May 12, 1953 J. F. DORR 2,638,092

INTRAMEDULLARY NAIL INSERTER

Filed Sept. 15, 1950

3 Sheets-Sheet 1

FIG-1

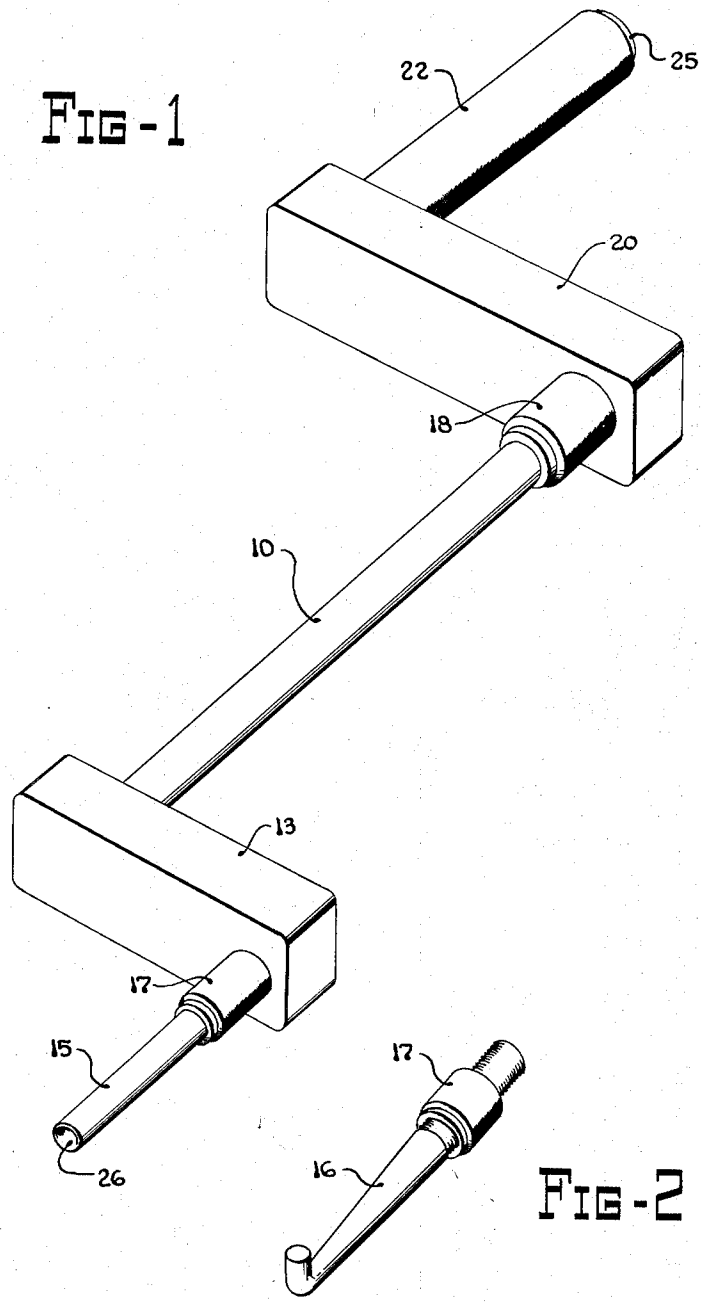






FIG-2

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INTRAMEDULLARY NAIL INSERTER

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FIG-5

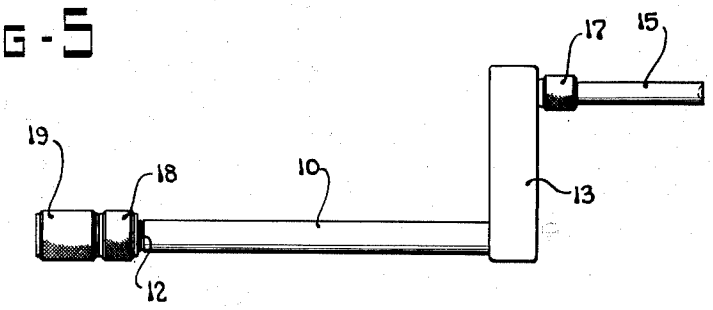



FIG-3

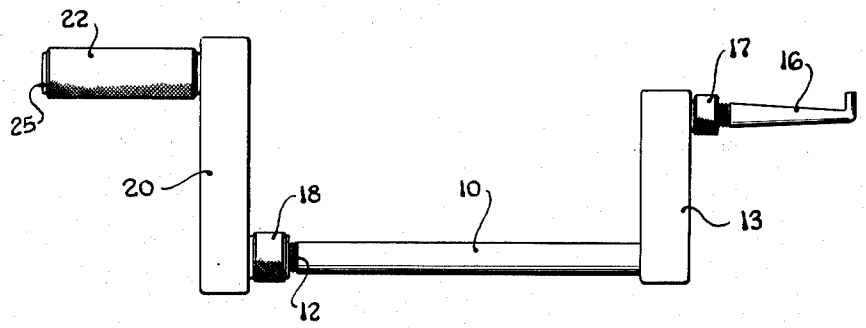



FIG-6

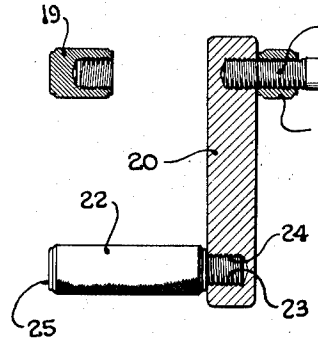
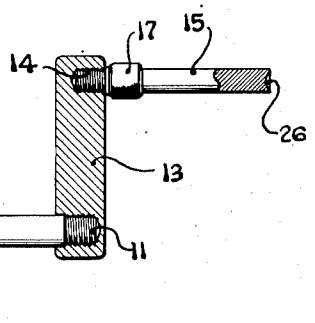



FIG-4




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INTRAMEDULLARY NAIL INSERTER

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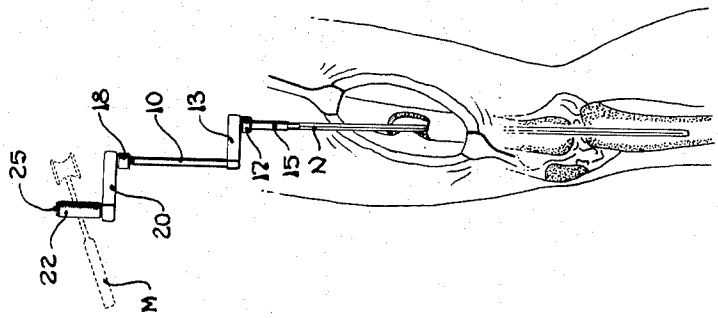



Fig. 5

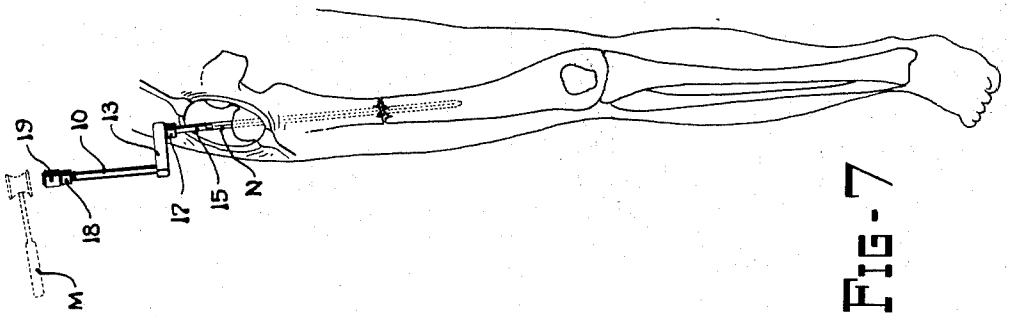



Fig. 7

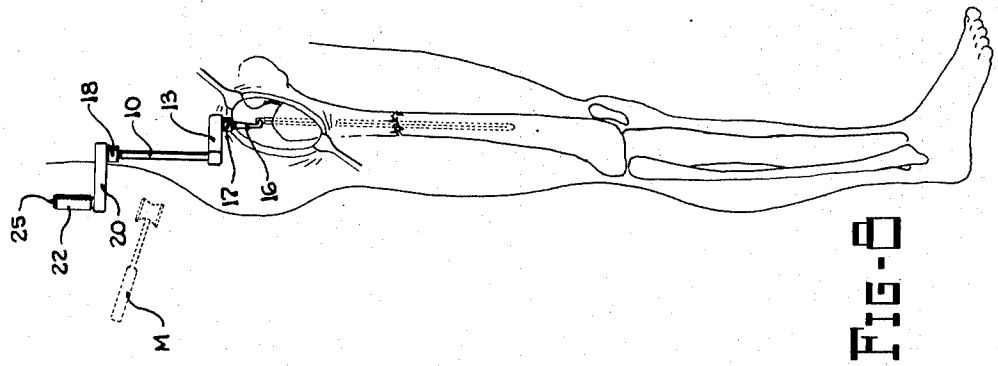



Fig. 6

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# UNITED STATES PATENT OFFICE

2,638,092

## INTRAMEDULLARY NAIL INSERTER

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Application September 15, 1950, Serial No. 184,987

5 Claims. (Cl. 128—83)

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This invention relates to a tool for use in orthopedic surgery and more particularly to improvements in an intramedullary nail inserter and extractor.

In the art of bone surgery it has become the practice to use a fracture fixation means in the form of a pin, commonly referred to as an intramedullary nail. Such nail is driven into the marrow cavity or passage of a broken bone to hold the severed parts thereof in alignment incident to knitting and healing of the break. In view of the difficulty encountered during insertion and extraction of these pins or nails, the device of the present invention has been devised to make the procedure less arduous for the surgeon.

Intramedullary nails are of various forms but it has been found most satisfactory in obtaining a solid and secure joinder of broken bones to use a nail which will not turn or twist within the marrow passage of the bone structure. For purposes of the present disclosure a nail which is diamond shaped in cross section is shown. This form of nail, when driven directly into the marrow passage of the bone, has proven most satisfactory in preventing turning of the nail within the marrow passages of these fragments. Such diamond shaped nails are preferably provided with eyes adjacent their ends to facilitate withdrawal of the nail by means of a hook connected to the eye in either end of the nail. Other forms of pins may be provided with a threaded end for connection to a tool having a threaded socket.

One object of the tool of the present invention is to facilitate a positive inserting or extracting force axially of the pin or nail despite variations in offset or angular disposition of the pin relative to the outer extremities of the limb or member embodying the broken bone.

Another object is to provide an intramedullary nail inserter and extractor which will facilitate axial movement of such nail without twisting or turning the same.

Another object is to provide an intramedullary nail inserter and extractor which will minimize flesh lacerations and bone chipping, cracking or splitting during inserting or extracting of such nail.

These and other objects and advantages of the present invention will become apparent from a reading of the following description in the light of the drawings in which:

Fig. 1 is a perspective view of the nail inserting tool of the present invention.

Fig. 2 is a perspective view of a nail extracting hook adapted for use with the tool of Fig. 1.

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Fig. 3 is a side view of the tool of Fig. 1 with the nail extracting hook of Fig. 2 associated therewith.

Fig. 4 is a side view of the tool of Fig. 1, partially broken away and with a part thereof adjusted into extended offset position.

Fig. 5 is a side view of a simplified form of the tool shown in Fig. 1.

Fig. 6 is a sectional view of an anvil head employed with the simplified form shown in Fig. 5.

Fig. 7 is a front view of a human limb illustrating the tool of Fig. 3 in use for extracting an intramedullary pin or nail.

Fig. 8 is a side view of a human limb illustrating the tool of Fig. 3 in use for extracting an intramedullary nail.

Fig. 9 is a perspective view illustrative of the tool shown in Fig. 4 in use while inserting a nail into a lower femur and knee joint of the human leg.

The tool of the present invention comprises a main shank 10 having both its ends 11 and 12 threaded. The base end 11 is threadedly secured to an offset bar 13 so as to form an L. The opposite end of the bar 13 has a threaded bore 14 adapted to receive a driving tip 15 (Fig. 1) or an extracting hook 16 (Fig. 2) as the case may be. Both the hook 16 and the tip 15 are provided with a knurled lock nut 17 for fixedly securing either of them to the bar 13 to prevent their removal therefrom during use of the tool.

The opposite threaded end 12 of the shank has a knurled lock nut 18 thereon by which an anvil head 19 (Figs. 5 and 6) is secured to the shank after being threaded onto the end 12. The lock nut 18 is also useful in locking an offset anvil arm 20 (Figs. 1, 3 and 4) to the threaded end 12 of the shank 10 so as to maintain the arm 20 at a fixed radial position relative to the shank 10 and relative to the radial disposition of the bar 13 thereon.

An elongated head 22 having a threaded connecting end 23 is secured in a threaded socket 24 in the arm 20 in parallel relation to the shank 10 but offset therefrom. This elongated head 22 has a knurled outer surface for providing a non-slip gripping surface for the surgeon's hand and is also provided with an anvil head 25 at its free end.

The driving tip 15 is provided with a concave end 26 for properly seating the tip 15 upon the end of the nail N to be driven. However, this end 26 may well be threaded, if desired, for direct connection to the threaded end of a nail if such a threaded end be provided thereon. Since the diamond shaped nail N is preferred, no twist-

ing or turning of such nail N should occur. In other words, if the nail N were turned, a reaming effect would take place within the marrow passage of the bone and the bone fragments to be joined might become loose from the nail which might possibly cause disalignment of the bone fragments. Therefore the importance of rendering the inserting or extracting tool mobile relative to the nail without twisting and turning the nail is apparent.

The tool of the present invention is calculated to insert or extract the nail N without unduly twisting or turning the nail relative to the bone structure in which it is or has been embedded.

Referring now to Figs. 7 through 9 it will be seen that once the point of entry of the nail is determined, a wound is opened up in the flesh of a limb embodying the broken bone to be repaired. The point of entry is preferably at the head of a femur bone (see Figs. 7 and 8) although it may well be at any intermediate location, as best illustrated in Fig. 9. When it is considered that a patient being treated is seldom conscious during the pin inserting or extracting procedure it will be appreciated that the limb under repair is relaxed. In other words, the flesh on the limb will be limp and often distorted due to the weight of the patient and dependent upon the position in which the patient is lying. Furthermore, the distance from the axis of the broken bone to the outer surface of the limb will vary in different patients. Consequently, it will not always be possible to swing a mallet adjacent the limb to drive the pin or nail into the marrow cavity of the bone. Therefore, in order to prevent undue tearing of the flesh around the wound, it becomes necessary to attain a greater range of freedom for swinging the pin driving mallet M in forcing the nail N into the severed bone.

At the outset, the mallet M may strike the bar 13 directly behind the driving tip 15 as seen in Fig. 7. However, as the bar 13 passes into the open wound it becomes difficult to strike the bar 13 with the mallet. From this and in Fig. 7 it will be seen that the anvil head 19 is more accessible and can be struck with sufficient force to drive the nail N further into place.

Since the anvil head 19 is secured to the end of the shank 10 and the latter is offset relative to the axis of the driving tip 15 and nail N, it will be seen that the mallet can be swung with greater ease than would be possible closer to the flesh. Moreover, since the driving force of the mallet is transmitted substantially axially of the driving tip 15, even though the anvil head 19 be replaced by the anvil arm 20, greater ease in swinging the mallet can be attained by striking the arm 20 further out than the axis of the shank 10 (see Fig. 9). The tool can be steadied by gripping the knurled surface of the elongated head 22 and the anvil head 25 of the latter can be struck with the mallet with equal effect to drive the nail N home.

It should here be noted that the arm 20, as well as the bar 13, is free to swing radially relative to the axis of the nail being driven. Consequently, the tool of the present invention is considerably mobile and adjustable into various positions rendering it much easier to strike with a mallet despite the position of the patient's limb and body.

After the pin is sufficiently embedded within the bone to join the severed parts thereof the wound is bandaged and the patient allowed to move about without the need of a cast or outside splint. Due to the fact that the nail N is firmly embedded within the core of the bone and was not twisted or turned while being inserted, by means of the present tool, the severed parts of the bone will be secured in alignment irrespective of movement of the limb. Thus the patient may be up and about in a short time and may even put his weight on the limb embodying the bone under repair without fear of misaligning the knitting bone structure.

After a reasonable time for knitting of the fractured bone structure the nail N is preferably drawn out of the marrow passage. Thus the point of entrance wound is again opened up so as to expose the eye in the end of the nail N. The tool, then assembled with the extracting hook 16, as seen in Fig. 3, is employed. Here again the mobility or adjustability of the tool relative to the axis of the nail N is important. Thus it will be noted that the laterally extending tip of the hook 16 can be set at various radial positions relative to the axial connection of the shank of the hook 16 on the bar 13. This is accomplished by setting the hook at the desired angle and then locking its threaded shank against the bar 13 with the knurled lock nut 17. The radial or angular disposition of the anvil arm 20 relative to the shank 10 is likewise adjustable by first setting the arm 20 in the position desired and then locking it in place with the lock nut 18 upon the shank 10.

Once the tool has been arranged with the tip of the hook and the bar 13 and arm 20 in a desired position, the tip of the hook 16 is inserted into the exposed eye of the nail N (see Fig. 8). The underside of the anvil arm 20 is then struck with the mallet M to unseat the nail N relative to the marrow tissues within the bone. Once the nail N is loosened from the marrow tissue the tool may be struck by the mallet either upon anvil arm 20 or the bar 13 in a direction to extract the nail from the bone.

Should it become difficult to swing the mallet due to an improper angular disposition of either arm 20 or bar 13 relative to the patient's body, the tool can be readjusted in a facile manner by loosening the lock nuts 17 and 18 to permit the arm and bar to be turned relative to the shank 10 and hook 16, respectively.

During extraction of the nail N as well as during insertion thereof it is important that the nail N be not turned or twisted. In this manner the marrow tissues of the bone will not become unduly disturbed; but more especially, cracking, splitting or chipping of the bone is avoided.

From the foregoing it will be apparent that the tool of the present invention aids in quickly and successfully inserting and extracting an intramedullary nail into and from a bone to minimize the possibility of misalignment of the severed sections thereof. Further, the present tool assures against any undue twisting or turning of the nail during either inserting or extracting optration to minimize disturbance of the marrow tissue. In either extracting or inserting operation of an intramedullary nail with the present tool, a wide range of mobility of striking surface is afforded thus assuring against unnecessary laceration at the entrance wound or accidental cracking, splitting or chipping of the bone under repair.

While I have described my intramedullary nail inserter and extractor in specific detail it will be apparent that it may be modified, varied or altered in many respects without departing from

the invention thereof. I therefore desire to avail myself of all modifications, variations and alterations as fairly come within the scope of the appended claims.

What I claim as new and desire to protect by Letters Patent is:

1. A tool for moving an intramedullary nail axially within a bone by hammer blows comprising a shank, an offset bar extending perpendicularly from one end of said shank, and having flat hammer impact receiving surfaces on both sides thereof in directions lengthwise of the shank, a nail engaging element secured to the free end of said bar to extend parallel to said shank; an anvil arm secured to the free end of said shank for extension radially therefrom and having hammer impact receiving surfaces on both sides thereof in directions lengthwise of the shank, and locking means mounted to lock said offset bar and said anvil arm in various positions of rotative adjustment relative to said shank and to each other for providing striking surfaces on said offset bar and said anvil arm free and clear of the flesh surrounding a bone in which said intramedullary nail is being moved axially.

2. An arrangement according to claim 1 wherein a striker handle is mounted to extend from the free end of the anvil arm parallel to the shank.

3. A tool for moving an intramedullary nail axially within a bone by hammer blows, comprising a shank, an offset hammer impact receiving bar secured to extend laterally from one end of said shank, a nail engaging element secured to said bar in laterally offset relation from, and parallel to said shank, an anvil arm mounted to extend laterally from the opposite end of said shank from said impact receiving bar and rotatively adjustable about the axis of said shank relative to said impact receiving bar, said anvil arm having a hammer impact receiving surface thereon at right angles to the shank axis, and locking means mounted to lock said anvil arm and said impact receiving bar in selected, relative, angularly adjusted position.

4. A tool for moving an intramedullary nail axially within a bone by hammer blows comprising a shank, an offset hammer impact receiving bar secured to extend laterally from one end of said shank, a nail engaging member secured to said bar in laterally offset relation from, and parallel to said shank, an anvil arm mounted to extend laterally from the opposite end of said shank from said impact receiving bar and having a hammer impact receiving surface thereon at right angles to the shank axis, said anvil arm and said impact receiving bar being relatively angularly adjustable about the shank axis, an elongated head with a striking face at its free end extending from said anvil arm in offset relation and parallel to said shank, and extending in a direction opposite to the direction in which said shank extends from said anvil arm, said handle having a hammer impact receiving surface on the free end thereof, and locking means mounted to lock said anvil arm and said impact receiving bar in variable angularly adjusted positions about said shank axis.

5. A tool for moving an intramedullary nail axially within a bone by hammer blows comprising a shank, a hammer impact receiving bar extending perpendicularly from one end of said shank, nail engaging means secured to said bar in laterally offset relation from, and parallel to said shank, said nail engaging means extending in a direction opposite to the shank from said bar, locking means mounted to lock said bar in various rotatively adjusted positions relative to said nail engaging means, an anvil arm secured to the opposite end of said shank for radial extension therefrom, an elongated head having a striking face thereon extending from the free end of said anvil arm parallel to said shank, said elongated head extending in a direction opposite to the shank from said anvil arm, and locking means mounted to lock said anvil arm in various rotatively adjusted positions relative to said shank and to said bar for providing a striking surface on said tool free and clear of the flesh adjacent a bone within which said intramedullary nail is to be moved axially.

JAMES F. DORR.


**References Cited** in the file of this patent

UNITED STATES PATENTS

| Number | Name | Date |
|---|---|---|
| 2,235,419 | Callahan | Mar. 18, 1941 |
| 2,528,941 | Bassett et al. | Nov. 7, 1950 |

FOREIGN PATENTS

| Number | Country | Date |
|---|---|---|
| 118,595 | Sweden | Apr. 15, 1947 |

OTHER REFERENCES

The Journal of Bone and Joint Surgery for January 1944, page 55.

The Journal of Bone and Joint Surgery for July 1949, advertising page 4.

Zentralblatt für Chirurgie for 1943, page 1659.

(Copies of these publications in Fig. 55.)