient arms of triangular shape in cross section and a shank portion, said arms being defined in part by spaced inner opposed faces and the outer end portions of said inner faces being formed inward of their outer extrem-

ities with transverse shoulders defining inwardly facing terminal hooks.

2. The structure of claim 1 characterized in that a clamp is slidably mounted on said shank, said sliding clamp having an inner configuration and inner dimension corresponding to the shank of the nail assembly whereby said sliding clamp can be adjusted lengthwise of the nail to retain said resilient arms in compressed position to provide a nail assembly of uniform outer dimension throughout the major portion of its structure.

3. In a device of the character described, a plate structure for attachment to a femur, said plate structure having a relatively heavy head with a guide slot formed therein, said guide slot being of general diamond shape in cross section with transverse dimension greater than the vertical dimension, a guide wire positioned axially within the guide slot formed in said head, a split nail in said guide slot in said head, said split nail being formed with an axial bore receiving said guide wire and being slidable therealong, said split nail including a shank portion having the same general cross section as said guide slot and being of greater transverse dimension than vertical dimension for sliding movement in said guide slot on said guide wire, said split nail including a pair of normally laterally sprung arm portions, said arm portions being of triangular cross section and being formed by removal of the vertical medial longitudinal portion of the split nail body, and sliding clamp means mounted on said split nail for retaining said normally laterally sprung arms in compressed position adjacent to each other to facilitate the insertion of the nail in the guide slot in the head of said plate and along said guide wire.

4. The structure of claim 3 characterized in that the sprung arm terminals are defined by converging inner and outer rounded faces and each of the inner faces terminates in a transversely extending notch defined by a transversely extending vertical face.

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