United States Patent

[11] 3,561,437

[72] Inventor Jose Luis Orlich
Apartado 81, San Jose, Costa Rica

[21] Appl. No. 714,661
[22] Filed Mar. 20, 1968
[45] Patented Feb. 9, 1971
[32] Priority Nov. 8, 1967
[33] Costa Rica
[31] 1,660

[54] APPARATUS FOR FIXING FRACTURES OF THE FEMUR

3 Claims, 8 Drawing Figs.

[52] U.S. Cl. 128/92
[51] Int. Cl. A61f 5/04
[50] Field of Search 128/92
B–B3, C–C, D, F

[56] References Cited

UNITED STATES PATENTS

2,612,159	9/1952	Collison	128/92
2,621,653	12/1952	Briggs	128/92
2,761,444	9/1956	Luck	128/92
3,433,220	3/1969	Zickel	128/92

FOREIGN PATENTS

195,043	1963	U.S.S.R.	128/92
893,401	6/1944	France	128/92

OTHER REFERENCES

Journal of Bone & Joint Surgery p. 7 Jan. 1955
Journal of Bone & Joint Surgery p. 38, Oct. 1951
Journal of Bone & Joint Surgery p. 162, Feb. 1952

Primary Examiner—Adele M. Eager
Assistant Examiner—J. Yasko
Attorney—Seidel and Gonda

ABSTRACT: Apparatus for fixing fractures of the femur includes a plate which is held by screws to the upper part of the femur and a channel like member fixed to the proximal end of the plate for slidingly engaging a flanged nail which is driven into the head of the femur. A second embodiment substitutes a cannulated pin which is inserted into the intramedullary canal of the femur.

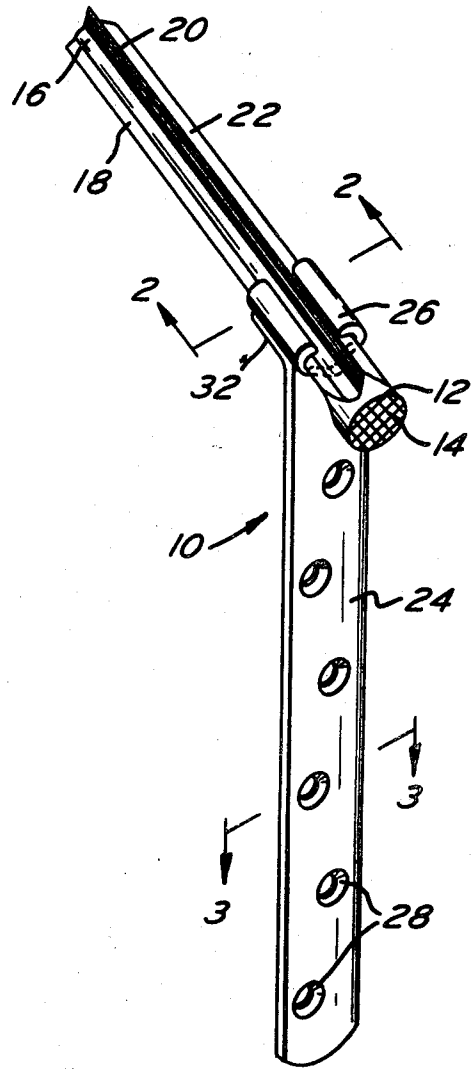
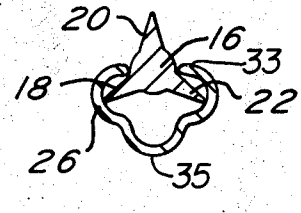


FIG. 2



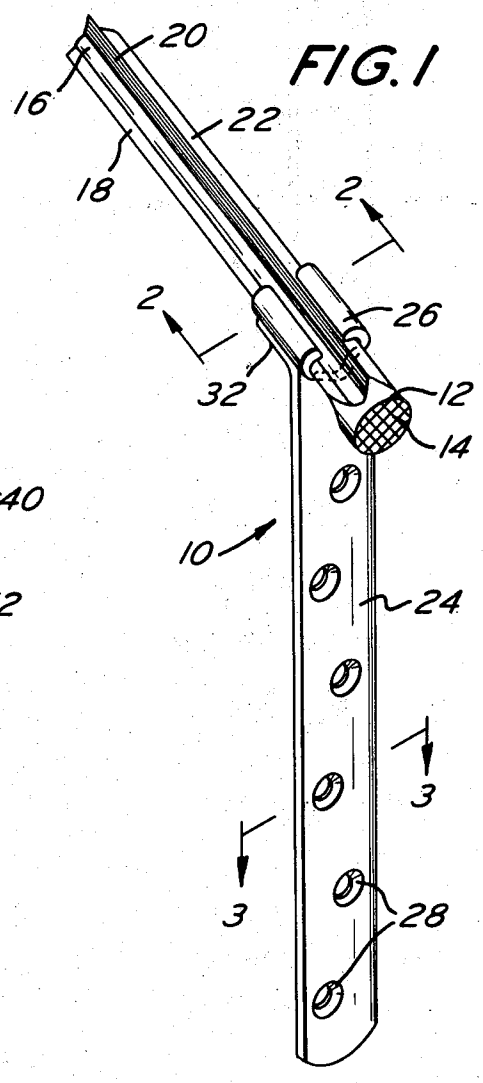


FIG. 1

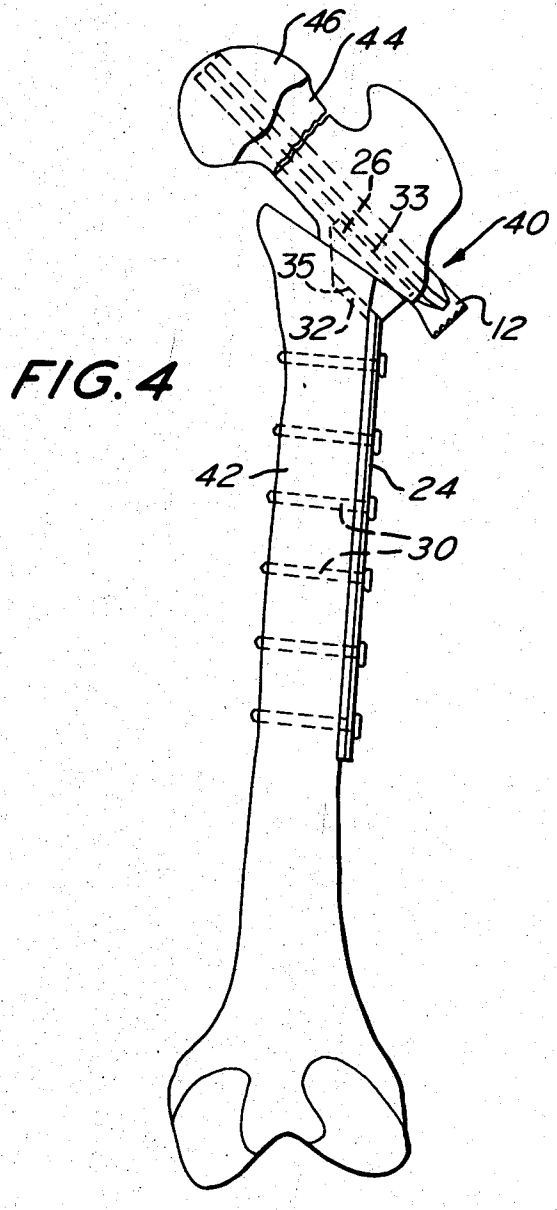


FIG. 4

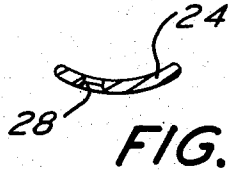


FIG. 3

INVENTOR
JOSE' LUIS ORLICH

BY

Seidel & Gonda
ATTORNEYS.

FIG. 6

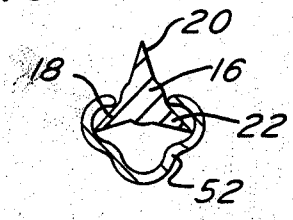


FIG. 5

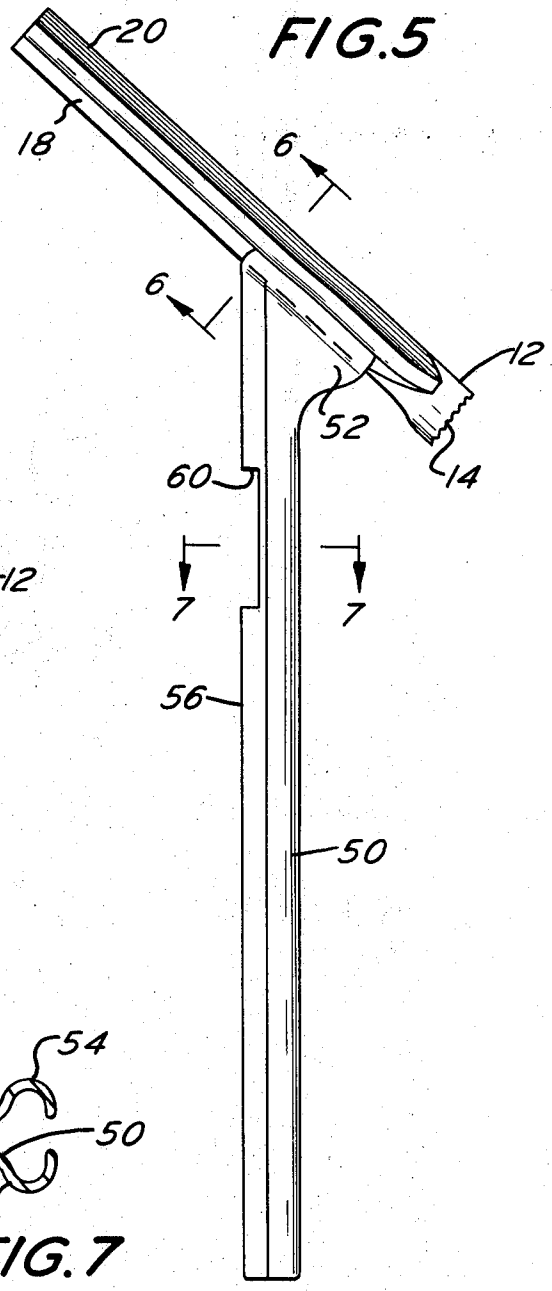


FIG. 8

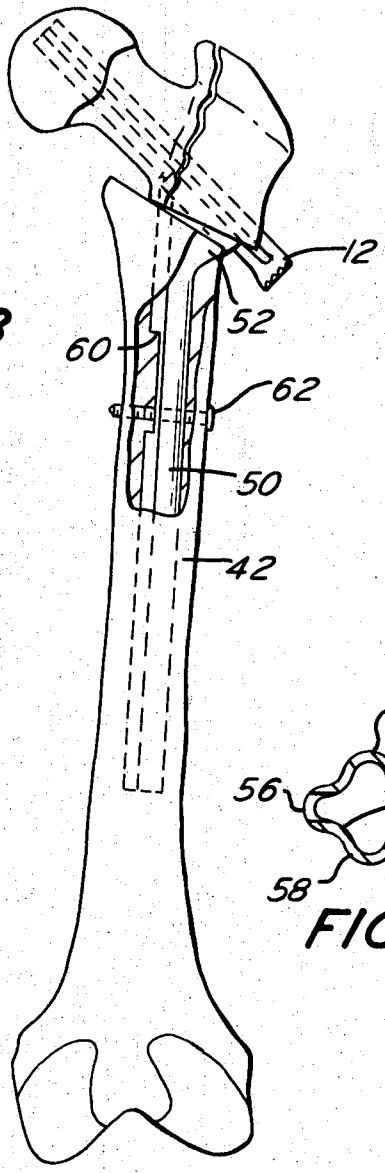


FIG. 7

INVENTOR
JOSE' LUIS ORLICH
BY
Seidel & Gonda
ATTORNEYS.

APPARATUS FOR FIXING FRACTURES OF THE FEMUR

This invention relates to apparatus for fixing lesions consisting primarily of fractures of the femur. More particularly, it relates to a pin and plate which may be used in combination with a flanged nail to fix fractures of the upper extremity of the femur which includes the head, the neck and the trochanters.

Fractures of the femur, particularly fractures of the upper or proximal end of the femur are rather common. It was early determined that the setting of such fractures by using casts was not likely to be very successful. Thereafter, attempts were made at internal fixation through the use of round or polygonal nails. But this type of treatment was abandoned because it brought about partial and temporary fixation only. Then in the late twenties, it was discovered that good fixation could be achieved by using a flanged nail. This nail has come to be known as the Smith-Petersen nail after its inventor.

Soon after the development of the Smith-Petersen nail and its equivalents, it was determined that even better fixation of the fracture could be achieved by attaching a plate to the shaft of the femur. The plate produced particularly good results in the cases of fractures of the trochanteric region. However, such plates are rigidly fixed to the end of the nail thereby complicating their attachment to the femur and making it impossible for the nail to slide back on the plate to provide impaction at the fracture site. In addition, such devices do not allow the patient to be mobilized as soon as he should. This is because the rigid fixation of the apparatus, which on muscle tension or on weight bearing, applies a force to the nail which may cause it to move medially and penetrate the head or neck of the femur, or the reactive force may tear the plate loose from the shaft of the femur. This condition exists because the known prior art apparatus does not allow for a shortening of the apparatus. In the absence of a sliding mechanism, the patient has to wait until callus is formed. The results of remaining too long in a sedentary position are well known to those in the medical profession. It is particularly hazardous for geriatrics, the group of persons most likely to incur fractures of the femur, because they readily contract pneumonia, pulmonary stasis, decubitus ulcers, or generalized weakness.

In accordance with the present invention, the disadvantages of prior plates and other devices attached to the shaft for use in combination with a Smith-Petersen nail or its equivalent are overcome by providing new and unobvious apparatus. In accordance with the present invention, the apparatus which is fixed to the shaft of the femur slidingly engages the fixation nail, thereby permitting impaction at either the fracture or the osteotomy site, or both. The patient can be immediately mobilized which promotes impaction and therefore provokes osteogenesis that results in the formation of callus. In addition, the apparatus permits positioning of the channel member that retains the nail in a position that promotes healing.

Some of the advantages of the apparatus for fixing fractures of the femur described herein can be stated as follows:

The apparatus permits treatment of different types of bone lesion including fractures, osteoarthritis, and hip fusion;

The apparatus permits immediate weight bearing by the patient;

The apparatus gives a strong immobilization of the parts of the bone;

The apparatus allows for good alignment of the parts of the bone;

The apparatus permits impaction of the parts of the bone;

The apparatus promotes faster and better healing;

When used with the operative technique described herein, the apparatus improves stability by permitting the shifting of the weight bearing line to a more perpendicular one since the shaft is displaced medially; and

The apparatus promotes good fixation and healing of even the unstable transtrochanteric fractures which are a type of fracture that is poorly held by most of the conventional apparatus.

For the purpose of illustrating the invention, there are shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a perspective view of the first embodiment of this invention showing a Smith-Petersen nail and plate.

FIG. 2 is a transverse sectional view of the apparatus shown in FIG. 1 taken along the line 2–2. 4

FIG. 3 is a transverse sectional view of the apparatus shown in FIG. 1 taken along the line 3–3.

FIG. 4 is a posterior surface view of a femur showing the apparatus positioned thereon to fix an intracapsular fracture.

FIG. 5 is an elevational view of the second embodiment of the present invention showing a Smith-Petersen nail positioned on a pin for insertion into the intramedullary canal.

FIG. 6 is a transverse sectional view of the apparatus shown in FIG. 5 taken along the line 6–6.

FIG. 7 is a transverse sectional view of the apparatus shown in FIG. 5 taken along the line 7–7.

FIG. 8 is a view of the posterior surface of the femur showing the apparatus of FIG. 5 in position to fix a transtrochanteric fracture.

Referring now to the drawings in detail, wherein like numerals indicate like elements, there is shown in FIG. 1 the first embodiment of the apparatus for fixing fractures of the femur designated generally as 10.

As shown, the apparatus includes a nail 12 of the Smith-Petersen type. The nail 12 conventionally includes a head 14 which is adapted to cooperate with an impacting tool which will drive it into the bone structure of the femur. The nail body 16 supports three flanges 18, 20 and 22 which extend substantially the entire length of the nail and are equidistantly spaced apart at angles of 120°. The Smith-Petersen nail is typical of the type of flanged nail commonly used to fix fractures of the femur. It should be understood, however, that there are other well-known types of nails which perform equivalent functions such as diamond shaped nails similar to the Hansen-Street nail used in surgery for reducing fractures of the shaft of the femur. Such equivalent nails may have specialized modifications but are still basically flanged nails. Accordingly, the Smith-Petersen nail should be regarded as exemplary rather than limiting.

The nail 12 is supported at the end of the plate 24 by a channel member 26. Plate 24 is elongated and provided with a plurality of chamfered holes 28 through which the screws 30 may be inserted for securing the plate to the shaft of the femur. As shown in FIG. 3, the plate 24 is curved about its longitudinal axis so as to match its surface to the curved surface of the lateral aspect of the femur. It should be noted that the shaft of the human femur is generally cylindrical and of substantially uniform diameter above center. Accordingly, little difficulty should be encountered in fitting the plate 24 to the shaft of any femur.

The plate 24 is bent at its upper or proximal end to provide a supporting surface 32 for the channel member 26. Channel member 26 which is defined by upper and lower boundaries 33 and 35 is fixed to the supporting surface by any conventional method of joining metallic elements.

As best shown in FIGS. 1 and 2, the channel member 26 is a unitary piece of metal which has been bent or otherwise deformed to define a channel having an open trefoil cross-sectional shape. The trefoil or cloverleaf cross-sectional shape has been found to provide excellent rigidity for the device while simultaneously being capable of slidingly retaining the nail. The position of the nail 12 in the channel member 26 is best shown in FIG. 2.

The length of the channel member is sufficient to enable it to slidingly engage the nail 12 so as to prevent any lateral displacement thereof. As positioned on the supporting surface 32, the upper and lower boundaries of channel member 26 extend laterally well beyond the concave surface of the plate 24 and at least a portion of the boundaries extend laterally outward from the convex surface of plate 24. Accordingly, the channel member must necessarily be positioned well below what would normally be the trochanteric region of the femur

and thereby provide good support. Other types of known plates mount the nail engaging portion well outside the axis of the shaft thereby reducing their supporting capability.

The angle between the longitudinal axis of the channel member **26** and the longitudinal axis of the plate **24** can be varied in accordance with the requirement of the case. In ordinary cases requiring only the repair of an intracapsular or trochanteric fracture, the preferable angle is 150° as measured between the longitudinal axis of the plate **24** and the longitudinal axis of the channel member **26**. This angle is taken in the first and fourth quadrant of coordinates intersecting at the junction of the aforesaid longitudinal axes. While 150° is the preferred angle for fixation of routine fractures, it is anticipated that the angle between the two longitudinal axes may vary from 115° to 170° depending upon the type of operation being performed. For example, in cases of hip arthrodesis, an angle of 170° may be required. In cases of osteoarthritic lesions, the angle varies depending upon whether the head is found in the varus or valgus position.

By way of example, but not of limitation, the dimensions of the plate **24** and channel member **26** can be as follows:

Width of plate **24** - 15 mm.
Thickness of plate **24** - 2.5mm.
Depth of curvature of plate - 4.5mm.
Diameter of holes **28** - 5mm.
Diameter of chamfer for holes **28** - 6.5mm.
Center to center distance between holes **28** - 21mm.
Length of plate **24** - variable (15cm. preferred)
Width of channel member **26** - 15mm.
Thickness of channel member **26** - 2mm.
Depth of channel member - 10mm.
Length of channel member **26** - 25mm.

The nail **12** and plate **24** are shown in position on a femur in FIG. **4**. The position shown illustrates how the apparatus **10** may be used to fix an intracapsular fracture. Briefly summarized, the operative technique for arriving at this result is as follows:

A. The patient is placed in a prone position on a conventional operating table with slight flexion of the hip joint at about 15° to 20°

B. The patient is given anesthesia. The type of anesthesia is determined by the anesthesiologist but an epidural anesthesia is to be preferred. This type of anesthesia is best for older persons and the position of the patient on the operating table is suitable for rendering the same.

C. A posterio-lateral incision is made. This incision is similar to the type sometimes called the southern approach or Moore incision. The gluteus maximus and tensor fascia lata are divided along the line of incision. The vastus lateralis and all external rotator muscles are separated by blunt bisection from their insertions. The joint capsule is opened by a midlongitudinal incision so that the entire proximal end of the femur is exposed.

D. An osteotomy is done at the intertrochanteric region designated generally by the numeral **40**. This allows medial displacement of the shaft **42** of the femur.

E. The angle of the channel member **26** is chosen according to the type of fracture or lesion being treated. In the embodiment shown, the femur is normal in the fracture of the intracapsular type. Accordingly, a 150° n gle is chosen.

F. The plate **24** is screwed to the lateral aspect of the femur shaft **42**.

G. A guide hole is drilled through the trochanteric region **40**, the neck **44** and the head **46**.

H. Thereafter, a nail **12** of the correct type and size is slid into the channel member **26** and then driven firmly into the head **46**. In certain cases where it is desirable to immobilize the entire joint, such as cases of arthrodesis, a nail as long as 20 centimeters may be used. This nail is driven through the head and into the iliac bone at the acetabulum. It may be driven into the iliac bone as far up as the sacroiliac joint.

I. The joint capsule is closed and all muscles, facia and skin are sutured in the conventional manner.

J. Finally, impaction of all fragments is done while the patient remains on the operating table. This is done by striking at the patient's heel with the leg straight. This impacts the fracture and immediate weight bearing can be started on the following day.

The advantage of permitting the nail **12** to slide back on the angled channel **26** is that it allows for impaction at the fracture site or at the osteotomy site. The entire apparatus, including the plate **24** and nail **12** results in proper alignment of the joints, impaction and full immobilization of the fracture treated. By using an osteotomy to position the plate, healing is promoted by accelerating osteogenesis because more raw bone surface is in contact at the fracture site. The osteotomy improves stability by shifting the weight bearing line to one that is more perpendicular as a result of the shaft **42** being displaced medially.

The entire operative procedure is relatively simple to perform and the time of performance is relatively short. In most cases, the plate **24** and pin **12** can be placed in 1 hour. No X-ray control is required because the hip joint is entirely exposed.

It should be understood the foregoing has been described in respect to an intracapsular fracture with a brief reference to arthrodesis, but the apparatus and technique for applying it are equally applicable to other types of fractures such as transtrochanteric fracture or an extracapsular fracture with equal facility.

Referring now to FIGS. **5**, **6**, **7** and **8**, there is shown a second embodiment of the present invention. In this embodiment, the plate **24** is replaced by a pin **50** which supports a nail **12** in a channel fixed at its proximal end. The nail **12** is of the Smith-Petersen type and includes a head **14**, a body **16** and flanges **18**, **20** and **22**. As shown in FIG. **6**, the nail **12** is retained in a channel member **52** which is positioned on the proximal end of the pin **50**. The pin **50** is cannulated and has an open trefoil cross-sectional shape so as to define three flanges **54**, **56** and **58**. The cannulated shape of the pin **50** permits it to be inserted into the intramedullary canal of the femur shaft without interferring with the overall function of that canal. The trefoil shape which defines the three flanges **54**, **56** and **58** prevents the pin from rotating once it is inserted in the intramedullary canal.

An opening in the form of a slot **60** is formed in the central flange **56** of the pin **50** adjacent the junction with the channel member **52**. The longitudinal axis of the slot **60** is parallel to the longitudinal axis of the pin **50** and in the same plane as the longitudinal axis of the channel member **52**. The slot **60** permits the insertion of a screw **62** which cooperates with the slot to prevent rotation of the pin **50**. The use of an elongated slot (one that is substantially longer than the diameter of screw **62**) permits the pin **50** to sink into the medullary canal when impaction occurs at the fracture site. To properly take advantage of this sinking feature, the screw **62** must extend through the slot **60** adjacent the end which is remote from the channel member **52**.

The channel member **52** is formed as an integral part of the pin **50** and as such flares outwardly and inwardly to define an open trefoil cross-sectional shape as illustrated in FIG. **6**. The channel member **52** receives and retains the nail **12** in the manner shown in FIG. **6** and as described above with respect to the channel member **26**. It should be noted, however, that the channel member **52** extends laterally only to one side of the pin **50**. This is the side opposite the flange **56**. The angle of the longitudinal axis of the channel member **56** with respect to the longitudinal axis of the pin **50** is obviously the same as that described with respect to the plate **24** and channel member **26** and measured in the same manner.

By way of example, but not of limitation, the following dimensions may be used in constructing the pin **50** and its integral channel member **52**:

Length of pin **50** from lower end to junction with channel member **52** - variable, 15cm. being preferred.

Wall thickness of pin **50** - 2mm.
Outside height and outside depth of cross section of pin **50** - variable between 9 to 14mm.
Length of slot **60** - 25mm.
Width of slot **60** - 4mm.
Length of channel member **52** - 25mm.
Width of channel member **52** - 15mm.
Wall thickness of channel member **52** - 2mm.
Outside depth of channel member **52** - 10mm.

The method of applying the pin **50** and nail **12** is substantially identical with that described above with respect to the plate **24** and nail **12**. The only variation is in step F wherein the proper size pin is selected according to the size of the intramedullary canal and placed into such canal. The pin is held in place by the medullary canal and rotation is prevented by one screw **62** that extends through the slot **60** adjacent its remote end. Otherwise the operative technique is identical.

The pin **50** is shown in position within the intramedullary canal of the shaft **42** of the femur in FIG. **8**. In FIG. **8**, the pin **50** and nail **12** are used to fix a transtrochanteric fracture of the femur, but other types of fractures could be fixed. As shown in FIG. **8**, the position of the pin **50** and channel member **52** are well placed to support the nail **12** and hence promote good fixation of the fracture.

The operative technique in placing the pin **50** is somewhat faster than the time required to place the plate **24**. Since only one screw is used, the entire operative technique can normally be completed in 45 minutes.

From the foregoing, it must be apparent that each of the described embodiments of this invention accomplish three basic functions necessary to properly fix a fracture of the femur. The apparatus *a* provides good, strong immobilization of the bone parts, *b* permits alignment of the bone parts and *c* allows impaction of the bone parts. The conjunction of the foregoing three factors produces better healing.

From the foregoing, it can be seen that there has been described apparatus for fixing fractures of the femur which accomplishes the advantages set forth above. Both embodiments can be used to treat any of the several types of hip lesions such as osteoarthritic conditions, fractures and arthrodesis of the hip joint. Both embodiments permit immediate weight bearing after surgery and both permit almost perfect alignment, impaction and immobilization of the bone fragments. The natural result of the foregoing is to provide much shorter healing times.

With respect to intracapsular fractures, both embodiments prevent nonunion of the femur neck which are frequent when other conventional devices are used because the fracture is impacted by muscle tension and primarily because of early weight bearing. Early weight bearing is achieved because of the sliding nail. The osteotomy improves the line of weight bearing by medially displacing the shaft and also promotes osteogenesis. Transtrochanteric fractures including the unstable ones are likewise made stable and held in place by good callus formation. Finally, both devices permit better alignment of the weight bearing line because the osteotomy permits the shift of the femural shaft while still holding it in place.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention.

I claim:

1. Apparatus for fixing fractures of the femur comprising a nail to be driven into the proximal extremity of the femur, an elongated plate, said plate being curved about its longitudinal axis to define a concave surface and a convex surface, a plurality of holes extending through said plate for accepting screws so that said plate can be secured to the shaft of the femur, a member defining an elongated open channel having upper and lower boundaries fixed at one end of said plate, the longitudinal axes of said channel and said elongated plate defining an obtuse angle, said upper and lower boundaries of said channel extending outwardly beyond said concave surface and outwardly beyond said convex surface so that loads transmitted from said nail to said elongated plate will be distributed uniformly to said plate by said channel member to thereby maximize the supporting capability of said apparatus, said nail being received in said channel for relative sliding movement therebetween along said nail, and said nail and said channel having mutually interlocking cross sections to prevent relative rotation therebetween.

2. Apparatus for fixing a fracture of the femur comprising a nail to be driven into the upper extremity of the femur, an elongated pin to be inserted into the intramedullary canal of the femur, a member defining an open channel fixed at one end of said elongated pin, the longitudinal axes of said channel and said elongated pin defining an obtuse angle, said nail being received in said channel for relative sliding movement therebetween along said nail, an elongated opening disposed along the longitudinal axis of said elongated pin, said elongated opening being remote from said channel, and said nail and said channel having mutual interlocking cross sections to prevent relative rotation therebetween.

3. Apparatus as defined in claim **2** wherein said opening is an elongated slot, an elongated fastening member to be inserted in the femur transversely of said elongated pin and be received in said elongated slot, and the length of said slot is substantially greater than the width of said fastening member to permit said elongated pin to move longitudinally relative to said fastening member.