Sept. 4, 1956 J. V. LUCK 2,761,444

BONE FIXATION DEVICE FOR THE HIP

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Fig. 1

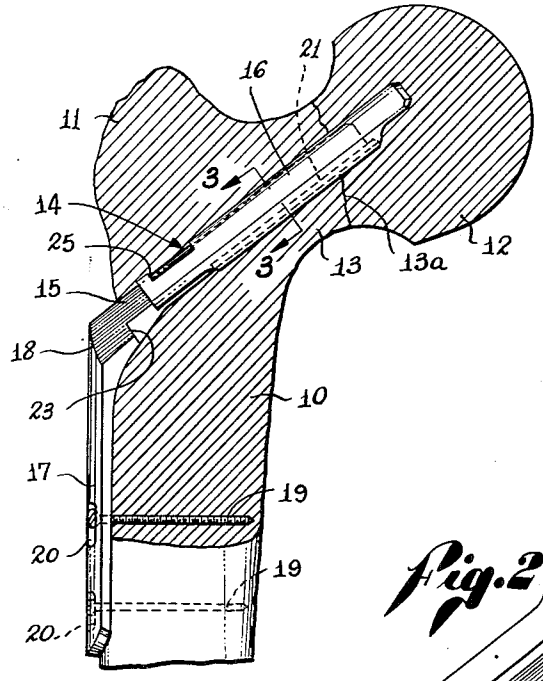


Fig. 3

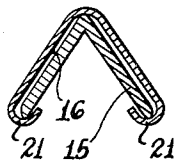


Fig. 2

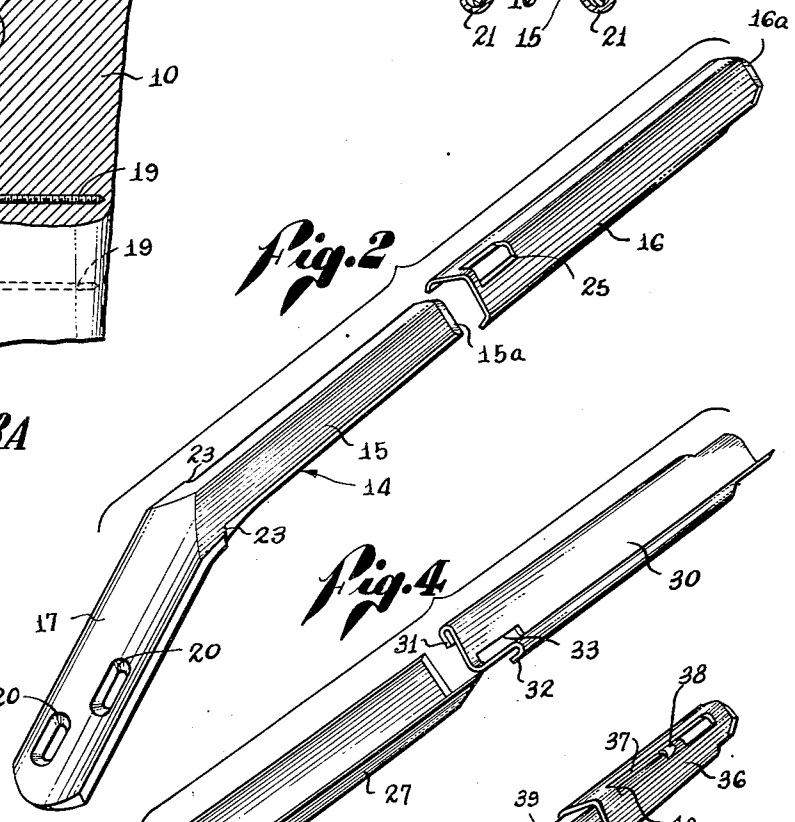


Fig. 3A

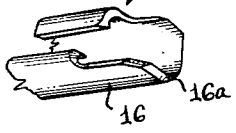


Fig. 4




Fig. 5

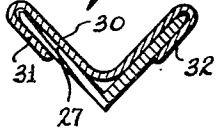


Fig. 6




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# BONE FIXATION DEVICE FOR THE HIP

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5 Claims. (Cl. 128—92)

This invention relates generally to surgical appliances and more particularly, to an improved bone fixation device employing a compound surgical nail for supporting and maintaining fractured bone portions in position for proper healing.

In bone surgery, it is oftentimes necessary to support damaged bone tissue in a set position. The fixation device or surgical nail used for this purpose should not only permit proper functioning of the bones but should adequately support them so that fractures may heal.

In the case of intertrochanteric and neck fractures of the femur bone, the surgeon first cuts a suitable aperture through the lateral portion of the femur. A surgical nail is then driven in through this aperture to cross the fracture site into the femoral head. An X-ray picture will reveal the extent of femoral head penetration, and if the extent is too small, the nail must be removed and a longer one inserted. Since it is most important that the surgical nail be of proper length to insure that the fractured bones will be adequately supported, several different lengths of nails must be kept on hand, and the proper length is generally selected by a process of trial and error.

In some instances, a considerable length of time may be required for healing after a proper length nail has been inserted. During the healing process the bone oftentimes tends to be absorbed, particularly adjacent the fracture site. This process may result in an outward shifting of the femoral head with the possibility that the sharpened extremity of the fixed nail may become exposed through the femoral head and injure the joint. Also, with certain prior art nails, fixation is inadequate, and there may occur a lateral migration of the nail with possibility of ultimate protrusion of the nail end into soft tissue areas, resulting in considerable pain. It is important, therefore, that any type of surgical nail or fixation device employed offer assurance that it will remain contained inside the bone, and be capable of maintaining a fixed direction and yet properly retain the fractured bones in proper functioning and anatomical position notwithstanding slow absorption of the bone at the fracture site.

A primary object of the present invention accordingly is to provide a compound type of surgical nail which is capable of assuming different lengths whereby a nail of universal length is provided and the usual trial of different length nails is avoided.

More particularly, an object of the invention is to provide a fixation device or surgical nail having universal characteristics such that any slight shifts in the fractured bone structure caused by absorption of the bone will not impair the efficiency of the nail for maintaining the fractured bones in proper alinement and position for healing.

Still another important object is to provide a surgical nail providing greatly improved results in the treatment of hip fractures, particularly intertrochanteric and neck fractures of the femur.

The nail of the invention is a compound two-part device consisting of two telescoping pin members, both sharpened at their forward ends for bone penetration, the first having an angular flange or shank part adapted to be secured to the outside of the femur for support of the assembly, and being adapted to be driven into the femoral neck past the site of the fracture. The second part of the pin goes in together with the first while in a retracted position on the first; and is subsequently extended, by longitudinal sliding movement on the first, to attain a properly adjusted penetration into the femoral head, as can be checked by X-ray. The telescopic sliding relation of the two parts of the pin offers a device of universal applicability insofar as length is concerned. Moreover, in event of subsequent shifting of the femoral head, the second or relatively movable part of the pin slides on the fixed pin member to accommodate such shifting, and liability of pin end protrusion beyond the head is eliminated. The two pin members also have interengaging stops when the second pin part is in a fully retracted position on the first. These stops are in engagement in the first stage of installation, i. e., while the assembly is first being driven in, and are separated when the second part has been driven deeper to penetrate the femoral head. In the conceivable event of a large amount of subsequent outward shifting of the second or advanced pin member on the first (owing to an extreme degree of outward shifting of the femoral head), these stops will again engage to prevent the moving pin member from actually protruding into the overlying tissues.

The shank portion of the compound nail may be provided with elongated openings for receiving screws to fasten the shank to a portion of the bone. These elongated openings permit slight relative movement in a longitudinal direction between the shank and such bone portion, whereby limited movement as a result of bone absorption is accommodated by the elongated dimension of the opening. Any lateral movement of the compound nail, however, is prevented.

The cross sections of the pin and supporting shaft are illustrated in the present case as V-shaped, whereby they may nest together for longitudinal sliding movement and yet be locked against relative rotation. This V-shaped cross section also provides a relatively large contact area between the nail surfaces and the surrounding bone tissue, thus insuring that the nail will properly maintain the fractured bones in proper alinement. Other cross-sections, however, are within the broad scope of the invention.

A better understanding of the invention and its mode of operation will be had by referring to the following detailed description of one illustrative embodiment taken in conjunction with the accompanying drawings, in which:

Fig. 1 illustrates, in cross-section, a femur bone fracture and the relative positioning of the compound nail of the present invention for maintaining the fractured portions in proper alinement for healing;

Fig. 2 is an exploded perspective view of the nail shown in Fig. 1;

Fig. 3 is a cross-section of the nail taken in the direction of the arrows 3—3 of Fig. 1;

Fig. 3*a* is a fragmentary inverted view of the forward end portion of the extensible pin member;

Fig. 4 shows a modified type of nail in exploded perspective view;

Fig. 5 is a cross-section of the nail of Fig. 4 when in assembled position; and,

Fig. 6 illustrates another modification applicable to the nails of Figs. 2 and 4.

The invention will be described in connection with the healing of a hip fracture, specifically a fracture of the femoral neck.

Referring to Fig. 1, there is shown a femur **10** terminating in a trochanter comprising a distal end **11** and a femoral head **12** connected to the distal end **11** by femoral neck **13**. A common point of fracture in this bone structure is across the femoral neck such as at **13***a*.

The surgical nail **14** is designed to secure the femoral head **12** in proper position with respect to the femur **10** and distal end **11** so that proper healing and knitting of the fracture may take place. In accordance with the invention, the nail comprises a compound telescopic pin assembly consisting of a first fixed pin member **15**, and a second pin member **16** telescopically associated with the first, i. e., longitudinally slidable on and guided by the member **15**. Pin member **15** has at one end an integral angularly extending shank portion **17**, which is shaped and adapted to be fastened to the femur **10** by means of screws **19** passing through suitable openings **20** in the shank. It will be noted that the openings **20** are elongated in the longitudinal direction of the shank to permit slight relative longitudinal motion between the femur **10** and the shank portion.

Referring to Figs. 2 and 3, the cross-sectional configuration of the fixed pin member **15** is here shown as substantially inverted V-shaped and the cross-section of the extensible pin member **16** is of a similar inverted V-shape, the two parts nesting together as clearly shown in Fig. 3. The longitudinal edges of the pin member **16** are formed with inwardly turned guides **21** to embrace the corresponding longitudinal edges of the pin member **15**. In the present case, these guides terminate somewhat short of the two ends of the pin, as can be seen in Fig. 1. The two pin members **15** and **16** can thus be described as telescopically associated, so as to be capable of relative longitudinal movement. The association is at the same time such as to prevent relative rotation between the members **15** and **16**. It is also to be noted that the V-shaped cross-section provides a relatively large surface area for frictionally securing the nail in the femoral head. Other cross-sectional shapes effecting the same result may, of course, be employed. The two pin members **15** and **16** are both sharpened at the forward ends for bone penetration, as indicated at **15***a* and **16***a*, respectively. The forward edges of the guide portions **21** of member **16** are also sharpened.

As shown clearly in Fig. 2, the fixed pin member **15** is provided with stops or shoulders **23** on opposite sides of its base end adjacent its integral connection to the shank **17**. These stops **23** provide suitable shoulder abutments against which the rearward end of the pin member **16** may abut, thereby limiting longitudinal movement of the pin member **16** in a direction towards the shank **17**. This construction insures that the pin member **16** will not be pushed back along the pin member **15** to protrude through the skin (not shown) surrounding the femur **10**.

In order to adjust the overall length of the nail, there is provided an opening **25** in one end portion of the pin member **16** providing edges against which a suitable instrument may engage for driving the member **16** into the femoral head once the fixed pin member **15** has been properly secured within the femoral neck. This same opening **25** provides a suitable means for receiving a hooked instrument to retract the member **16**.

In Figs. 4 and 5, there is shown a somewhat modified type of nail in which the open channels defined by the V-shaped cross-section of the pin and shaft are directed upwardly rather than downwardly. As shown in Fig. 4, the fixed pin member **27** integrally extends from a shank **28** fastened to the femur by suitable screws passed through the openings **29**. The extensible pin member **30** has a cross-section defining an upwardly directed open channel having walls with turned over longitudinal edges **31** and **32** for receiving and guiding the corresponding longitudinal edges of the shaft **27**.

At the near end of the pin **30** there is provided an opening **33** for cooperation with a suitable instrument for inserting or removing the device. In this instance, the inserting or removing instrument may extend in the V-shaped channel **34** of the shaft whereby minimum disturbance of the tissue occurs during driving or retracting of the nail.



As in the embodiment of Figs. 1 to 3, the pin member **27** is provided with a shoulder **35** adapted to abut against the rearward end of the curved over edge portion **32** of the pin member **30** for limitation of outward longitudinal sliding movement of the member **30**.

In Fig. 6, a nail similar in general respects to that shown in Fig. 2 is fragmentarily illustrated. In this instance there is provided in the extensible pin component **36** an elongated slot **37**, rather than a short opening such as **25** in Fig. 2. Extending within this slot is a small projection or flap **38** formed on the fixed pin component **39**.

It will be clear at once that abutment of the projection **38** against the rear end **40** of the slot **37**, limits the extent of telescoping movement of the pin, and also serves to retract the pin when the shaft is to be removed. In other words, the provision of the slot and projection avoids the necessity of employing an instrument to withdraw the extensible pin member after the fixed pin portion of the nail has been removed, both components being removable by simply withdrawing the member **39**.

Several of the important features and advantages of the above described construction of the compound nail will be evident from a more detailed consideration of the operations involved in treating intertrochanteric fractures of the femur.

In the case of either an intertrochanteric or neck fracture, the surgeon cuts a suitable aperture through the lateral portion of the femur, limiting the depth of this aperture to something of the order of ⅛" to ¼". This aperture can best be formed to correspond with the cross-sectional shape of the pin, and hence, for the present case, will preferably be of V-section. This can best be done by first making a series of small diameter bores covering a V pattern, and then cutting to connect such bores. In applying the compound nail of the present invention, the pin member **15**, with the extensible pin member **16** retracted to abut shoulder **23** is inserted through the prepared opening and driven ahead toward and into the femoral neck until the shank **17** has engaged the femur, to which shank **17** is then fastened by screws **19**. This has served to drive the forward ends of both pin members **15** and **16** well past the site of the fracture. A suitable driving instrument is then engaged against the rearwardly facing end of the opening **25**, and operated to drive the extensible pin member **16** further into the femoral head **12**.

At this stage in the operation, the bone structure is X-rayed to discern the extent of penetration of the extensible portion **16** of the compound nail within the femoral head **12**. If this extent does not appear to be sufficient, the pin portion **16** is driven a further distance and the bone again X-rayed. As pointed out above, if the surgical nail was not of proper length, as disclosed by X-ray, the nail had to be completely removed and another one of a greater length inserted. The present invention avoids this previous trial and error method by being adjustable in length to suit any situation. As also discussed above, bone absorption is most likely to occur adjacent the fracture site **13***a*. Such absorption can result in the femoral head **12** tending to shift towards the distal end **11** in order to fill the void left as a result of the absorption. Such relative movement between the head **12** and distal end **11** is easily accommodated by the compound nail of the present invention inasmuch as the movable pin member **16** is free to slide rearwardly on the fixed member **15** with any such shifting of the head **12**. In the event a nail of fixed length were employed, there is a real possibility under such conditions that the

forward extremity of the nail would protrude into the hip socket and cause considerable pain as well as joint damage.

It is also possible with those prior art nails not fixed to the femoral shaft for the nail to migrate laterally into an adjacent muscle and even through overlying skin. This phenomenon results when the nail is not properly supported in the bone and, on becoming loose, migrates laterally. With the compound nail of the present invention, the universal length feature insures that the nail will be of proper length. Further, since one component of the nail, namely, the member **15**, is provided with an integral shank portion **17** in turn adequately secured to the femur portion **10** against lateral movement or migration, the member **15** is firmly supported, and in turn supports the longitudinally movable member **16**, so that lateral migration of both parts of the compound nail is prevented. The shank portion **17** thus inhibits lateral migration, though because of the elongation of the screw holes **20**, it will accommodate slight vertical shifts.

Various modifications within the scope and spirit of the present invention as defined by the claims will occur to those skilled in the art. The compound nail therefore is not to be thought of as limited to the specific embodiments disclosed for illustrative purposes.

I claim:

1. In a hip fracture nail device, the combination of: a first nail comprising a plurality of fins joining one another along common longitudinal edges at an angle and sharpened at the forward extremity thereof for bone penetration by driving action, a base plate rigid with and extending angularly from the opposite extremity thereof adapted to engage and be fastened to the femur, and a longitudinally and rectilinearly movable second nail mounted on said first nail and comprising a plurality of fins joining one another along common longitudinal edges at an angle and sharpened at the forward extremity thereof for bone penetration, said second nail telescopically slidable on said first nail, with angularly disposed fins of said second nail adjacent and slidable along corresponding angularly disposed fins of said first nail, the outermost edges of the fins of said second nail having recurvate flanges defining guide grooves in which outermost edge portions of corresponding fins of said first nail are received, said flanges also being sharpened at their forward extremities, and inwardly facing drive shoulders on the outer edge portions of the outer extremities of the fins of said first nail engageable by the outer extremities of the fins of said second nail in a retracted position of the second nail on the first nail, said



nails being drivable together, as a unit, through the femur and into the femoral neck with said shoulders of said first nail in driving engagement with the outer extremities of the fins of said second nail, until the first nail is finally seated and anchored, with the base plate thereof in contact with the femur, and said second nail being then further drivable, independently of the first nail, but guided rectilinearly by the first nail, to a variably determined depth beyond the forward extremity of the first nail, said second nail being capable of rectilinear recession on said first nail to a limit imposed by re-engagement of said shoulders in the event of subsequent outward shifting of the femoral head.

2. The subject matter of claim 1, in which the fins of the telescopically related first and second nails as seen in cross section are in the form of an inverted V.

3. The subject matter of claim 1, in which the fins of the telescopically related first and second nails as seen in cross section are in the form of a V.

4. The subject matter of claim 1, in which the second nail is formed near its rearward extremity with an aperture at the apex formed by its fins to afford means by which the second nail can be engaged by an instrument for driving or retracting said second nail.

5. The subject matter of claim 1, in which one of said nails has a longitudinal slot and the other has a stop projecting longitudinally into said slot, said pin and slot limiting telescopic movement of said nails relative to one another, and furnishing a lost-motion connection between the second nail and the first nail whereby the second nail can be withdrawn by means of the first nail.


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