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COMBINATION BONE CLAMP AND ADJUSTABLE DRILL GUIDE

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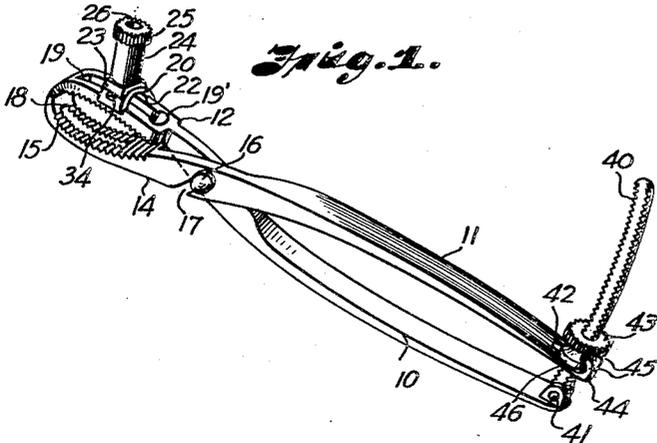


Fig. 1.

Fig. 2.

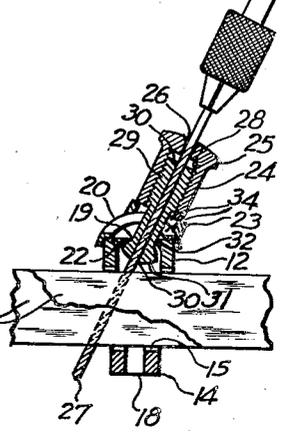


Fig. 3.

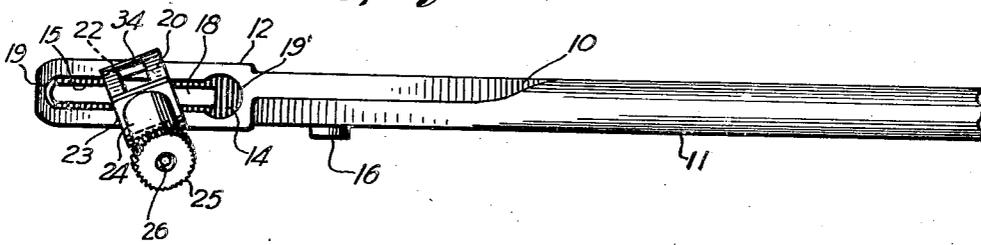


Fig. 5.

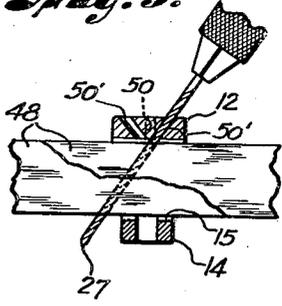


Fig. 4.

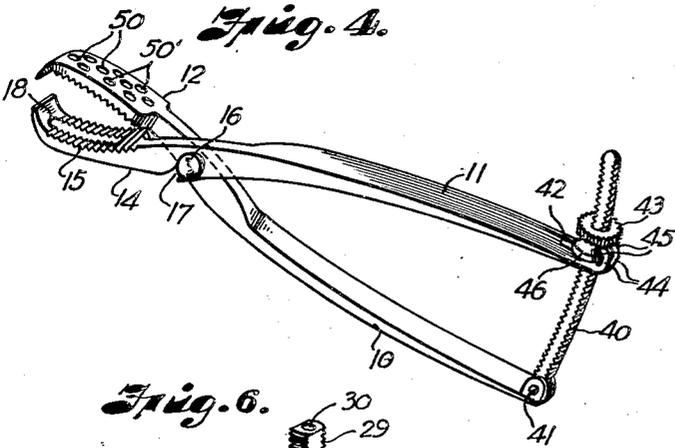
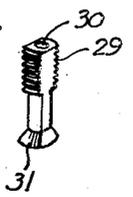


Fig. 6.



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COMBINATION BONE CLAMP AND ADJUST- ABLE DRILL GUIDE

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17 Claims. (Cl. 128—83)

The present invention has relation to improvements in surgical instruments and apparatus, with particular reference to tools and implements employed in the reduction of bone fractures, for maintaining the fractured parts in proper relative position, preparatory to the use of suitable securing means for holding the parts permanently together.

The primary object of the present invention is to provide a bone-clamping device, of a forceps character, having an adjustable drill-guiding means associated with one of the jaws of the device, and having provision for adjusting the position of the guiding means to set the same for directing the operation of the drilling tool at any desired angle with reference to the bone fragments of the fracture.

For this purpose, I have devised a bone-clamping instrument having cooperating bone-clamping jaws, one of which is provided with a drill-guiding attachment which may be conveniently set in various adjusted positions, as well as in different angular positions, in oblique relation to the bone fracture, for obtaining the desired position of adjustment according to the position or angle at which the drilling operation is to be carried out with reference to the parts of the fracture.

With the foregoing objects in view, the invention will now be described by reference to the accompanying drawing, illustrating suitable types or forms of construction which I have devised for embodying the proposed improvements, after which those features and combinations deemed to be novel and patentable will be particularly set forth and claimed.

In the drawing—

Figure 1 is a perspective view showing a combination bone-clamping tool with drill-guide means, embodying the present improvement;

Figure 2 is a sectional detail through the jaw portion of the tool, showing an adjusted position of the drill-guiding means, for drilling through a bone fracture;

Figure 3 is a plan view, illustrating a different adjusted position of the drill-guiding attachment;

Figure 4 is a perspective view illustrating a modified form of the device; and

Figure 5 is a sectional detail of the same, similar to Figure 2; and

Figure 6 is a perspective view of the stem portion of the drill-guide attachment.

The drilling of holes through long bone fragments, in the open reduction of fractures resulting in such types of fragments, has always proven

to be a difficult procedure because of the extreme hardness or density of the bone fragments, and the difficulty of holding them in proper alinement while the holes are being drilled through the fragments. It is important of course not only to drill the holes as accurately as possible and in the correct angular relation for passage through the bones in such a way as to provide the safest and most secure union of the bone fragments, but also to accomplish the operation with the least disturbance of the tissues around the fracture. Accordingly, the present invention aims to provide a forceps type of bone-clamping instrument, which is provided with an improved type of drill-guiding means which will afford universal angulation for the drilling of holes at substantially any desired angle; and the invention further comprises such improved drill-guiding means in the form of an attachment which is separable from the bone clamping instrument, so that the position of the latter need not in any wise be disturbed; and preferably the parts of the bone-clamping means are also separable to permit their insertion and removal from operative position with a minimum disturbance of the tissues.

Referring now to the drawing in detail, the device is illustrated as comprising a pair of handle portions 10, 11, formed with jaws 12, 14, respectively, and provided with the usual serrations 15 inside the jaws. These handle and jaw members are pivotally connected for operation in the manner of forceps, by means of a pivot element 16 carried by one of the members, such as the combination member 10—12, and adapted to enter an inclined slot 17 in the other member 11—14, the angular relation of such slot permitting the withdrawal of the latter member approximately lengthwise, for reasons hereinafter explained.

The jaw 14 is relatively narrower than the upper companion jaw 12 and is provided with a longitudinal slot 18.

The upper jaw 12 is also provided with a relatively wider slot 19 having an enlargement 19' at one end thereof for permitting insertion and removal of the parts comprising the adjustable drill-guide means.

As more particularly illustrated in Figure 2, the adjustable drill-guide means comprises an arch shaped support 20 adapted for adjusting movement lengthwise of the jaw 12 and provided with suitable angular recesses 22 for tracking engagement with the outer edges of said jaw 12. Mounted on the curved upper face of the supporting element 20 is a washer element 23 having its under face curved for adjustable trans-

verse movement, over the curved upper face of the element 20, while the upper face of the washer 23 is flattened for engagement with the end of the drill-guide cap element 24. The cap member 24 has a knurled head portion 25 and is also formed with a drill-guide passage 26 of selected size for the passage of a drill-bit, as indicated at 27 in Figure 2, and also a threaded passage 28 for threaded engagement with a drill-guide stem 29 having a bore 30 in alignment with the passage through the cap member, as well as a curved or ball-shaped head portion 31 adapted for adjustable tracking engagement with curved shoulders or tracks 32 formed along the inside of the opposite edges of the slot 19 of the jaw 12. The enlarged end 19' of the slot 19 is of a size to permit the insertion or removal of the head 31 of the drill-guide stem 29.

Both the element 20 and the washer 23 are provided with straight-sided slots 34 for the passage of the drill-guide stem 29, which is flattened on opposite sides for fitting said slots and at the same time preventing any rotation of the stem within the slot 19, as required for the tightening of the cap member 24 in clamping the device in any adjusted position.

From this construction it will be seen that the drill-guide means can be adjusted longitudinally along the slot 19, as well as transversely as permitted by the oblong slot 34 in the member 29, to accommodate which adjustment the washer element 23 of course moves transversely over the upper curved face of the element 20. Still further adjustment, hereinafter referred to, is also permitted by unscrewing the cap member sufficiently to disengage the opposite ends of the element 20 from the side edges of the jaw 12, and permit the parts 29 and 23 to be turned into various angular positions with reference to the upper face of said jaw 12, as illustrated in Figure 3.

An improved clamping means is provided for the ends of the handle portions 10-11 which comprises a threaded rod 40 pivoted to the outer end of the lower handle 10 as indicated at 41, and adapted to swing into or out of a terminal slot 42 in the upper handle member 11, and carrying a thumb nut 43 for clamping the ends of the handle together, in the bone-clamping operation. The slotted end of the handle member 11 is provided with upturned fingers 44, the ends of which are formed with lugs 45 projecting for engagement with a flange 46 formed on the clamp nut 43 for the purpose of securing said nut in any adjusted or set position. The length of the slot 42 is sufficient to permit the inward movement of the rod 40 for disengagement of the flange 46 and the lugs 45, and which movement is of course necessary for obtaining any change in the position of the handles except by actual turning of the nut.

One position for the drilling operation is illustrated in Figure 2. Cap members 25 are provided with different sizes of passages 26 for different sizes of drilling bits 27, the bore 30 of the stem 29 being large enough to accommodate the largest size of bit 27. The drill-guiding parts are mounted upon the jaw 12 by insertion of the ball portion 20 through the opening 19' for movement along the longitudinal slot 19. If the drilling operation is to be carried out substantially at right angles through the fracture, a longitudinal adjustment of the drill-guiding attachment will suffice to properly position the same for the drilling operation, in which position

the parts are clamped by screwing the cap member 25 tightly upon the stem 29, and the drill-bit inserted into the guide passage provided by the bores 26 and 30. The drill is then operated to drill the holes through the matched fragments, the bit 27 passing on through the bone fragments 48 and into the opposite slot 13 of the lower jaw 14. During this operation the clamping jaws have been held firmly in position by the clamping screw 40 and nut 43 at the ends of the handles, as shown in Figure 1. On completion of the drilling, the drilling tool is removed and the drill-guide attachment also removed by unscrewing the cap member 25 and sliding the attachment to the opening 19', through which the ball element 20 passes for permitting the removal of the device without any disturbance of the clamping jaws. A screw or other securing means may now be inserted, without any disturbance of either the clamping means or the bone fragments.

If the drilling operation is to be carried out at an angle, however, a change may be made in the position of the attachment to meet the requirements of such angulation. That is to say, after the adjustment along the slot 19, the attachment may also be adjusted transversely into any desired angular position, as illustrated in Figure 2, and also rotatively if desired, as represented in Figure 3. In this connection it will be noted that the completion of the drilling will result in the drill-bit projecting out below either through the slot 18 or at either side of the lower jaw 14, which is thus made preferably narrower than the upper jaw 12, to afford the added range of lateral as well as angular adjustments of the drilling position. Upon setting and screwing the attachment for the desired angle of drilling, the operation is completed and the attachment removed for the insertion of screws or the like, as already explained.

In Figures 4 and 5 I illustrate a modified form of construction, which eliminates the provision of any special form of attachment for the purpose of guiding the drill. In this modified form, instead of providing the upper jaw 12 with longitudinal slots, this jaw 12 is drilled with a set of openings, comprising a central row of vertical openings 50, and two side rows of oblique openings 50'. Thus a given number of selected positions are provided for the carrying out of the drilling operation, that is, either vertically through any one of the openings 50 as aligned with the lower slot 18 or through any one of the openings of either set or row of side openings 50', the latter openings being inclined at such angles as will cause the drill point to clear the sides of the lower jaw 14, as is clearly illustrated in Figure 5.

While such modified form provides for a more limited range of adjustment, in comparison with the form shown in Figures 1-3, the construction is simpler and less expensive, and not only simplifies the operation but is especially adapted for use in fractures of the smaller bones, where flexible material is generally used for fixation. For example, after drilling at right angles to the fracture and removing the drill, the fixation material (such as fine wire or other flexible thread) is inserted through the hole and pushed down through the slot 18; thereupon as the jaws are removed separately, this will result in bringing the fixation material forward into position for the joining of the ends in an efficient manner

and with a minimum of disturbance of the tissues.

It will therefore be apparent that I have devised a practical and efficient type of instrument, which permits complete, universal angulation of the parts of the device for the drilling operation, for enabling the holes to be drilled at substantially any desired angle through the bone fragments, and thereafter the removal of the drill-guiding means from the remainder of the instrument without any disturbance of the clamping action, for permitting the fixation of the bone fragments with a minimum of disturbance of either the bone parts or the surrounding tissues. The provision of clamping means for the handles 10, 11, of the type shown, is also an important feature, as regards the holding of the nut 43 in proper position, and not allowing it to slide off the handle, and the construction also making it necessary for the nut to be disengaged from the retaining lugs 45 for making any quick change in the handle adjustment.

While the foregoing represents what I have now found to constitute the most practical and efficient forms of the tool for carrying out the desired objects of my invention, it is of course understood that the described forms are merely illustrative, and may be greatly varied, while still adhering to the principle of my invention; I therefore desire to be understood as expressly reserving the right to make all changes and modifications fairly falling within the spirit and scope of the appended claims.

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

1. A combination bone-clamping and drill-guiding means comprising, a forceps structure comprising removably connected handles provided with cooperating and oppositely bowed jaws for clamping the bone fragments of long bone fractures, one of said jaws being provided with means for guiding a drill tool through the bone fragments between the jaws.

2. A combination bone-clamping and drill-guiding means comprising, a forceps structure having cooperating jaws for clamping the bone fragments of a fracture, one of said jaws being provided with selective means for guiding a drill tool at various angles to the fracture through the bone fragments between the jaws.

3. A combination bone-clamping and drill-guiding means comprising, a forceps structure having cooperating jaws for clamping the bone fragments of a fracture, one of said jaws being provided with selective means adapted for variously positioning the drill tool for drilling at various angles to the fracture through the bone fragments between the jaws.

4. A combination bone-clamping and drill-guiding means comprising, a forceps structure, and a drill-guiding attachment removably mounted upon one of the jaws of the forceps and adjustable thereon longitudinally with reference to the principal dimension of the jaw.

5. A combination bone-clamping and drill-guiding means comprising, a forceps structure, and a drill-guiding attachment removably mounted upon one of the jaws of the forceps and adjustable thereon transversely with reference to the principal dimension of the jaw.

6. A combination bone-clamping and drill-guiding means comprising, a forceps structure, and a drill-guiding attachment removably mounted upon one of the jaws of the forceps and ad-

justable thereon obliquely with reference to the principal dimension of the jaw.

7. A combination bone-clamping and drill-guiding means comprising, a forceps structure, and a drill-guiding attachment removably mounted upon one of the jaws of the forceps and adjustable thereon both longitudinally and transversely with reference to the principal dimension of the jaw.

8. A combination bone-clamping and drill-guiding means comprising, a forceps structure, and a drill-guiding attachment removably mounted upon one of the jaws of the forceps and adjustable thereon both longitudinally and obliquely with reference to the principal dimension of the jaw.

9. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot, and a drill-guiding attachment removably mounted on said jaw and adjustable both longitudinally along said slot and also in angular relation thereto.

10. A combination bone-clamping and drill-guiding means comprising, a forceps structure having the jaws thereof formed with aligned longitudinal slots, and a drill-guiding attachment mounted on one of said jaws in both longitudinally and angularly adjustable relation thereto.

11. A combination bone-clamping and drill-guiding means comprising, a forceps structure having jaws of relatively different widths and formed with aligned longitudinal slots, and a drill-guiding attachment mounted on the wider jaw in both longitudinally and angularly adjustable relation thereto.

12. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot, a drill-guiding attachment having a passage for a drill-bit, and means for clamping said element in various positions along said slot.

13. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot, a drill-guiding attachment having a passage for a drill-bit and movable into various angular positions with reference to the bone fragments between the jaws, and means for clamping said element in various positions along said slot.

14. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot, and a drill-guiding attachment comprising a stem having a passage for the drill-bit and adapted for clamping engagement with the side margins of the slot, and a cap member also having a drill passage in alinement with said first passage and operable to clamp said stem in various angular positions with reference to the bone fragments between the jaws.

15. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot, and a drill-guiding attachment comprising a stem having a passage for the drill-bit and a head portion for adjustable clamping engagement beneath the side margins of said slot, and a screw cap member also having a drill passage in alinement with said first passage and operable to clamp said stem in various angular positions with reference to the bone fragments between the jaws.

16. A combination bone-clamping and drill-guiding means comprising, a forceps structure having one of the jaws thereof provided with a longitudinal slot formed with an enlarged end portion, and a drill-guiding attachment comprising a stem having a passage for the drill-bit and a head portion removable through the end portion of said slot and also adapted for adjustable clamping engagement beneath the side margins of said slot, and a screw cap member also having a drill passage in alignment with said first passage and operable to clamp said stem in various angular positions with reference to the bone fragments between the jaws.

17. A tool of the character described, comprising a forceps having handles and oppositely bowed jaws adapted to clamp the bone fragments of a long bone fracture, and a pin and angular slot pivot-structure connecting said handles and permitting separation of the handles by endwise movement relative to each other, one of said jaws being provided with means for guiding a drill tool in its operation through the bone fragments while clamped in overlapping relation between said jaws.

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