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(54) Osteal medical staple

(57) An osteal medical staple 2 for attaching soft tissue such as ligaments or tendons to bone has depending leg portions 20, 22 of triangular cross section flaring outwardly. Loosening or reversal of the driven staple is all but eliminated by reason of retention barbs 38, 40 formed on two sides of each leg. The curvilinear surfaces of the cross-bar portion of the staple insure a minimum of damage to soft tissue surrounding the bone with which the staple is utilised. Securing spikes 12 are formed on the undersurface of the cross-bar portion of the staple, which is of integral metal construction.

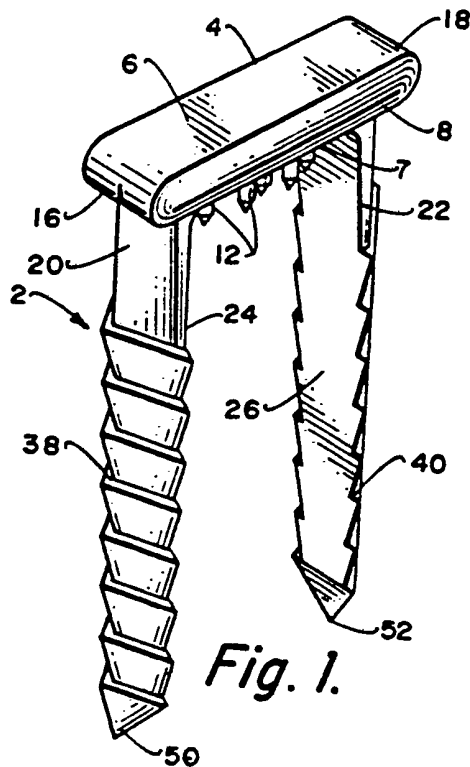


Fig. 1.

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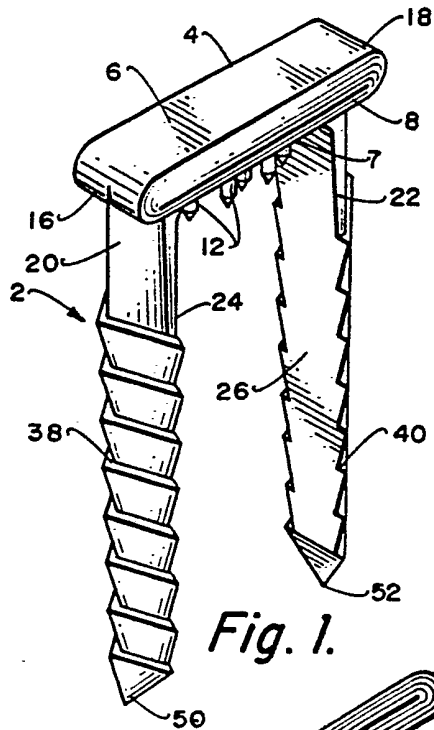


Fig. 1.

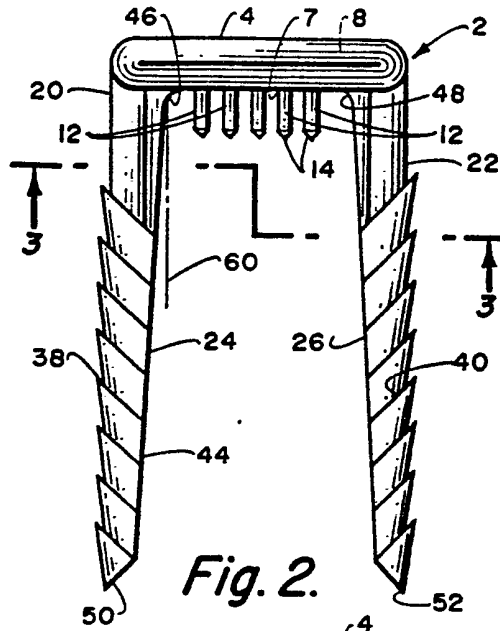


Fig. 2.

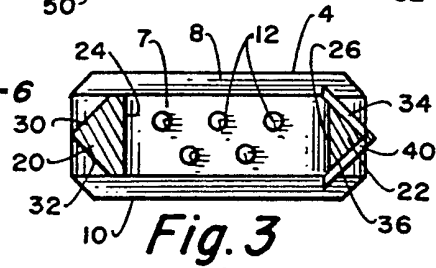


Fig. 3.

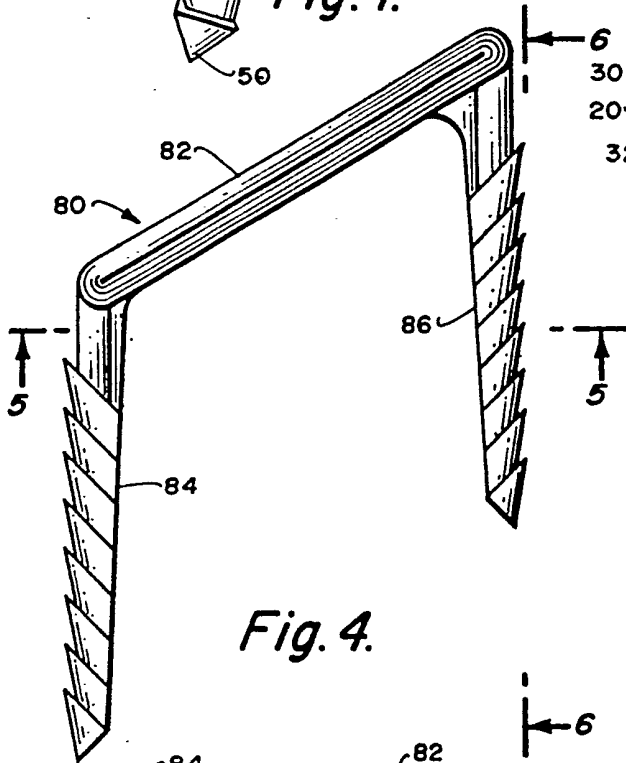


Fig. 4.

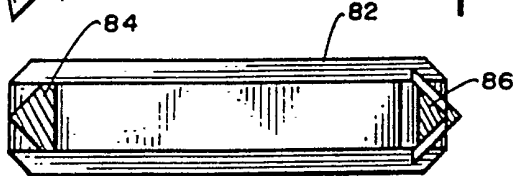


Fig. 5.

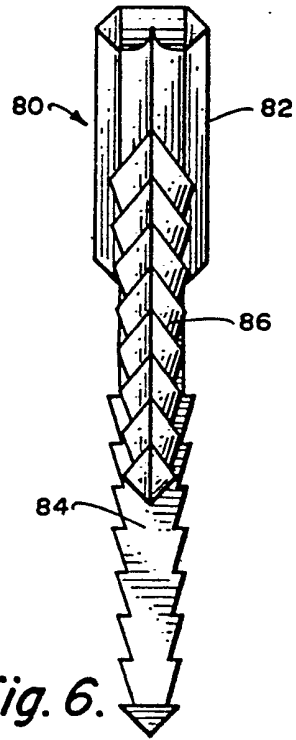


Fig. 6.

## SPECIFICATION

**Osteal medical staple**

5 This invention pertains to medical staples of the type that are utilized by orthopedic surgeons for the repair or broken bones and the like, and the attachment of natural and artificial ligaments in reconstructive surgery and  
10 the like.

The prior art has suggested various types of staples, some of which have been specifically fabricated for association with staple drivers and the like, and one such staple is shown in  
15 the prior art patent to Griggs, U.S. 4 263 903.

The staple of the present invention overcomes many of the shortcomings of prior art staples. It is capable of retaining soft tissue and bone in a rigid and secure manner  
20 wherein the staple is provided with various features to facilitate the end function and result for which it is intended.

The medical staple used in soft tissue and bone fixation should be one that provides  
25 uniformity and constancy of results regardless of its area of application. A medical staple must be one that is easily driven through soft tissue and bone with a minimum of damage,  
30 yet providing a maximum of retention in securing so as to accomplish the job for which it is intended. The medical staple of the type utilized with staple holders or drivers must also provide suitable and adequate gripping  
35 surfaces by which the staple may be held for implantation and removal, if necessary.

The staple of the invention meets all of the foregoing criteria in that a medical staple is provided which is integrally fabricated of biologically inert metal, such as stainless steel,  
40 titanium cobalt-chromium-molybdenum or the like, and has a cross-bar portion selectively configured to accommodate various driving and holding devices and further, has depending legs which are triangular-shaped in cross-section wherein the interior or base of the triangle is smooth while the remaining intersecting legs of the triangle are provided with chevron-shaped ridges or barbs, insuring secure retention once the medical staple has  
45 been set or implanted.

The medical staple has slightly outwardly flaring legs so that a uniform, constant spread of the legs is obtained during the implantation or driving process through bone and the like.  
50 To facilitate driving, tapered termini to the legs is provided, and to insure retention of soft tissue, retaining and holding spikes are provided on the undersurface of the cross-bar portion of the staple.  
60

It is an object of the invention to provide an osteal medical staple of unique configuration and design.

According to the present invention there is  
65 provided an osteal medical staple comprising

70 the combination: an integral member having a cross-bar portion defining gripping means by which said staple may be grasped, said cross-bar portion having curvilinear termini, each of which terminate in depending legs extending therefrom, each of said legs flaring outwardly from said cross-bar portion; and barbed means on each of said depending legs adapted to inhibit withdrawal movement of  
75 said staple once same has been positioned in its fixation environment.

In an exemplary embodiment, the invention is directed to a staple comprising the combination of an integral member having a cross-bar portion defining gripping means by which  
80 said staple may be grasped. The cross-bar portion has curvilinear or rounded termini or edges terminating in depending and extending legs, each of the legs flaring outwardly from the cross-bar portion wherein the legs have barbed means thereon to inhibit withdrawal movement of the staple once same has  
85 been positioned in its fixation environment.

These and further objects of the invention will become apparent from the hereinafter following commentary taken in conjunction with the drawing.

*Figure 1* is a perspective view of one of the embodiments of the medical staple of the  
95 invention;

*Figure 2* is a side elevational view of the staple illustrated in Fig. 1;

*Figure 3* is a view taken along the line 3-3 of Fig. 2;

100 *Figure 4* is a side elevational view of another embodiment of the medical staple of the invention;

*Figure 5* is a view taken along the line 5-5 of Fig. 4;

105 *Figure 6* is a view taken along the line 6-6 of Fig. 4.

While the medical staple of the invention will be described as it specifically relates to those embodiments of the invention depicted in the drawing, it should be understood that various size and various legged staples are contemplated, i.e., where the cross-bar is longer, wider, or the like, than that shown, and where the depending legs are multiple and spaced apart further or closer, or longer or shorter, depending upon the ultimate field of application. The parameters of the inventive staple, as will become apparent to those of ordinary skill in the art, may be applied to all such different sizes of devices, and while a specific design or configuration to the cross-bar of the medical staple will be disclosed, those of ordinary skill in the art will at once recognize that the attributes and essence of the invention may be applied to medical staples of different design so long as the basic medical staple features, as will be described, are adhered to.

Referring to the figures of drawing wherein  
130 like numerals of reference designate like ele-

ments throughout, two of five or six different sizes of staples are illustrated in this particular case being of stainless steel (of surgical type) or of a cobalt-chromium-molybdenum alloy or of titanium metal. The staple 2 is shown as comprising a cross-bar portion 4, having an upper surface 6 and a lower surface 7 and having a somewhat rectangular configuration with lateral projecting surfaces 8 and 10, somewhat hexagonal-shaped, providing gripping surfaces by which the staple 2 may be securely and rigidly held by means of a staple holder device not shown.

The staple 2 is of integral construction and the undersurface 7 is provided with spaced, projecting spikes 12, in this particular instance five in number, and having tapered points 14 intended to secure soft issue, ligaments or the like as is commonplace in orthopedic surgery. It will be noted that the lateral surfaces 8 and 10 are somewhat curvilinear as opposed to having sharp, breaking edges or surfaces to thereby prevent undue traumatization to surrounding soft tissue when the staple 2 is being driven or implanted. The cross-bar portion 4 terminates in termini 16 and 18 similarly curvilinear or rounded so as to prevent soft tissue destruction.

The termini 16 and 18 have depending and extending legs 20 and 22, the interior surfaces 24 and 26 of which are smooth, while the adjacent surfaces are barbed or the like.

The depending legs 20 and 22 are triangular-like in cross-section with the smooth surfaces 24 and 26 forming the base of the triangle while the opposed legs 30 and 32 of legs 20 and 34 and 36 of leg 22 are configured with chevron-shaped ridges 38 and 40 respectively, forming barbed means for insuring secure retention of the staple 2 once the staple has been driven into bone structure or the like.

The ridges 38 and 40 form a 45-degree angle with respect to a horizontal datum 44. The legs 20 and 22 are filleted or rounded as at 46 and 48 where same intersect the undersurface 7 of cross-bar portion 4. The depending legs 20 and 22 terminate in chiseled or pointed ends 50 and 52 respectively, the ends being tapered at about a 45-degree angle to facilitate driving of the staple 2 through tissue and bone.

The legs 20 and 22 are slightly tapered with respect to each other and flare outwardly to insure compression retention of the staple once same is driven through soft tissue and into bone or the like structure. The legs flare outwardly about 2-6 degrees from a vertical and in the illustration shown, about 3 degrees from a vertical datum 60.

The relationship of the triangular cross-section of the legs 20 and 22 to the chevron-shaped ridges 38 and 40 in conjunction with the flare or outwardly spreading of the legs is such that regardless of the size of the staple

2, the legs 20 and 22 always flare outwardly a uniform and constant amount, that amount being about 0,51 cm. Thus, regardless of the distance between the legs 20 and 22 and regardless of the length of the legs a driven and set staple will flare outwardly and take a set of a constant dimension, which along with the barbed means on the legs 20 and 22 make the staple 2 of the invention about 3 times more difficult to remove than prior art medical staples not having the features of the staple 2.

The staple 2 with its broad cross-bar portion 4 and the configuration thereof, and in particular, the setting spikes 12 insure less trauma to surrounding soft tissue while being set or driven and at the same time insures that soft tissue will be retained where wanted for a sufficiently long time for tissue fixation to take place. The outwardly protruding gripper sides 8 and 10 insure the ability to securely grasp and hold the medical staple either by hand or with a staple driver during the setting or removing process. The barb-like arrangement of the triangular-shaped legs 20 and 22 insure against vertical or lateral pullout of the staple 2 from the bone structure with which it is associated. The chiseled or tapered points 50 and 52 of legs 20 and 22 along with the slight outwardly flaring of said legs provide ease of setting of the staple and also create compression forces between the staple legs contributing to decrease of the potential for vertical backout of the medical staple 2 and compresses bone fragments which facilitates bone healing.

Referring now to Figs. 4-6, inclusive, another embodiment of the invention is depicted which has all of the salient features alluded to hereinbefore for the staple 2 but differs only in certain aspects, as will be seen.

Herein the staple 80 has a cross-bar portion 82 fulfilling all of the parameters set forth for the cross-bar 4 of medical staple 2, but in this instance being of slightly elongated configuration for hybrid utilization in particular end uses.

The staple 80 has depending leg 84 which spaced depending leg 86. In all other particulars with the exception of the slant or askewness of the cross-bar 82 relative to legs 84 and 86 and the difference in spacing of legs 84 and 86, all other aspects of the staple 80 coincide with those aspects heretofore described with respect to staple 2 with the obvious exception, of course, of the deletion of spikes 12 on the undersurface of cross-bar 82.

Since those of ordinary skill in the art will at once recognize the field of use and the details of construction of the staple 80 in reference to the previous description of the staple 2, further description of the staple 80 will not be delved into.

The cross-bar of the staples of the invention

may be of any size, but the most versatile sizes are those ranging from 1 to 2 centimeters with various increments in between wherein the legs, measured from the under-  
 5 side or surface of the cross-bar, may be between 1-4 centimeters depending upon end use function desired. In the embodiment of the invention illustrated in Figs. 1-3, inclusive, the spikes 12 may be eliminated, as  
 10 those of ordinary skill in the art will recognize. Likewise, while a specific hybrid staple is illustrated in Fig. 4, other various sizes and shapes will present themselves depending upon field application and desirability imposed  
 15 by the orthopedic surgeon. However, the various attributes of the invention and their application to medical staples having different gripping surfaces, or indeed, barbed means on the legs, will be apparent to those of  
 20 ordinary skill in the art. Thus, there has been disclosed a medical staple particularly adapted for association with soft tissue and bone structure wherein the staple provides for controlled leg bending and reduced backout and tissue  
 25 injury problems. The polygonal cross-bar of the staple having rounded edges and broad tissue contact area helps distribute the load and thus reduces potential for soft tissue injury. The configuration of the broad cross-  
 30 bar also insures sufficient gripping of the staple either by hand or with a staple holder device. The triangular-shaped barbs eliminate backout potential from either vertical or lateral force applications while the surfaces between  
 35 the cross-bar and the legs being of filleted or oblique configuration eliminates sharp edges and right angles which may cut or tear soft tissue.

The rigid, triangular legs of the staple with  
 40 the chisel points facilitate driving and setting of the staple, and the reinforced corners at the juncture of cross-bar and depending legs reduces uncontrolled staple leg bending while the taper or flare on the legs creates compres-  
 45 sion upon driving of the staple.

While there are various changes and modifications other than those briefly alluded to hereinbefore that will occur to those of ordinary skill in the art, all such changes and  
 50 modifications are intended to be encompassed by the appended claims.

#### CLAIMS

1. An osteal medical staple comprising an  
 55 integral member having a cross-bar portion defining gripping means by which said staple may be gripped, said cross-bar portion having curvilinear termini and lateral protuberances; and at least one depending leg having a  
 60 cross-sectional configuration which is triangular, two sides of said depending leg having barbed means thereon to inhibit withdrawal movement of said staple.

2. The staple in accordance with claim 16  
 65 which additionally includes at least an addi-

tional depending leg spaced from at least one depending leg of like configuration, each of said legs being in flared relationship to each other and said cross-bar.

70 3. A staple substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

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