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[54] **SURGICAL NAIL EXTRACTOR**
4 Claims, 7 Drawing Figs.

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 EC, 92, 92 E; 81/3.04, 3.05, 53.2; 29/278, 281;
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[56] **References Cited**

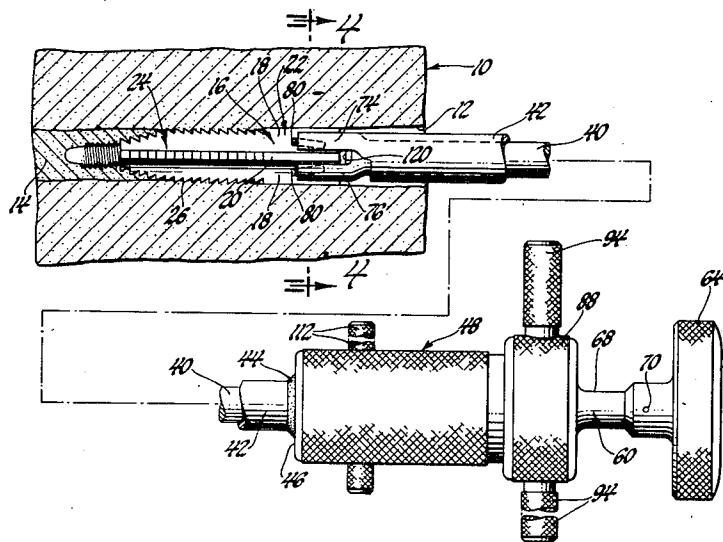
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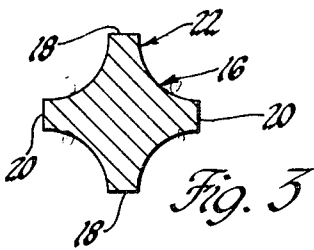
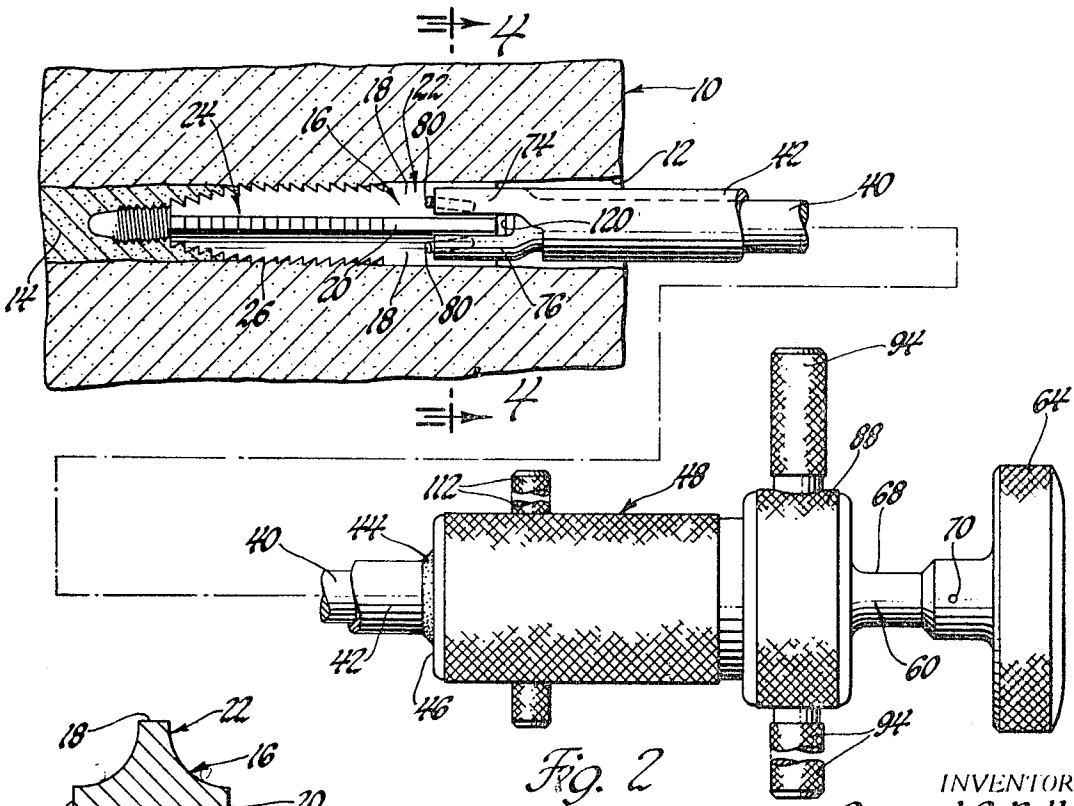
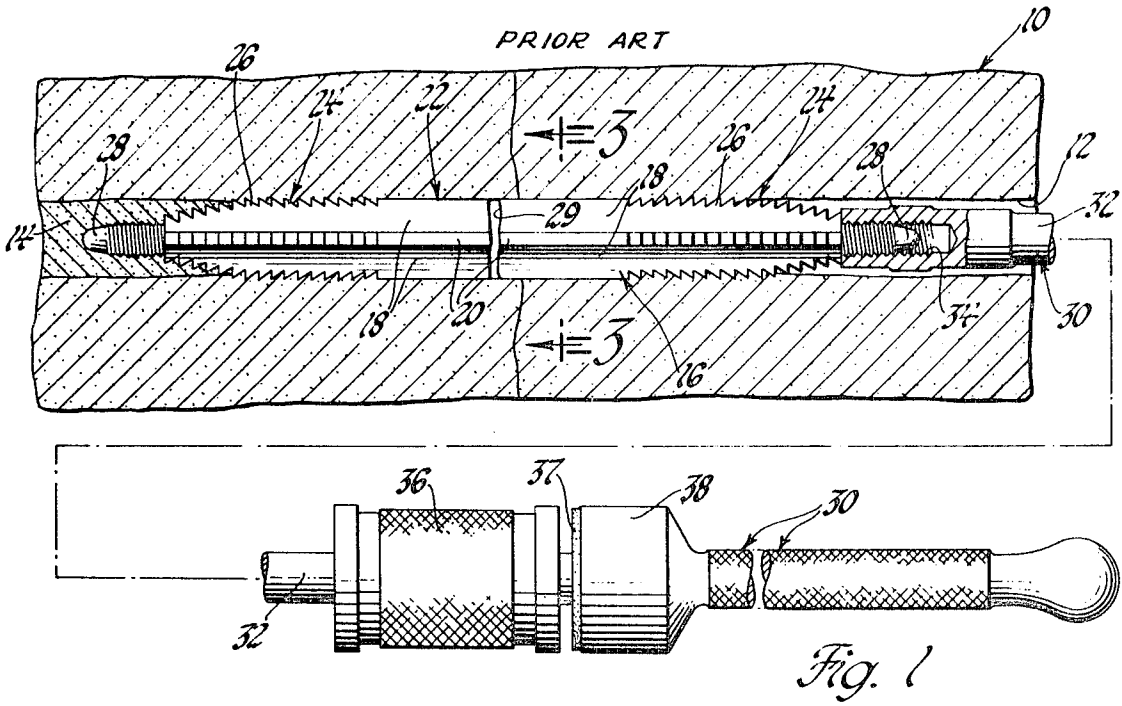
2,579,438 12/1951 Longfellow 145/52

OTHER REFERENCES

The British Medical Journal, June 27, 1936 page 1304,
 copy in group 330 128/92

ABSTRACT: An extractor for removing a broken portion of an intramedullary nail includes an inner rod member and an outer concentric tubular member, each having a pair of axially extending fingers at one end. The fingers are arranged in respective pairs and each finger of such pair includes a pin having a portion extending beyond the inner surface of the finger, with the projecting portions of the pins axially and circumferentially converging with respect to each other. The other end of the inner member is secured to a drum rotatably and slidably received within a housing secured to the other end of the outer member. Fixed handles on the housing have their inner ends extending into an annular groove of the drum to limit axial movement of the drum and inner member relative to the housing and outer member. A manually rotatable handle on the housing has its inner end engaging the wall of an axially extending groove in the drum to rotate the drum and housing and the inner and outer members relative to each other and bring the projecting portions of the pins into clamping engagement with a land of the cruciform cross sectionally shaped nail. The inner member also includes an end anvil which can be used to shift the broken portion of the nail within the medulla to free the nail for easier removal. A handle assembly secured to the drum permits attachment of conventional instruments which apply intermittent axial driving forces to the inner member.





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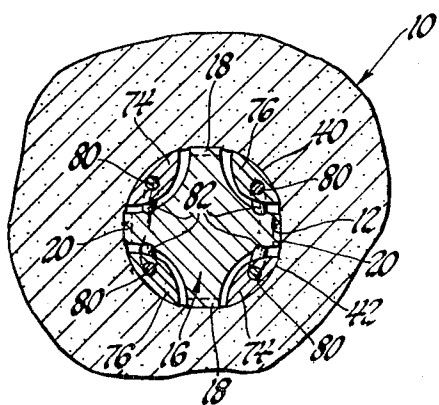


Fig. 4

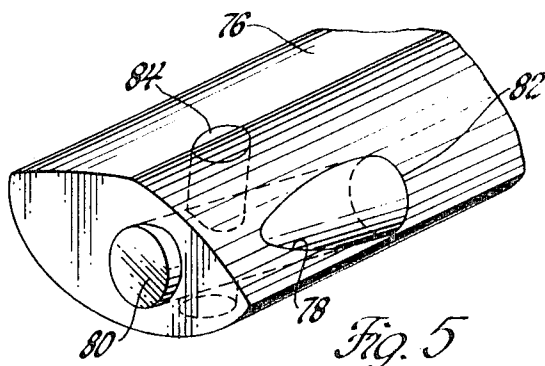


Fig. 5

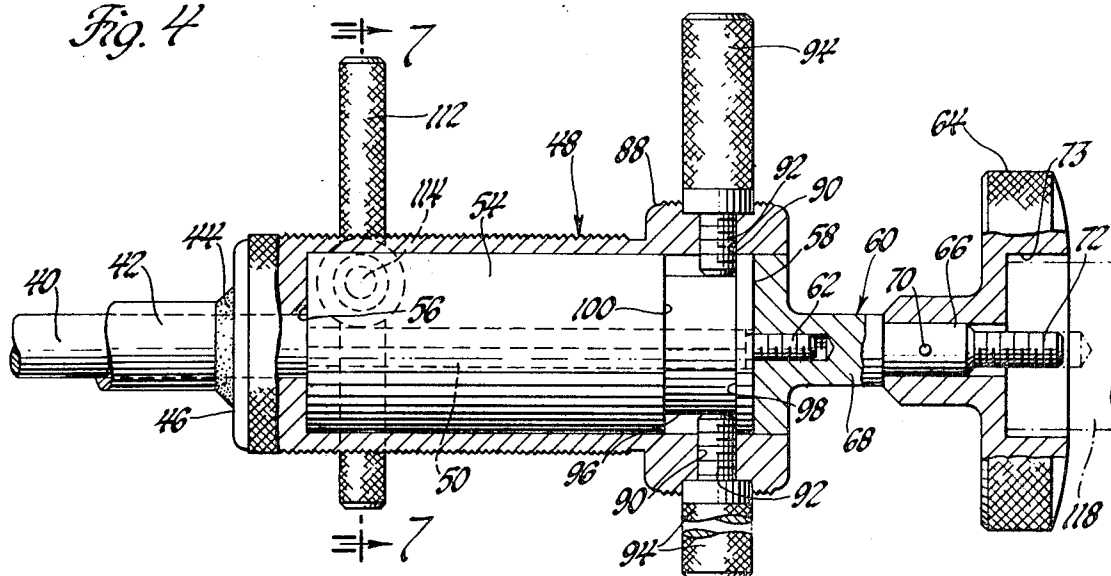


Fig. 6

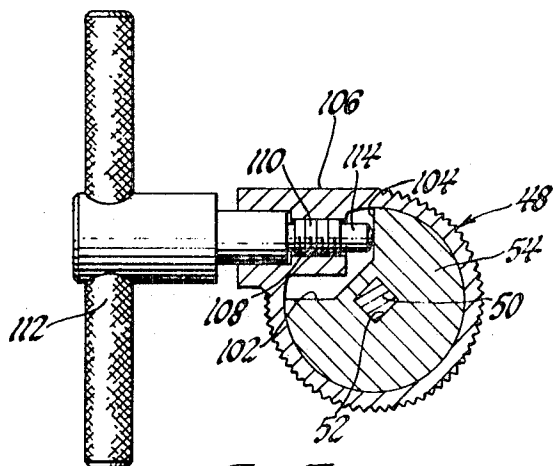


Fig. 7

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SURGICAL NAIL EXTRACTOR

This invention relates to medical instruments and more particularly to an extractor for removing a broken portion of an intramedullary nail from within the medulla of a bone.

Intramedullary nails are used to strengthen fractured bones while the bones heal. Ordinarily such nails remain in place for years without any problems. However, occasionally the nail will fracture and must be removed. Prior to our invention, it was impossible to remove both broken portions of the nail through the same opening in one end of the bone.

Generally, the intramedullary nail is of cruciform cross section and includes a central part having smooth edged lands, an intermediate cylindrical part extending to each side of the central part and having axially and radially inwardly tapering lands continuing the lands of the central part and provided with sharp-edged ribs, and a screw-threaded end part extending from each intermediate part. The nail is inserted within the bone medulla with the central part located across the fracture, with the edges of the central part lands and certain of the ribs engaging the wall of the medulla to retain the nail in place, and with one of the screw-threaded end parts extending into one bone end or cartilage.

Once an opening has been formed in the end of the bone and the broken portion of the nail adjacent this opening removed, the extractor of this invention permits ready removal of the remote broken portion of the nail through the same opening in the end of the bone. Thus no additional entrances to the bone medulla are required to permit removal of the remote broken portion of the nail.

In the preferred embodiment of the invention, the extractor includes inner and outer concentric tubular members which are both rotatable and axially reciprocable relative to each other. The free end of each member is provided with a pair of fingers, with one finger of one member being respective to one finger of the other member so that the fingers are arranged in respective pairs. The other end of the inner member is secured to a drum which is rotatable and axially reciprocable within an outer cylindrical housing having a closed end wall secured to the other end of the outer member. The drum includes a handle extending outwardly of the open end wall of the housing so that the drum and the inner member may be axially shifted and rotated relative to the outer member and housing. The housing mounts a threaded member which is engageable with a radially facing axially extending surface of the drum to rotate the inner and outer members relative to each other and thereby move the respective pairs of fingers toward each other.

When a broken intramedullary nail is to be removed, a conventional instrument, such as a Reynold's Driver having a threaded socket, is inserted through the opening in one end of the bone and into the bone medulla into threaded engagement with the threaded end part of the broken portion of the nail adjacent the opening. Thereafter, by manipulation of the ring weight of the instrument, this broken portion is removed, with the ribs on the intermediate part broaching the medulla wall during removal.

Thereafter the extractor of this invention is inserted into the medulla, with the fingers of the inner member axially extended with respect to the fingers of the outer member. The fingers of the inner member are then positioned with the aid of a fluoroscope or otherwise within the bone marrow in one diagonally opposite pair of valleys between the lands of the nail. The inner member further includes an end anvil or abutment which is then moved into engagement with the fractured end of the remote broken portion. A conventional instrument, such as a Reynold's Driver, is then attached to the drum handle and the remote broken portion of the nail shifted axially within the medulla so that the ribs of the intermediate part of this broken portion broach the medulla wall and free the broken portion from engagement therewith. Since the drum and inner member are shiftable as a unit relative to the housing and outer member, the latter remains relatively stationary as the instrument is used.

The inner member is then axially retracted with respect to the outer member and rotated approximately 90° to position the fingers of the inner member in general axial alignment with the other diagonally opposite pair of valleys between the lands of the broken portion of the nail. The inner member is then axially extended with respect to the outer member to position the fingers in the bone marrow between the other pair of valleys. The outer member is then shifted axially of the inner member to position the fingers of the outer member in the cavities in the one pair of valleys made by the fingers of the inner member. Each finger of each respective pair includes an axially extending gripping member of hardened steel, with these gripping members converging toward each other circumferentially and axially outwardly of the medulla or axially opposite the direction in which the extractor is inserted. The threaded member on the housing is then rotated to rotate the inner and outer members toward each other and cause the gripping members to bite into the opposite surfaces of the lands of the remote broken portion of the nail. Thereafter a conventional instrument, such as a Reynold's Driver, is again attached to the handle of the inner member and, by use of the ring weight of the instrument, the extractor and the remote broken portion of the intramedullary nail are removed from the medulla. A new intramedullary nail can thereafter be readily inserted if necessary.

The primary object of this invention is to provide an extractor for removing a broken portion of an intramedullary nail from within the medulla of the bone. Another object of this invention is to provide such an extractor which can be inserted into the medulla and thereafter moved into gripping engagement with the broken portion of the nail to remove this broken portion through an opening to the medulla in an end of the bone remote from the broken portion. A further feature of this invention is that the extractor permits both portions of the intramedullary nail to be readily removed through only one opening to the medulla. Yet another feature of this invention is that the extractor includes a pair of telescopic and rotatable members, each of which includes gripping finger means at one end thereof which are arranged in respective pairs for gripping engagement with the arms or lands of the cruciform part of the nail. Yet a further feature of this invention is that the members are concentric and that the inner member includes an anvil or an abutment which may be engaged with the end of the broken portion of the nail to move the broken portion relative to the medulla and broach the medulla wall to permit easier removal of this broken portion.

These and other objects and features of this invention will be readily apparent from the following specification and drawings wherein:

FIG. 1 is a view partially in section showing a broken intramedullary nail within the cavity of a fractured femur and a conventional instrument attached to the one broken portion of the nail adjacent an opening in one end of the bone for removing this one broken portion through the opening;

FIG. 2 is a view similar to FIG. 1 and showing the extractor of this invention grippingly engaged with the other broken portion of the nail remote from the opening to remove this other broken portion through the opening;

FIG. 3 is an enlarged view taken on line 3—3 of FIG. 1 showing the cross section of the cruciform part of the intramedullary nail;

FIG. 4 is an enlarged sectional view taken generally on the plane indicated by line 4—4 of FIG. 2;

FIG. 5 is an enlarged perspective view of a portion of a finger common to the inner and outer members;

FIG. 6 is an enlarged broken away view of a portion of FIG. 2; and

FIG. 7 is a sectional view taken generally along the plane indicated by line 7—7 of FIG. 6.

FIGS 1, 2 and 4 of the drawing show a portion of a fractured human femur designated generally 10 and including a medulla 12 which is normally filled with bone marrow 14. Positioned within the cavity 12 is a conventional intramedullary nail 16 of

cruciform cross section having pairs of oppositely extending arms or lands 18 and 20. The ribs of the center part 22 of the nail are smooth edged, FIG. 3, while the ribs of the intermediate parts 24 of the nail taper oppositely of each other toward a respective end of the nail and are provided with sharp-edged circumferentially aligned ribs 26. The tapered end parts 28 of the nail are screw threaded. As shown in FIG. 1, the center part 22 of the nail is normally positioned across the fracture in the femur 10. Normally such nails in adults remain in place for life after insertion and the bone marrow 14 fills the valleys between the lands. Occasionally, the nail may fracture as indicated at 29 in FIG. 1 and the broken portions of the nail must then be removed. If not removed, the broken portions of the nail move relative to each other as the femur 10 flexes and the sharp jagged edges of the lands 18 and 20 at the fracture 29 engage the wall of the medulla 12 and cause pain and discomfort to the person.

The first step in removing the broken portions of the nail 16 consists of providing an opening, now shown, to the medulla 12 in the upper or right-hand end, not shown, of the femur 10. The opening can be the same as the original opening through which the nail 16 was inserted. Once this opening is provided, a conventional instrument, such as a Reynold's Driver 30, has its shank 32 inserted through the opening into the medulla 12. A screw-threaded socket 34 at the lower end of the shank 32 is then threaded onto the threaded part 28 of the upper or right-hand broken portion of the nail which is adjacent the opening. Thereafter the slidable weight 36 of the Driver is manually reciprocated along the shank 32. The intermittent engagement of the upper or right-hand end of the weight 36 with the rubber washer 37 and annular shoulder portion 38 of the Driver gradually moves the broken upper or right-hand portion of the nail outwardly of the medulla 12. During this movement, the sharp-edged ribs 26 broach grooves in the wall of the medulla and provide paths for the lands 18 and 20 of the center part 22. Normally, the lands 18 and 20 and the ribs 26 are partially embedded in the medulla wall if the nail has been inserted for a period of time.

The extractor of this invention is shown in detail in FIGS. 2 through 7 of the drawings and generally includes an inner rod member 40 and an outer concentric tubular member 42. As shown in FIGS. 2 and 6, the right-hand end of the tubular member 42 is welded at 44 to the apertured end wall 46 of a hollow open cylindrical housing designated 48. The right-hand end of the rod member 40 extends through the opening in the end wall 46 and includes a square-shaped portion 50, FIG. 7, which extends through a like-shaped bore 52 in a drum 54 which is rotatably and slidably received in the housing 48. The one end wall 56 of the drum, FIG. 6, seats against the shoulder between the square-shaped portion 50 and the remainder of the rod 40 and the other or right-hand end wall 58 of the drum is engaged by a handle assembly 60 which is screwed onto the threaded right-hand end 62 of rod member 40. Thus the drum 54, the handle assembly 60 and the inner rod member 40 are movable as a unit relative to the housing 48 and outer member 42. The handle assembly 60 includes an annular handle member 64 having a knurled outer surface. A bore in the handle member 64 receives a reduced diameter extension 66 of a mounting member 68 of the assembly, FIG. 6, with members 64 and 68 being pinned together at 70. A threaded portion 72 of the extension 68 extends outwardly of a recess or bore 73 of the assembly.

As shown in FIGS. 2 and 4, the other end of the outer member 42 is provided with a pair of fingers 74 and the other end of the inner member 40 is provided with a like pair of fingers 76. One finger 74 is respective to one finger 76 to arrange the fingers in two respective pairs. As can be seen in FIG. 2, the fingers 76 are radially offset from the member 40 so as to lie in the same cylindrical plane as the fingers 74.

As shown in FIG. 5, each finger is provided with an axial bore 78 which received a pin 80 of hardened steel. The bores 78 of each respective pair of fingers 74 and 76 converge axially and circumferentially with respect to each other remote

from the free end of the fingers of the members 40 and 42. Thus sharp-edged angular projecting portions 82 of the pins of each respective pair of fingers likewise converge axially and circumferentially of each other. The pins 80 may be secured in any conventional manner within the bores 78 such as by cementing or by the use of pins 84 which extend laterally through aligned openings provided in the fingers and in the pins 80. The fingers 74 and 76 are of a cross-sectional shape so as to fit within the valleys between the lands 18 and 20 as shown in FIG. 4.

Referring now to FIGS. 6 and 7, the open end of the housing 48 includes an enlarged annular rib 88 having a knurled outer surface and diametrically opposite threaded bores 90 which receive the threaded inner ends 92 of a pair of knurled handles 94. The ends 92 extend inwardly of bores 90 and within an axially enlarged circumferential groove 96 of the drum 54. The alternate engagement of the spaced walls 98 and 100 of the groove 96 with the ends 92 provide stops limiting axial movement of the inner member 40, drum 54 and handle 60 relative to the housing 46 and outer member 42.

As shown in FIG. 7, the drum 54 further includes an axial groove 102 having a radially facing axially extending wall 104. The housing 48 includes a shouldered boss 106 having an internally threaded portion 108. The shouldered partially threaded shank 110 of a manually rotatable handle 112 is threadedly received within the boss 106. The engagement of the semispherical end 114 of the handle 112 with the wall 104 upon rotation of handle 112 rotates the drum 54 and the inner member 40 relative to the housing 48 and the outer member 42 and moves the fingers 74 and 76 of each respective pair of fingers toward each other. Since the wall 104 is axially elongated, the inner member 40 and outer member 42 may be rotated relative to each other at any relative axial position thereof, such position, of course, being limited by the engagement of the ends 92 of handles 94 with walls 98 or 100.

After the right-hand or upper broken portion of the nail 16 has been removed, the members 40 and 42 of the extractor are inserted through the opening in the upper end of the femur into the medulla 12. The respective pairs of fingers 74 and 76 are then located in diagonally opposite valleys of the central part 18 of the remote broken portion of the nail as previously described and as shown in FIGS. 2 and 4. The handle 112 is then rotated to cause the end 114 to engage the wall 104 and rotate the drum 54 and the inner member 40 relative to the housing 46 and outer member 42 so that the sharp-edged portions 82 of the pins 80 of respective pairs of fingers bite into the lands 18 and 20 of the nail and grip or clamp the other broken portion of the nail to the extractor. Thereafter a conventional instrument, such as a Reynold's Driver, indicated schematically at 118 in FIG. 6 is threaded to portion 72 of extension 66 and the manipulation of the ring weight of the instrument draws the remote broken portion of the nail 16 outwardly of the medulla 12 through the opening in the upper end of the femur.

The extractor of this invention also includes an additional feature which is provided by an annular end anvil or abutment 120, FIG. 2, provided on the free end of the inner member 40 between the fingers 76. When the extractor is initially inserted into the medulla and the fingers 76 positioned in one diagonally opposite pair of valleys with the aid of a fluoroscope, the anvil 120 will be seated on the fractured end of the remote broken portion of the nail. A conventional instrument, such as a Reynold's Driver, is thereafter attached to the handle assembly 60 as previously described. By manipulation of the ring weight of the instrument, the anvil 120 will shift the remote broken portion of the nail slightly to the left or axially inwardly of the medulla so as to cause the sharp-edged ribs 26 to broach the wall of the cavity 12 and permit easier removal of this broken portion of the nail.

In order to prevent possible damage to the instrument or to the lands 20 and 22 of the nail, the handle 112 may be provided with a conventional torque-limiting clutch arrangement so that once a certain amount of force is applied between the

housing 48 and drum 50, continued rotation of the handle will cause slippage between the handle and the threaded portion 108 of the boss 106.

Thus this invention provides an improved extractor for removing a broken portion of an intramedullary nail.

We claim:

1. An extractor for removing from a skeletal member cavity an intramedullary nail having a portion of generally cruciform cross section comprising, in combination, a pair of annular telescopic and rotatable members, each including a plurality of generally axially extending finger means at one end thereof arranged in respective annularly spaced pairs, each pair of finger means adapted to axially receive a respective land of the nail therebetween, means for rotating the members relative to each other to move the finger means of each respective pair circumferentially toward each other to grip the respective nail land circumferentially therebetween, and means for applying an axial force to the members to remove the gripped nail and members from the skeletal member cavity.

2. An extractor for removing from a skeletal member cavity an intramedullary nail having a portion of generally cruciform cross section comprising, in combination, a pair of annular telescopic and rotatable members, each including a plurality of generally axially extending fingers at one end thereof arranged in respective annularly spaced pairs, each pair of fingers including coaxing gripping means adapted to axially receive a land of the nail therebetween, a radially facing axially extending abutment on one member, means on the other member engageable with the abutment for rotating the members relative to each other to move the fingers of each respective pair toward each other to move the gripping means into engagement with the nail land, and means for applying an axial force to the members to remove the gripped nail and members from the skeletal member cavity.

3. An extractor for removing from a skeletal member cavity

an intramedullary nail of generally cruciform cross section having an end portion and a ribbed portion wedged into the cavity wall comprising, in combination, a pair of annular telescopic and rotatable members, means on the end of one member engageable with the end portion of the nail to axially shift the nail within the cavity and cause the ribbed portion to broach the cavity wall and free itself therefrom, each member including a plurality of generally axially extending finger means at the one end thereof arranged in respective annularly spaced pairs, each pair of finger means adapted to axially receive a land of the nail therebetween, means for rotating the members relative to each other to move the finger means of each respective pair toward each other to grip the nail land therebetween, and means for applying an axial force to the members to remove the gripped nail and members from the skeletal member cavity.

4. An extractor for removing from a skeletal member cavity an intramedullary nail having a portion of generally cruciform cross section comprising, in combination, a pair of annular telescopic and rotatable members, each including a plurality of generally axially extending fingers at one end thereof arranged in respective annularly spaced pairs, each respective pair of fingers being adapted to axially receive a land of the nail therebetween, an axially extending gripping member on each finger, the gripping member on respective pairs extending axially and circumferentially convergent to each other, means for rotating the members relative to each other to move the fingers of each respective pair toward each other and engage the gripping members with the nail land therebetween, and means for applying an axial force to the members in the axial direction of convergency of the gripping members to remove the gripped nail and members from the skeletal member cavity.

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