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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : A61B

A2

(11) International Publication Number: WO 94/14366

(43) International Publication Date: 7 July 1994 (07.07.94)

(21) International Application Number: PCT/US93/12601

(22) International Filing Date: 28 December 1993 (28.12.93)

(30) Priority Data:
07/997,416 28 December 1992 (28.12.92) US

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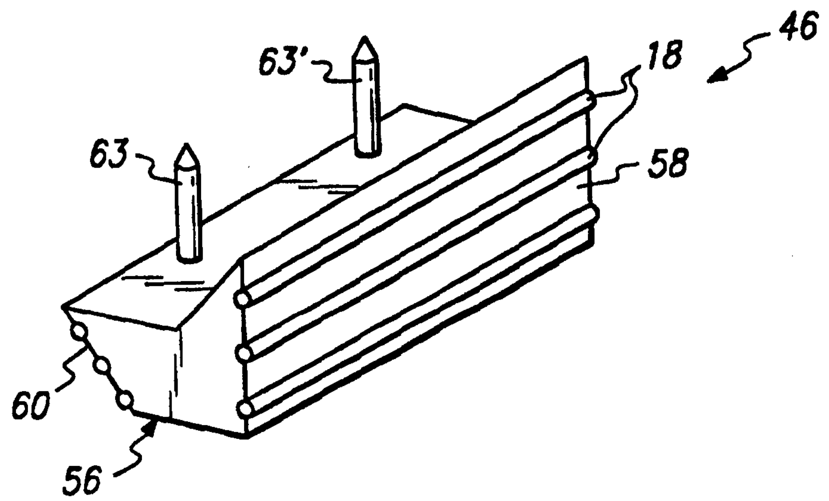
(81) Designated States: AU, CA, JP, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
Without international search report and to be republished upon receipt of that report.

(54) Title: SURGICAL CUTTING BLOCK AND METHOD OF USE



(57) Abstract

An improved surgical cutting surface for guiding bone saws in joint surgery and similar instruments is disclosed. The cutting block is provided with one or more cutting guide surfaces that may be positioned on exterior faces of the block or along channels within the block. The reference cutting surface of the material is composed of a material that has a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of less than 10 % and a nickel content of less than 4 %. The cutting guide is also variously configured with rails or protuberances to provide a reference cutting surface having reduced frictional characteristics. Also a dual cutting block system for femoral resection is provided. Each of the two cutting blocks is configured to provide a cutting guide for both a standard cut and the complementary chamfer cut.

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SURGICAL CUTTING BLOCK AND METHOD OF USE

Field of the Invention

The field of the invention relates to surgical cutting devices, and more particularly to surgical cutting blocks used for guiding saws and similar cutting devices in the shaping of femurs for the receipt of knee prostheses.

Reference

Sunderman et al. 1989. Journal of Orthopaedic Research 7:307-315.

Background of the Invention

Artificial joints, such as knee and hip socket replacements, are frequently implanted in the body to repair or replace damaged or diseased joints. In order to achieve a successful implant, the bone adjacent to the joint must first be resected into in an appropriate shape that is reciprocal to the shape of the implant. Typically, the majority of cutting is done with a saw blade attached to a motorized surgical handpiece, which propels the blade in a variety of directional or bi-directional motions.

In most joint replacement surgery, such as knee replacement, the fit between the bone surface and the replacement is very precise, often with tolerances of a few thousandths of an inch. Virtually all surgeons use a cutting block to force, hold captive or guide a blade along a reference cutting surface of a cutting guide, which is positioned along one or more sides of the cutting block. The reference cutting surface assures that the plane of the cut will be properly aligned on the bone by guiding the cutting path of the saw blade.

Although widely used, known cutting blocks and surgical methods based on the use of known cutting blocks suffer from several serious problems. A commonly encountered problem is systemic toxicity following treatment. Standard surgical cutting blocks are made from various grades of stainless steel that are quickly eroded by the high speeds at which most surgical blades operate. The result of such erosion is the production of a slurry, commonly referred to in the industry as "sludge," some of which is deposited at the surgical site during surgery. The sludge contains the various elements present within the steel alloy which makes up both the cutting block and the surgical blades. A number of metals often found in stainless steel alloys, including both nickel and chrome, are left behind in the joint and eventually make their way throughout the patient's body. Nickel in particular is a known carcinogen. In a recent study, Sunderman et al. (1989) report that nickel concentrations in patients having joint replacement surgery rose 11 fold in the 1-2 days following surgery as compared to preoperative levels.

Aside from the problem of toxic sludge, erosion of stainless steel cutting blocks quickly cause the fretting of the reference plane surface, thereby destroying the ability of the cutting block to provide a precise reference edge during surgery. In most applications, tolerances of a few thousandths of an inch are lost after 5-10 minutes of cutting, thereby forcing the surgeon to replace the cutting block (often impractical during surgery) or accept a less precise cut. Unfortunately, the failure to provide a precise alignment along the surface of contact between the prosthesis and the remaining bone can result in post-operative bone degradation, infection and joint failure.

Another serious problem encountered in the use of known cutting blocks is the heat of friction created during surgery. Although much of the heat comes from the frictional interaction of the saw teeth and the bone, a substantial amount of heat is generated, and thus added to the blade, by friction between the blade and the cutting block. It is well known that damage to bone tissue begins after bone temperature exceeds 50°C and that irreparable damage takes place after temperatures exceed 70°C for three or more minutes. Existing cutting devices and methods of use can generate heat in excess of 50°C and even 70°C.

The configuration of the cutting block system used to resect bone in a knee or other joint can also create impediments to the success of the procedure. In particular, known dual cutting block systems, which comprise a first cutting block for making anterior and posterior cuts, and a second cutting block for making the posterior chamfer and anterior chamfer cuts, suffer from several inherent difficulties. First, because the first cutting block is designed to remove bone sections from the front and back faces of the distal portion of the femur, it is common for the body of the cutting block to exceed, or "hang over," the sides of the distal end of the femur. As a result, the reference cutting surface is not flush to the bone but rather separated from it by some amount of air space. This makes the anterior and posterior cuts more difficult because the surgeon is not under good control of the cutting edge of the saw blade. Skiving, a tendency of the blade to be deflected by the bone and thus produce an inferior cut, is a significant problem in these situations.

Another difficulty with existing dual cutting systems for femoral resection is the relatively small surface area presented by either cutting guide surface in a typical prior art chamfer cutting block. The small extent of the surface area, particularly the relatively short length of the cutting guide relative to the length of the saw blade, significantly reduces the surgeon's ability to guide and direct the blade in making a proper cut.

In view of the foregoing, there is a clear need for a cutting block and method of use that does not deliver toxic elements to the patient as a by-product of erosion of the cutting block and/or blade. There is also a need for a cutting block with superior hardness that is capable of retaining its original configuration without unacceptable fretting during surgery. A further need is for a cutting block and blade combination that has a relatively low coefficient of friction during operation, thereby reducing blade heating and bone tissue degradation. In addition, there is a need for a femoral cutting block system that increases surgeon control and cut precision during the resectioning of a femur in knee surgery.

Summary of the Invention

It is a general object of the invention to provide an improved cutting block having a reference surface composed of a composition that has minimal amounts of toxic and carcinogenic elements such as nickel and chrome.

It is another object of the present invention to provide a cutting block having a cutting guide surface with a superior hardness such that the configuration and tolerances of the cutting surface is retained substantially throughout use during an operation.

It is yet another object of the present invention to provide a cutting block having a cutting guide surface that has a relatively low coefficient of friction when used in surgery with a given blade whereby heat build up in the blade from frictional contact with the cutting guide surface is minimized.

Still another object of the invention is to provide a method for cutting bone and similar hard tissue that does not leave behind toxic by-products at the operation site.

Another object of the invention is to provide a method of cutting bone and similar hard tissue that is capable of making a precise cut with a desired tolerance of a few thousandths of an inch.

A further object of the invention is to provide a method of cutting bone or similar hard tissue that minimizes heat damage to bone tissue.

Another object of the invention is to provide a method for precise cutting of hard tissues, such as bone and cartilage, that does not result in deposits of toxic substances in the body or result in heat-associated tissue damage.

Yet another object of the invention is to provide a femoral cutting block system that combines the ability to make a posterior or anterior cut, as well as the opposing chamfer cut, in a single cutting block.

Still another object of the invention is to provide for improved stability and precision in the attachment and usage of femoral cutting blocks to the femur.

Another object of the invention is to provide an adaptor that can be used to couple a variety of instruments, including cutting blocks and sizing plates, to a bone to be cut.

A further object of the invention is to provide an expanded and widened chamfer cutting guide in order to increase surgeon control of saw blades and precision in making posterior and anterior chamfer cuts.

The invention meets these objects by providing an improved cutting block having one or more cutting guide surfaces composed of a composition having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of less than 10% by weight and a nickel content that is substantially less than 4% by weight.

The cutting block of the invention may be entirely composed of the desired composition or may be a composite construction having a core unit composed of stainless steel or other material suitable for surgical applications that is fitted with and coupled to one or more units composed of the composition described above and configured with a desired cutting guide surface. Such units may be discrete blocks or laminas that are physically affixed to or inlaid into a desired surface of the core unit or alternatively may constitute coatings or deposits that are bonded to a desired surface of the core unit using known techniques.

According to another aspect of the invention, an improved configuration for the reference cutting surface of the cutting guide is provided. In lieu of the typical planar configuration provided in prior art devices, the present invention utilizes the use of ridges or protuberances to define a reference cutting surface, thereby greatly reducing the extent of actual physical, and therefore frictional, contact between the surgical saw blade and the cutting guide. According to one aspect of the invention, two or more raised rails are configured on the surface of the cutting guide. According to another aspect, semi-spherical protuberances are arrayed in linear or curvilinear rows, or at random, across the surface of the cutting guide. The summits of the protuberances define the reference cutting surface and are the only part of the cutting guide that actually contacts the saw blade during an operation.

According to yet another embodiment of the invention, a dual block femoral cutting block system is provided. The cutting block system comprises the use of two stationary cutting blocks, each designed to make a standard cut (posterior or anterior) in a plane more or less parallel to the anatomical axis of the femur, and a chamfer cut opposite the position of the standard cut in a plane at an acute angle to the anatomical axis of the femur. The blocks also differ in the configuration of means of attachment to the distal or knee-end of the femur. One block of the dual block system is adapted to be received over the planar surface of the distal femoral cut, which is substantially perpendicular to the anatomical axis of the femur and is the first cut made when a femur is being resectioned for receipt of a femoral component of a knee prosthesis. Because the first block in the system is used to make a chamfer cut, the distal end of the femur is converted from a planar to an angled surface having three distinct planes, one the result of the original distal femoral cut and the other created by the chamfer cut and posterior or anterior cuts made using the first cutting block. For this reason, the attachment means of the second cutting block in each system must be angled in order to be snugly received over the end of the femur. It will be apparent therefore that two cutting block systems, comprising four distinctly configured cutting blocks are possible within this system.

The surgical device and method of the invention are advantageous over prior art in that toxic deposits within the joint as a result of surgery are minimized, in that the tolerances of the reference cutting surface are maintained throughout surgery, and in that blade heating due to friction between the blade and cutting guide surface is reduced, in that surgeon control in making cuts, particularly chamfer cuts is improved and in that the placement and precision of cuts is improved.

These and other objects and advantages of the invention will be more fully apparent when the following detailed description of the invention is read in conjunction with the accompanying drawings.

Brief Description of the Drawings

FIGS. 1A & 1B are views in perspective of two embodiments of a cutting block of the invention.

FIGS. 2A & 2B are views in perspective of two saw-captive embodiments of a cutting of the invention.

FIGS. 3A & 3B are views in perspective of a cutting block of the invention showing a three-rail configuration of a the reference cutting surface.

FIGS. 4A & 4B are views in perspective of a cutting block of the invention showing the use of protuberances to define a reference cutting surface.

FIGS. 5A & 5B are views in perspective of cutting blocks of a first embodiment of the dual cutting block system of the invention showing cutting guides with planar cutting reference surfaces.

FIGS. 6A, 6B & 6C are views in perspective of cutting blocks of a first embodiment of the dual cutting block system of the invention showing cutting guides using rails and protuberances to define the cutting reference surface.

FIGS. 7A, 7B, 7C, & 7D are views in cross-section of first and second saw-free embodiments of the dual cutting block system of the invention.

FIGS. 8A, 8B, 8C & 8D are views in cross-section of first and second saw captive embodiments of the dual cutting block system of the invention.

FIG. 9A is a view in perspective of the adaptor of the invention. FIG. 9B is a view in cross section of the adaptor of the invention in combination with a cutting block.

FIG. 10A is a view in perspective of the sizing plate of the invention. FIG. 10B is a view in cross section of the sizing plate of the invention.

Detailed Description of the Invention

I. CUTTING REFERENCE SURFACE

According to one aspect of the invention, an improved cutting reference surface will now be described. The cutting reference surface is a key element of any cutting block or other surgical device because it is the surface that the surgeon uses to guide a saw blade or similar instrument to cut and section bone tissue. The frictional and compositional characteristics of the cutting reference surface determine to a large degree the effectiveness of cut made by the surgeon.

Configuration. Turning now to FIGS. 1-4, the configuration of the cutting reference surface of the present invention will now be described. According to the invention, a cutting block **10** with a cutting guide **12** having cutting reference surface **14** is provided. According to a first aspect of the invention, cutting reference surface **14** is a substantially even, continuous plane, across which and in physical contact with which a surgical saw blade passes. In this configuration of the invention, a flat surface of the more or less planar saw blade is in substantial physical contact with cutting reference surface **14**.

According to another aspect of the invention, as shown more fully in FIG. 3, cutting guide **14** of cutting block **12** is provided with two or more rails **16**. The rails **16** are elevated above the general surface **15** of cutting guide **12**. The rails may be preformed on general surface **15** of cutting guide **12** by casting the cutting guide in a mold or tooling a cutting guide to form such rails according to methods well known in the art. Alternatively, the rails can be formed by partially capturing rods **18** within tracks **20** which have been formed within cutting guide **12** on general surface **15**. Rods **18** may be comprised of the same composition as that of cutting guide **12**, or may be fabricated from an entirely different composition as described further below.

The number of rails **16** or rods **18** (collectively hereafter as "rails") is at least two and is preferably three in number. The rails are configured to rise an equal distance above general surface **15** so that the apices of the rails define a plane substantially parallel with the plane occupied by general surface **15**. The plane defined by the rails forms the cutting reference surface of the cutting guide. It will be appreciated by those skilled in the art that the frictional contact between a saw blade and a reference surface defined by a limited number of rails will be substantially less than the frictional contact between two flush planar surfaces.

In the preferred embodiment incorporating three rails, the apices of the all three rails will define such a single plane. However, it may be preferable in some instances to elevate the two outer rails relative to the third central rail so that only the outer rails define a plane substantially parallel to general surface **15**. This last configuration, as discussed further below, allows for greater flexure of the saw blade by allowing the blade to be bowed concavely below the plane defined by the two outer rails, with the third central rail nevertheless preventing contact with the cutting guide.

It should be further understood that although the rails have been depicted as linear constructs in the Figures, such a configuration is not necessary to the operation of the invention. In fact, the rails may be curvilinear instead, each rail defining an arc the shape which is limited only by the physical dimensions of the general surface **15** of cutting guide **12**. In certain applications, such as with oscillating saw blades, configuring the rails to be arc-shaped can further reduce frictional contact by further minimizing the amount of frictional contact between the saw blade surface and the rails.

A third aspect of the cutting reference surface of the invention entails the use of convexly curved, lens-shaped protrusions **22**, or alternatively, substantially spherical objects **24**, in two or more linear or curvilinear arrays, as illustrated in Fig. 4, or scattered in or more or less random fashion across the cutting guide. Similar in fabrication to the rails **16** discussed above, the protrusions can be formed on general surface **15** of cutting block **12** by casting the cutting block as a single piece or by attaching preformed, lens-shaped objects having the desired dimensions to the general surface **15** by any means well-known in the art. Alternatively, substantially spherical objects **24**, such as ball bearings and the like, can be captured within tracks **26** on the reference surface **15**.

In the preferred embodiment of this aspect of the invention, a plurality of substantially spherical objects **24** are captured within the adjacent tracks. The objects **24** may be free to move within the tracks **26**, or more preferably are arrayed adjacent to one another in fixed position. The objects **24** are captured so that a portion of each object protrudes a substantially equal distance above the cutting reference surface, such that the apices together will define a single plane that is substantially parallel to the general surface **15**. This plane constitutes the cutting reference surface of cutting guide **12** across which the surgical saw blade or similar instrument may pass. As before, it may be preferable in some instances to elevate spherical objects **24** captured in the two outer tracks **26** relative to the spherical objects **24** captured within the central track **26** in order that objects **24** in the outer tracks **26** define a plane substantially parallel to general surface **15**, similar to a similar configuration describe for the rails **16** immediately above.

Composition. According to another aspect of the invention, the cutting reference surface **14** is comprised of a material or materials designed both to reduce friction between the cutting surface and a surgical saw blade and, more importantly, to reduce the introduction and deposition of toxic materials to the patient at the surgical site.

Although the composition of the cutting reference surface can be of almost any durable, hard material that is not easily fractured, such as stainless surgical steel, cutting reference surface **14** is preferably comprised of a material having a high degree of harness coupled with low chrome and nickel content. Satisfactory parameters for such a material include Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of from 0% up to 10% and a nickel content of from 0% up to 4%. A preferred material would have a Knoop harness of 800 or greater (under a 500 gm load or greater), a chrome content of from 0% to 8% and a nickel content of from 0% to 3%. A most preferred material would have a Knoop hardness of 1000 or greater (under a 500 gm load or greater), a chrome content of from 0% to 6% and a nickel content of from 0% to 2% or less.

It will be appreciated that cutting guide **12** can itself be entirely composed of one of the desired materials discussed above and can be laminated or otherwise affixed at desired positions an angles on a core unit that may or may not have the Knoop hardness and alloy characteristics of the cutting guide material. Alternatively, such cutting surface may be achieved by directly depositing a material having these characteristics on a preformed cutting guide surface having a desired configuration, so long as the thickness of the material deposited is sufficiently thick to perform under normal surgical conditions. Of course, it will also be apparent to one skilled in the art that the entire block may be fabricated out of a composition having the desired hardness and chemical composition outlined above, provided that doing so is time and cost effective. Further it will be clear that it would also be satisfactory to fabricate the rails **16**, rods **18**, protrusions **22** and objects **24** from a material having the desired hardness and alloy characteristics outlined above and couple these to a cutting block **10** comprised of a suitable, but less expensive and more easily worked material such as surgical steel or alumina, in as much as portions of the rails **16**, rods **18**, protrusions **22** and objects **24** will define the cutting reference surface **14** of cutting guide **12**. Further, it is entirely suitable to fabricate the rails, rods, protrusions and objects from surgical steel or a like material.

Suitable materials having the desired hardness and alloy characteristics include ceramics such as zirconia, aluminas; certain borides such as titanium diaboride and boron carbide; nitrogen-hardened titanium and similar materials. Such materials are known in the art and can be readily obtained, for example, from Coors Ceramic Company (Golden, Colorado). Although any of the materials just listed have the desired characteristics for cutting surface material as described above, ceramics like zirconia with very high Knoop hardness, high fracture toughness and low thermal conductivity are preferred. Such compounds are additionally advantageous because they have particularly low coefficients of friction when used with standard metallic cutting blades, thus reducing heat generation, and are essentially nickel and chrome-free.

II. DUAL CUTTING BLOCK SYSTEM

According to another aspect of the invention, the dual cutting block system for shaping a femur for receipt of a knee prosthesis will now be described, with references to FIGS. 5-8.

The system of the present invention comprises the use of two stationary cutting blocks, each designed to make a standard cut (posterior or anterior) in a plane more or less parallel to the anatomical axis of the femur, and a chamfer cut opposite the position of the standard cut in a plane at an acute angle to the anatomical axis of the femur. The blocks also differ in the configuration of means of attachment to the distal or knee-end of the femur. One block of the dual block system is adapted to be received over the planar surface of the distal femoral cut, which is more or less perpendicular to the anatomical axis of the femur and is the first cut made when a femur is being shaped for receipt of a femoral component of a knee prosthesis. Because the first block in the system is used to make a chamfer cut and the opposing posterior or anterior cut, the distal end of the femur is converted from a planar to an angled surface having two distinct planes, one the result of the original distal femoral cut and the other created by the chamfer cut made using the first cutting block. For this reason, the attachment means of the second cutting block in each system must be angled in order to be snugly received over the end of the femur.

From the foregoing, it will be apparent that two cutting block systems, comprising four distinctly configured cutting blocks are possible. A first cutting block system **28**, shown in FIG. 7A-B, is provided with a first cutting block **30** and a second cutting block **38**. First cutting block **30** is provided with an anterior cutting guide **32**, a posterior chamfer cutting guide **34**, and an attachment means **35**, which further comprises a planar attachment surface **36** and attachment pins **37** and **37'**. Second cutting block **38** is provided with a posterior cutting guide **40**, an anterior chamfer cutting guide **42** and an attachment means **43**, which further comprises a biplanar, angled attachment surface **44** and attachment pins **45**.

A second cutting block system **46**, as shown in FIG. 5, 6 & 7C-7D, comprises a first cutting block **48** and a second cutting block **56**. First cutting block **48** is provided with a posterior cutting guide **50**, an anterior chamfer cutting guide **52**, and an attachment means **53**, which further comprises a uniplanar attachment surface **54** and attachment pins

55 and **55'**. Second cutting block **56** is provided with an anterior cutting guide **58**, a posterior chamfer cutting guide **60** and an attachment means **61**, which further comprises an angled, biplanar attachment surface **62** and attachment pins **63**.

In as much as each cutting block system is a mirror image of the other, incorporating the same features and advantages, it will be appreciated that further discussion of the details of the second cutting block system **46** will apply equally to first cutting block system **28**. In one embodiment of the cutting block system described herein, each of the cutting guides **40**, **42**, **50** and **52** can be provided with a reference cutting surface having any of the configurational or compositional characteristics described in Section I above. Thus, the cutting may be nothing more than the substantially planar side of cutting block itself, as shown in FIG. 5A, or it may be formed on an insert (or lamination) **64**, as shown in FIG. 5B. Preferentially, however, the configuration of the reference cutting surface will be defined by the presence of two or more rails **16**, created either by molded raised portions of the cutting block or by captured rods **18**, as shown in FIGS. 6A-6B. In the most desired embodiment of the system, the reference cutting surface is defined by three substantially linear rods which are captured within the cutting block, each having an exposed curved portion equivalent in extent and elevation to each other rod. The summit or ridge of each rod collectively defines a reference cutting surface for the cutting guide of the cutting block. Such a configuration is preferentially employed in each of the type of cutting guide present in each cutting block of the two cutting block systems.

With regard to the composition of the body of the cutting blocks, it is preferred to use surgical grade steel, although any hard, durable, erosion-resistent, non-toxic composition would be acceptable, including the compositions discussed above that are preferred for that portion of the cutting guide that defines the reference cutting surface. With regard to the cutting guides themselves, and in particular the cutting reference surfaces, it is highly preferred to use compositions having a high Knoop hardness and very low or non-existent levels of chrome and nickel, such as ceramics as is discussed in greater detail in Section I above.

It will of course be apparent that the two cutting block systems described above employ cutting blocks having free or open cutting guides. According to another embodiment of the invention, the cutting blocks of these systems can be configured with captured cutting guides in which the cutting guide takes the form of a through channel and the reference cutting surface is defined on of the interior surfaces of the through channel.

Although cutting blocks with cutting guides positioned on one or more outside faces of the cutting block are suitable for virtually all types of bone surgery, saw-captive blocks are preferred by some surgeons. Thus, according to another embodiment of the invention, the cutting blocks described immediately above can be configured with saw-captive cutting guides in which the cutting guide takes the form of a through channel and the reference cutting surface is defined on one or both of the broad interior surfaces of the through channel. Such saw-captive guides can be also be configured to provide open channels extending laterally from each end of the cutting block.

Saw-captive embodiments of the cutting blocks of the invention are depicted in FIG. 8 and will now be described. A first saw-captive cutting block system **66**, shown in FIG. 8A-8B is provided with a first cutting block **68** and a second cutting block **80**. First cutting block **68** is provided with an anterior cutting guide **72** in a first through channel **73**, a posterior chamfer cutting guide **74** in a second through channel **75**, and an attachment means **76**, which further comprises a planar attachment surface **77** and attachment pins **78** and **78'**. Second cutting block **80** is provided with a posterior cutting guide **82** in a first through channel **83**, an anterior chamfer cutting guide **84** in a second through channel **85**, and an attachment means **86**, which further comprises a biplanar, angled attachment surface **87** and attachment pins **88**.

A second cutting block system **90**, as shown in FIGS. 8C-8D, comprises a first cutting block **92** and a second cutting block **106**. First cutting block **92** is provided with a posterior cutting guide **94** in a first through channel **96**, an anterior chamfer cutting guide **98** in a second through channel **100**, and an attachment means **102**, which further comprises a uniplanar attachment surface **104** and attachment pins **105**. Second cutting block **106** is provided with an anterior cutting guide **108** in a through channel **110**, a posterior chamfer cutting guide **112** in a second through channel **114**, and an attachment means **116**, which further comprises an angled, biplanar attachment surface **117** and attachment pins **118**. It will be appreciated that the discussion of configuration and composition of the cutting blocks, cutting guides and reference cutting surfaces set forth above will be the same for the saw-captive cutting block systems just described.

According to yet another embodiment of the invention, and as illustrated in FIG. 9, an adaptor **100** is provided for use with the cutting blocks and cutting block systems just described. The adaptor **100** is comprised of a plate **102**, placement prongs **104** and **104'**, and an alignment prong **106**. The adaptor **100** is configured to be received over the planar distal femoral cut of a femur or similar cut on some other bone. Adaptor **100** is received over the distal femoral cut by receipt of the placement prongs within drill holes that would otherwise receive the placement prongs of various cutting blocks. Once in place, adaptor **100** is used as the coupling for attaching various instruments, including the cutting blocks and cutting block systems of the present invention, as shown in FIG. 9B. Adaptor **100** can be comprised on any strong, durable, non-rusting product such as plastic or various metals alloys, although surgical steel is preferred.

Turning now to FIG. 10, a sizing plate **110** will now be described. Because all bones, including femurs, vary in size and morphology, it is necessary to configure cutting blocks and similar instruments in a variety of sizes, so that the cutting planes of the cutting block can be matched to the bone shape and size. Proper sizing is important because too shallow a cut will result in poor fit of the prosthesis and too deep a cut will expose the femoral cortex, decreasing the stability of the femur and longevity of the prosthetic implant. Thus, according to one aspect of the invention, a cutting block sizing plate **110** is provided. Sizing plate **110** is comprised of a substantially planar block member **112** in which are arrayed a series of through channels **114**. Block member **112** may also be provided with a slot **116** that is configured to allow the sizing plate to be snugly fitted over adaptor **100**. Sizing plate **110** may be comprised of any suitable material that is both strong and durable, such as metal alloys and some plastic polymers, however, surgical steel is preferred because of it is both strong and inexpensive.

In operation, the through channels **114** of sizing plate **110** are aligned at an angle to simulate the angle of a particular cutting guide in a cutting block. The channels **114** are configured to receive a drill bit of a desired length, which is extended through the channels and into the bone. The drill bit is extended through the channel and into the femur. If the bit does not emerge from the femur, then the cut is too deep and a larger cutting block is chosen. If the drill bit passes through air before entering the femur then the cut is too shallow and a smaller block must be chosen.

III. METHODS OF USE

According to another aspect of the invention, a method of resectioning the distal or knee-end of a femur for receipt of the femoral component of a knee prosthesis is described using the second cutting block system **46** and unique reference cutting surfaces of the invention described above in Sections I and II.

Resection of a patient's knee begins with the surgical opening of the knee and exposure of the distal end of the femur. Although this procedure is well known to knee surgeons and other skilled in the art, a standard medial parapatellar arthrotomy is made and anterior skin incision at the knee to expose the patella. After the patella is exposed, it is everted and the knee flexed for the remainder of the operation.

With the knee opened and flexed, the intramedullary channel of the femur is identified so that an initial distal femoral cut can be made to produce a flat surface across the top of the femur that occupies a plane substantially perpendicular to the intramedullary channel. Once this cut has been made, the location pins of first cutting block **48** are hammered into the flat surface at the distal end of the femur created by the distal femoral cut in an orientation to secure removal of a posterior section of the femur. The pins **55** of attachment means **53** secure the block to femur and help to prevent the block from torquing out of proper alignment. Once in place, a section of the posterior lateral portion of the femur is removed using a powered hand or similar device, using the posterior cutting guide **50** as a reference. The resulting cut produces a planar surface on the posterior side of the distal end of the femur that occupies a plane substantially perpendicular the intramedullary channel of the femur. Following the posterior cut, resection of an anterior portion of the femur is accomplished with a powered surgical saw using the anterior chamfer cutting guide **52** as a reference. The resulting cut produces a planar surface on the anterior side of the femur that intersects the surface created by the initial distal femoral cut at an acute angle, generally of substantially 45°.

Following the two cuts described above, the first cutting block **48** is removed and the second cutting block **56** is affixed. The contour of the attachment surface **62** of the second cutting block is biplanar and angled to compliment precisely and snugly receive the angled surface created on the end of the femur using the first cutting block **48**. After affixation, a first cut is made using the anterior cutting guide **58** to remove much of the anterior condyles and form a flat surface more or less parallel to the surface created using the posterior cutting guide **50** of the first cutting block. The final resection of the femur is accomplished using the posterior chamfer cutting guide **60** to remove a small portion of bone at the end of the original posterior cut, thereby creating five distinct and sequentially intersecting surfaces of the distal end of the femur. Once finished, these cut and prepared surfaces compliment the angled interior surface of the femoral component of a knee prosthesis, allowing the prosthesis to be closely fitted over the femur with substantially complete contact between the bone of the femur and the inner angled surfaces of the implant.

From the foregoing, it will be appreciated how the objects and features of the invention are met. The hardness of the cutting guide surface helps to maintain an even cutting reference surface that is not liable to fret. The preferred materials are also low in toxic metal ions which my be shed in residue during surgery. Further, the hardness of the material, particularly ceramics such as zirconia, ensure that fretting is minimized which reduces friction and thus heat generation during operation and reduces sludge production that can be shed during the operation in the treatment area.

Although the invention has been described with respect to a particular surgical cutting block and method for its use, it will be appreciated that various modifications of the apparatus and method are possible without departing from the invention, which is defined by the claims set forth below.

We claim:

1. A surgical cutting block for creating both a posterior cut and an anterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block comprising:

a) means for coupling said cutting block over a pre-formed, planar surface created by a distal femoral cut,

b) a posterior cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur; and

c) an anterior chamfer cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur.

2. The cutting block of claim 1 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

3. The cutting block of claim 2 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

4. The cutting block of claim 1 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

5. The cutting block of claim 4 wherein the material is selected from the group consisting of zirconia and alumina.

6. The cutting block of claim 5 wherein the material is zirconia.

7. The cutting block of claim 1 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

8. The cutting block of claim 7 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

9. The cutting block of claim 7 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

10. The cutting block of claim 9 wherein the material is selected from the group consisting of zirconia and alumina.

11. The cutting block of claim 10 wherein the material is zirconia.

12. The cutting block of claim 1 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting

guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

13. The cutting block of claim 12 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and nickel content of 0-4 per cent.

14. The cutting block of claim 13 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

15. The cutting block of claim 14 wherein the material is selected from the group consisting of zirconia and alumina.

16. The cutting block of claim 15 wherein the material is zirconia.

17. A surgical cutting block for creating both an anterior cut and a posterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block comprising:

a) means for coupling said cutting block over an angled surface created by a combination of a distal femoral cut and an anterior chamfer cut on the distal end of the femur,

b) an anterior cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

c) a posterior chamfer cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane at an angle to the long axis of the femur.

18. The cutting block of claim 17 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

19. The cutting block of claim 18 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

20. The cutting block of claim 17 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

21. The cutting block of claim 17 wherein the material is selected from the group consisting of zirconia and alumina.

22. The cutting block of claim 21 wherein the material is zirconia.

23. The cutting block of claim 17 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the

cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

24. The cutting block of claim 23 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

25. The cutting block of claim 23 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

26. The cutting block of claim 23 wherein the material is selected from the group consisting of zirconia and alumina.

27. The cutting block of claim 26 wherein the material is zirconia.

28. The cutting block of claim 17 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

29. The cutting block of claim 28 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent and a nickel content of 0-4 per cent.

30. The cutting block of claim 28 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

31. The cutting block of claim 28 wherein the material is selected from the group consisting of zirconia and alumina.

32. The cutting block of claim 31 wherein the material is zirconia.

33. A surgical cutting block for creating both an anterior cut and a posterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block comprising:

a) means for coupling said cutting block over a pre-formed, planar surface created by a distal femoral cut,

b) an anterior cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

c) a posterior chamfer cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane at an angle to the long axis of the femur.

34. The cutting block of claim 33 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

35. The cutting block of claim 34 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

36. The cutting block of claim 33 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

37. The cutting block of claim 33 wherein the material is selected from the group consisting of zirconia and alumina.

38. The cutting block of claim 37 wherein the material is zirconia.

39. The cutting block of claim 33 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

40. The cutting block of claim 39 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0 - 4 per cent.

41. The cutting block of claim 39 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

42. The cutting block of claim 39 wherein the material is selected from the group consisting of zirconia and alumina.

43. The cutting block of claim 42 wherein the material is zirconia.

44. The cutting block of claim 33 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

45. The cutting block of claim 44 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

46. The cutting block of claim 44 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

47. The cutting block of claim 44 wherein the material is selected from the group consisting of zirconia and alumina.

48. The cutting block of claim 47 wherein the material is zirconia.

49. A surgical cutting block for making creating both a posterior cut and an anterior

chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block comprising:

a) means for coupling said cutting block over a pre-formed, angled surface created by the a combination of a distal femoral cut and a posterior chamfer cut,

b) a posterior cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur; and

c) an anterior chamfer cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur.

50. The cutting block of claim 49 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

51. The cutting block of claim 50 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

52. The cutting block of claim 50 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

53. The cutting block of claim 50 wherein the material is selected from the group consisting of zirconia and alumina.

54. The cutting block of claim 53 wherein the material is zirconia.

55. The cutting block of claim 49 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

56. The cutting block of claim 55 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

57. The cutting block of claim 55 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

58. The cutting block of claim 55 wherein the material is selected from the group consisting of zirconia and alumina.

59. The cutting block of claim 58 wherein the material is zirconia.

60. The cutting block of claim 49 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting

guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

61. The cutting block of claim 60 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

62. The cutting block of claim 60 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

63. The cutting block of claim 60 wherein the material is selected from the group consisting of zirconia and alumina.

64. The cutting block of claim 63 wherein the material is zirconia.

65. A cutting block system for use with a surgical saw blade in cutting and shaping a femur to receive a knee prosthesis, the femur having a distal end at a knee joint and a long axis substantially defined by the intramedullary channel component, said cutting block system comprising:

a) a first cutting block provided with:

i) means for coupling said first cutting block over a pre-formed, planar surface created by a distal femoral cut,

ii) a posterior cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) an anterior chamfer cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur; and

b) a second cutting block provided with:

i) means for coupling said second cutting block means over a pre-formed angled surface created by a combination of a distal femoral cut and an anterior chamfer cut on the distal end of the femur,

ii) an anterior cutting guide means for guiding the surgical saw blade in the removal of an anterior portion of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) a posterior chamfer cutting guide means for guiding the surgical saw blade in the removal of a posterior portion of the distal end of the femur in a plane at an angle to the long axis of the femur.

66. The cutting block of claim 65 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a planar cutting reference surface.

67. The cutting block of claim 66 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

68. The cutting block of claim 65 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

69. The cutting block of claim 65 wherein the material is selected from the group consisting of zirconia and alumina.

70. The cutting block of claim 69 wherein the material is zirconia.

71. The cutting block of claim 65 wherein each of the cutting guide means and the chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form a cutting reference surface.

72. The cutting block of claim 71 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

73. The cutting block of claim 71 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

74. The cutting block of claim 71 wherein the material is selected from the group consisting of zirconia and alumina.

75. The cutting block of claim 74 wherein the material is zirconia.

76. The cutting block of claim 65 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

77. The cutting block of claim 76 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

78. The cutting block of claim 76 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

79. The cutting block of claim 76 wherein the material is selected from the group consisting of zirconia and alumina.

80. The cutting block of claim 79 wherein the material is zirconia.

81. A cutting block system for use with a surgical saw blade in cutting and shaping a femur to

receive a knee prosthesis, the femur having a distal end at a knee joint and a long axis substantially defined by the intramedullary channel component, said cutting block system comprising:

a) a first cutting block provided with:

i) means for coupling said first cutting block over a pre-formed, planar surface created by a distal femoral cut,

ii) an anterior cutting guide means for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) a posterior chamfer cutting guide means for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur; and

b) a second cutting block provided with:

i) means for coupling said second cutting block over an angled surface created by a combination of a distal femoral cut and a posterior chamfer cut on the distal end of the femur,

ii) a posterior cutting guide means for guiding the surgical saw blade in the removal of a posterior portion of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) an anterior chamfer cutting guide means for guiding the surgical saw blade in the removal of an anterior portion of the distal end of the femur in a plane at an angle to the long axis of the femur.

82. The cutting block of claim 81 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a planar cutting reference surface.

83. The cutting block of claim 82 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

84. The cutting block of claim 82 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

85. The cutting block of claim 82 wherein the material is selected from the group consisting of zirconia and alumina.

86. The cutting block of claim 85 wherein the material is zirconia.

87. The cutting block of claim 81 wherein each of the cutting guide means and the chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form a cutting reference surface.

88. The cutting block of claim 87 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

89. The cutting block of claim 87 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

90. The cutting block of claim 87 wherein the material is selected from the group consisting of zirconia and alumina.

91. The cutting block of claim 90 wherein the material is zirconia.

92. The cutting block of claim 81 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

93. The cutting block of claim 92 wherein the cutting guide is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

94. The cutting block of claim 92 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium and borides.

95. The cutting block of claim 92 wherein the material is selected from the group consisting of zirconia and alumina.

96. The cutting block of claim 95 wherein the material is zirconia.

97. A surgical cutting block for making creating both a posterior cut and an anterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block provided with a first through channel and a second through channel and further comprising:

a) means for coupling said cutting block over a pre-formed, planar surface created by a distal femoral cut,

b) a posterior cutting guide means within said first channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur; and

c) an anterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur.

98. The cutting block of claim 97 wherein the posterior cutting guide means and the anterior

chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

99. The cutting block of claim 98 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

100. The cutting block of claim 97 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

101. The cutting block of claim 97 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

102. A surgical cutting block for making creating both an anterior cut and a posterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block provided with a first through channel and a second through channel and further comprising:

a) means for coupling said cutting block over an angled surface created by a combination of a distal femoral cut and an anterior chamfer cut on the distal end of the femur,

b) an anterior cutting guide means within said first through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

c) a posterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane at an angle to the long axis of the femur.

103. The cutting block of claim 102 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

104. The cutting block of claim 103 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

105. The cutting block of claim 102 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

106. The cutting block of claim 102 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

107. A surgical cutting block for creating both an anterior cut and a posterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block provided with a first through channel and a second through channel and further comprising:

a) means for coupling said cutting block over a pre-formed, planar surface created by a distal femoral cut,

b) an anterior cutting guide means within said first through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

c) a posterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane at an angle to the long axis of the femur.

108. The cutting block of claim 107 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

109. The cutting block of claim 108 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

110. The cutting block of claim 107 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

111. The cutting block of claim 107 wherein the anterior cutting guide means and the posterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

112. A surgical cutting block for making creating both a posterior cut and an anterior chamfer cut to a distal end of a femur at a knee joint, the cuts configured for receipt of a knee prosthesis component, said cutting block provided with a first through channel and a second through channel and further comprising:

a) means for coupling said cutting block over a pre-formed, angled surface created by the a combination of a distal femoral cut and a posterior chamfer cut,

b) a posterior cutting guide means within said first through channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur; and

c) an anterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur.

113. The cutting block of claim 112 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having a planar cutting reference surface.

114. The cutting block of claim 113 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

115. The cutting block of claim 112 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form cutting reference surface.

116. The cutting block of claim 112 wherein the posterior cutting guide means and the anterior chamfer cutting guide means each comprises a cutting guide having a plurality of substantially spherical

objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

117. A cutting block system for use with a surgical saw blade in cutting and shaping a femur to receive a knee prosthesis, the femur having a distal end at a knee joint and a long axis substantially defined by the intramedullary channel component, said cutting block system comprising:

a) a first cutting block provided with a first through channel and a second through channel, said first cutting block provided with:

i) means for coupling said first cutting block over a pre-formed, planar surface created by a distal femoral cut,

ii) a posterior cutting guide means within said first through channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) an anterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur; and

b) a second cutting block provided with a third through channel and a fourth through channel, said second cutting block provided with:

i) means for coupling said second cutting block means over a pre-formed angled surface created by a combination of a distal femoral cut and an anterior chamfer cut on the distal end of the femur,

ii) an anterior cutting guide means within said third through channel for guiding the surgical saw blade in the removal of an anterior portion of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) a posterior chamfer cutting guide means within said fourth through channel for guiding the surgical saw blade in the removal of a posterior portion of the distal end of the femur in a plane at an angle to the long axis of the femur.

118. The cutting block of claim 117 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a planar cutting reference surface.

119. The cutting block of claim 118 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

120. The cutting block of claim 117 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having

two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form a cutting reference surface.

121. The cutting block of claim 117 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

122. A cutting block system for use with a surgical saw blade in cutting and shaping a femur to receive a knee prosthesis, the femur having a distal end at a knee joint and a long axis substantially defined by the intramedullary channel component, said cutting block system comprising:

a) a first cutting block provided with a first through channel and a second through channel, said cutting block provided with:

i) means for coupling said first cutting block over a pre-formed, planar surface created by a distal femoral cut,

ii) an anterior cutting guide means within said first through channel for guiding the surgical saw blade in the removal of an anterior section of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) a posterior chamfer cutting guide means within said second through channel for guiding the surgical saw blade in the removal of a posterior section of the distal end of the femur in a plane lying at an angle to the long axis of the femur; and

b) a second cutting block provided with a third through channel and a fourth through channel, said second cutting block provided with:

i) means for coupling said second cutting block over an angled surface created by a combination of a distal femoral cut and a posterior chamfer cut on the distal end of the femur,

ii) a posterior cutting guide means within said third through channel for guiding the surgical saw blade in the removal of a posterior portion of the distal end of the femur in a plane substantially parallel to the long axis of the femur, and

iii) an anterior chamfer cutting guide means within said fourth through channel for guiding the surgical saw blade in the removal of an anterior portion of the distal end of the femur in a plane at an angle to the long axis of the femur.

123. The cutting block of claim 122 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a planar cutting reference surface.

124. The cutting block of claim 123 wherein the cutting reference surface is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

125. The cutting block of claim 122 wherein each of the cutting guide means and the chamfer cutting guide means each comprises a cutting guide having two or more rods partially captured within two or more tracks formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form a cutting reference surface.

126. The cutting block of claim 122 wherein each of the cutting guide means and the chamfer cutting guide means comprises a cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

127. A surgical cutting block comprising at least one cutting guide, said cutting guide provided with a cutting reference surface having ridged friction reduction means for reducing the frictional contact between a surgical blade and the cutting reference surface as the surgical saw blade passes over the cutting reference surface during a bone incision.

128. The surgical cutting guide of claim 127 wherein said ridged friction reduction means comprises two or more convexly curved rails elevated

above the cutting guide, said convexly curved rails defining the cutting reference surface.

129. The surgical cutting guide of claim 128 wherein the two or more convexly curved rails are comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

130. The surgical cutting block of claim 129 wherein the material is zirconia.

131. A surgical cutting block comprising at least one cutting guide having a through channel, said cutting guide provided within the through channel a cutting reference surface having ridged friction reduction means for reducing the frictional contact between a surgical blade and the cutting reference surface as the surgical saw blade passes over the cutting reference surface during a bone incision.

133. The surgical cutting guide of claim 131 wherein said ridged friction reduction means comprises two or more convexly curved rails elevated above the cutting guide, said convexly curved rails defining the cutting reference surface.

133. The surgical cutting guide of claim 132 wherein the two or more convexly curved rails are comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

134. The surgical cutting block of claim 133 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium, and borides.

135. The surgical cutting block of claim 134 wherein the material is zirconia.

136. A surgical cutting block comprising at least one cutting guide, said cutting guide having two or more rods, each rod partially captured within a track formed on a surface of the cutting guide, a lengthwise portion of each rod being exposed and elevated above the cutting guide to form a cutting reference surface.

137. The surgical cutting guide of claim 136 wherein the two or more rods are comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

138. The surgical cutting block of claim 137 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium, and borides.

139. The surgical cutting block of claim 138 wherein the material is zirconia.

140. A surgical cutting block comprising at least one cutting guide provided with a through channel, said cutting guide having two or more rods, each rod partially captured within a track formed on a surface of the cutting guide within the through channel, a lengthwise portion of each rod being

exposed and elevated above the cutting guide to form a cutting reference surface.

141. The surgical cutting guide of claim 140 wherein the two or more rods are comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

142. The surgical cutting block of claim 141 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium, and borides.

143. The surgical cutting block of claim 142 wherein the material is zirconia.

144. A surgical cutting block comprising at least one cutting guide, said cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

145. The surgical cutting guide of claim 144 wherein the plurality of spherical objects is comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

146. The surgical cutting block of claim 145 wherein the material is selected from the group

consisting of zirconia, alumina, nitrogen-hardened titanium, and borides.

147. The surgical cutting block of claim 146 wherein the material is zirconia.

148. A surgical cutting block comprising at least one cutting guide provided with a through channel, said cutting guide having a plurality of substantially spherical objects partially captured within two or more tracks formed on a surface of the cutting guide within the through channel, a more or less equal portion of each spherical object being exposed and elevated above the surface of the cutting guide to form a cutting reference surface.

149. The surgical cutting guide of claim 178 wherein the two or more rods are comprised of a material having a Knoop hardness of 466 or greater (under a 500 gm load or greater), a chrome content of 0-10 per cent, and a nickel content of 0-4 per cent.

150. The surgical cutting block of claim 149 wherein the material is selected from the group consisting of zirconia, alumina, nitrogen-hardened titanium, and borides.

151. The surgical cutting block of claim 150 wherein the material is zirconia.

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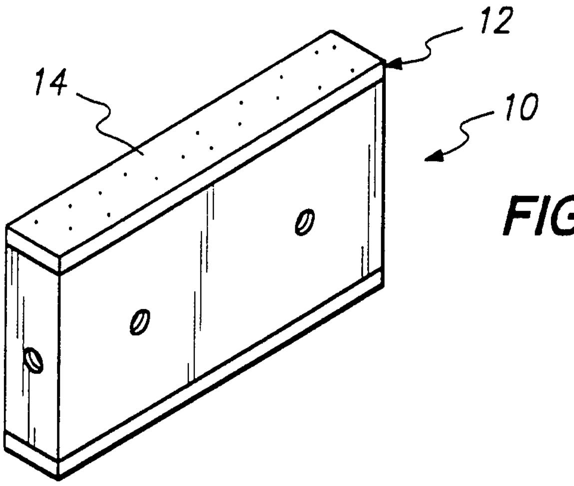

FIG. 1A

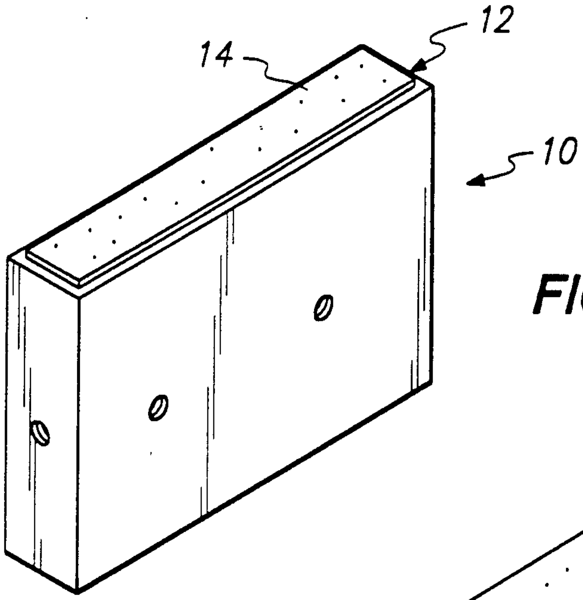

FIG. 1B

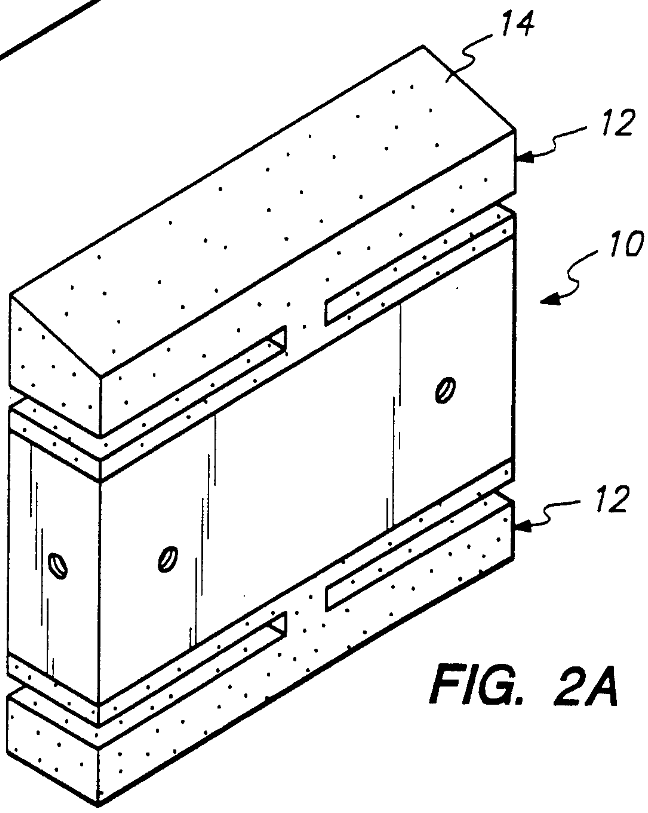

FIG. 2A

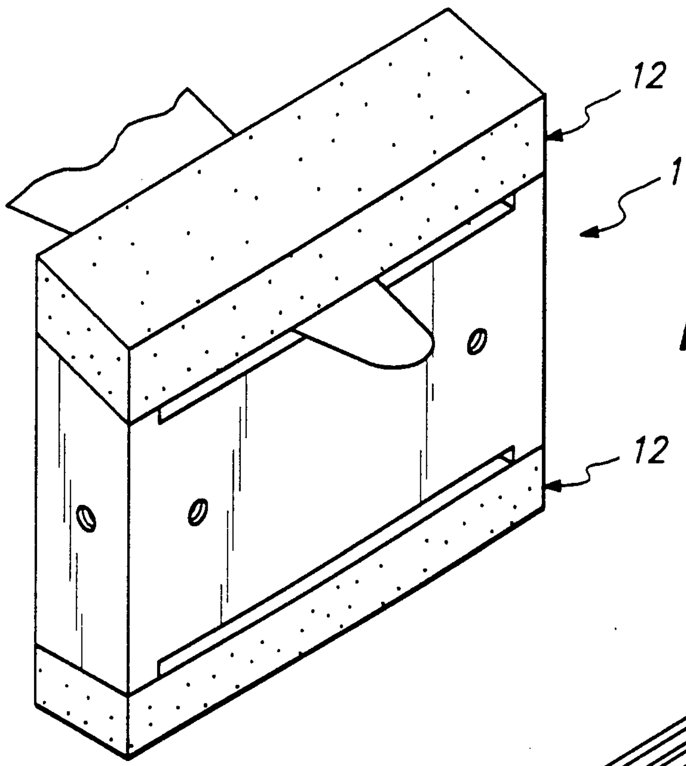

FIG. 2B

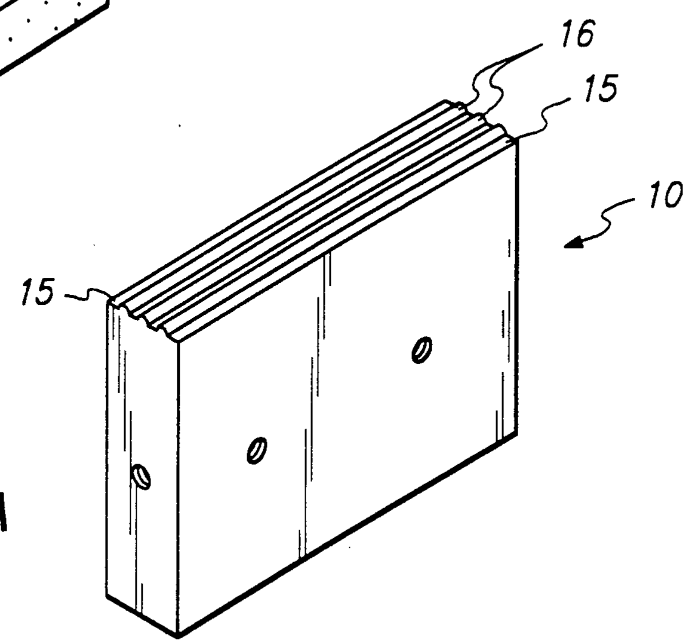

FIG. 3A

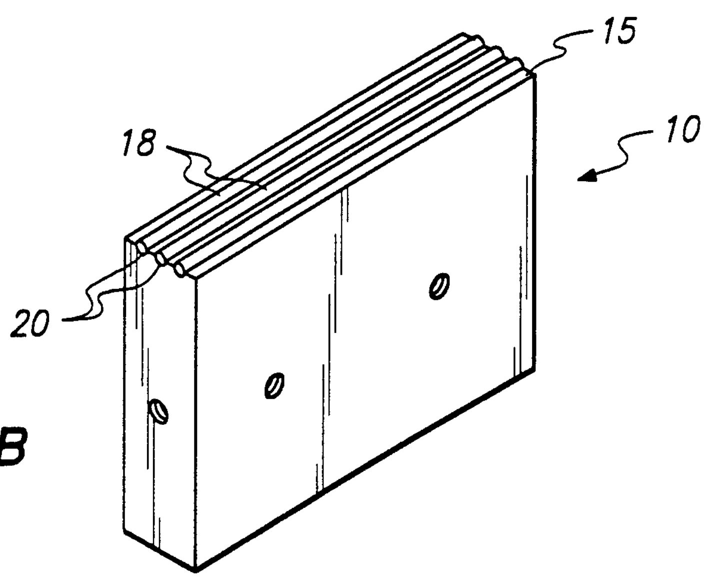

FIG. 3B

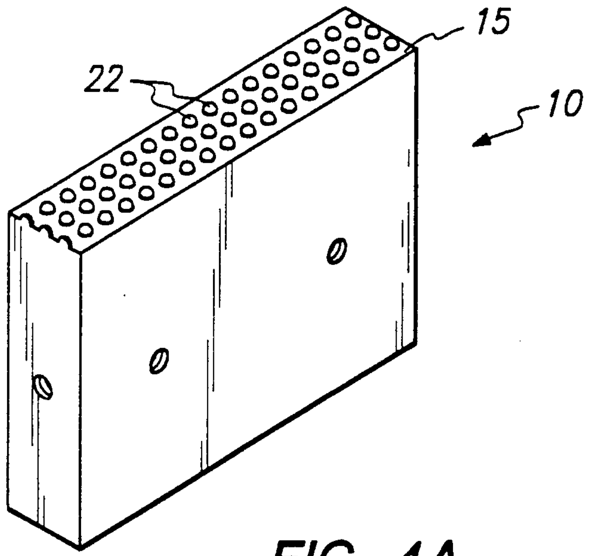

FIG. 4A

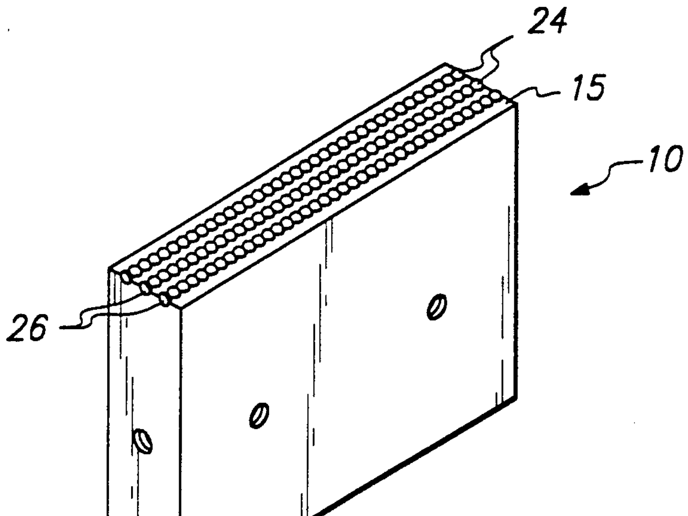

FIG. 4B

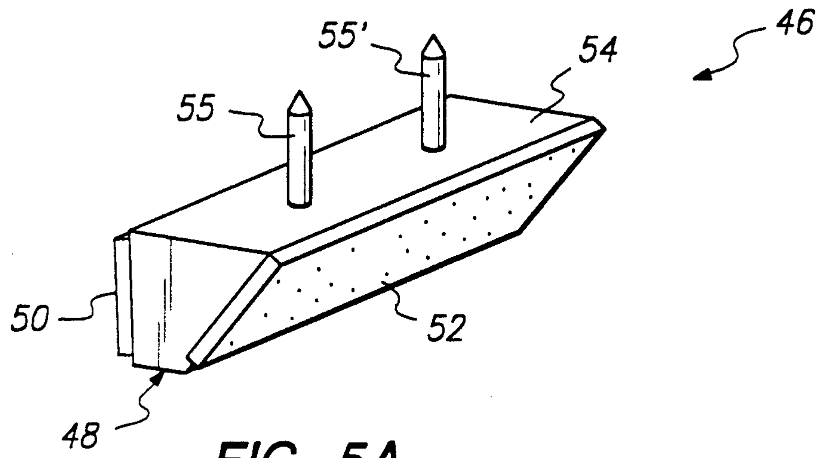

FIG. 5A

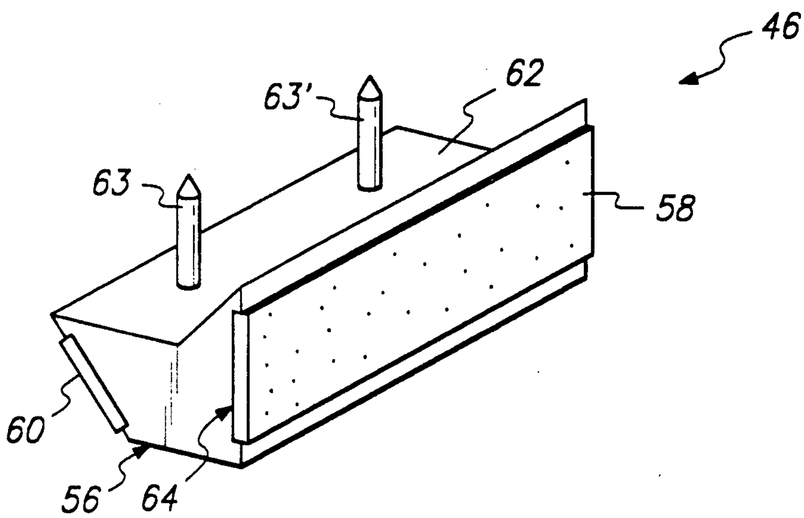

FIG. 5B

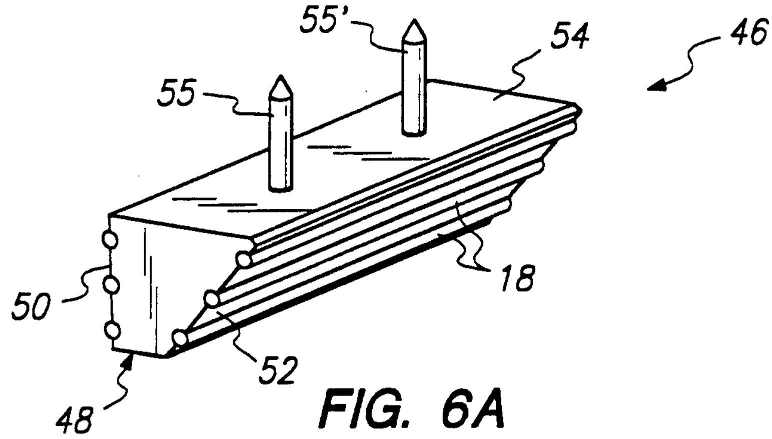

FIG. 6A

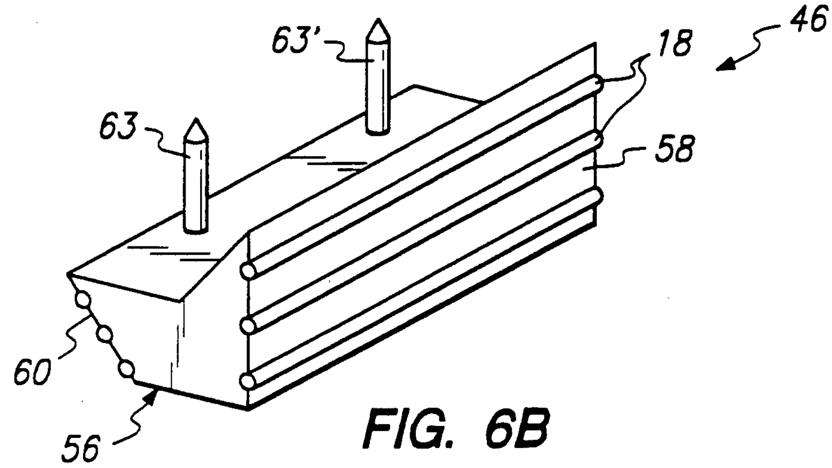

FIG. 6B

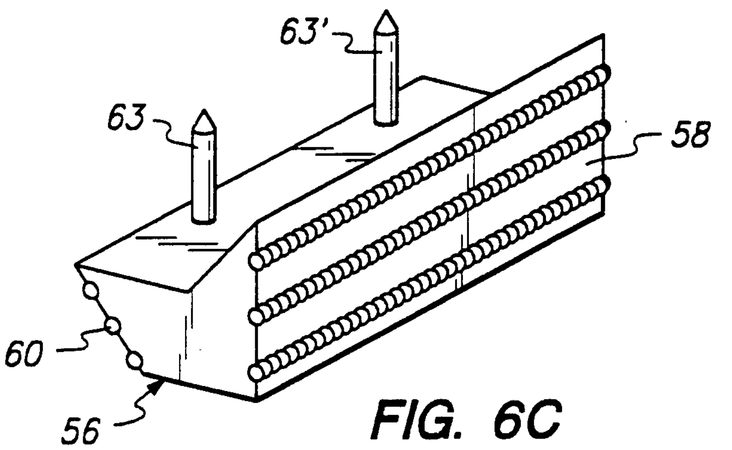

FIG. 6C

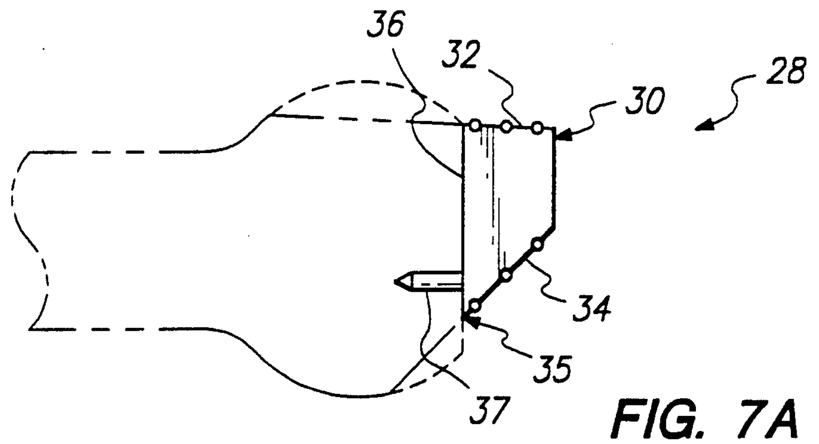

FIG. 7A

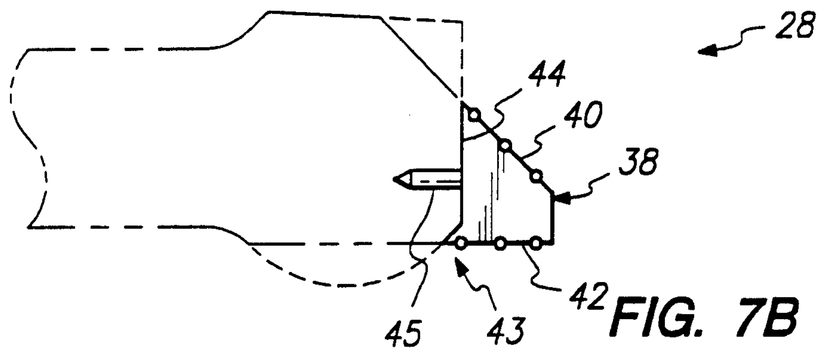

FIG. 7B

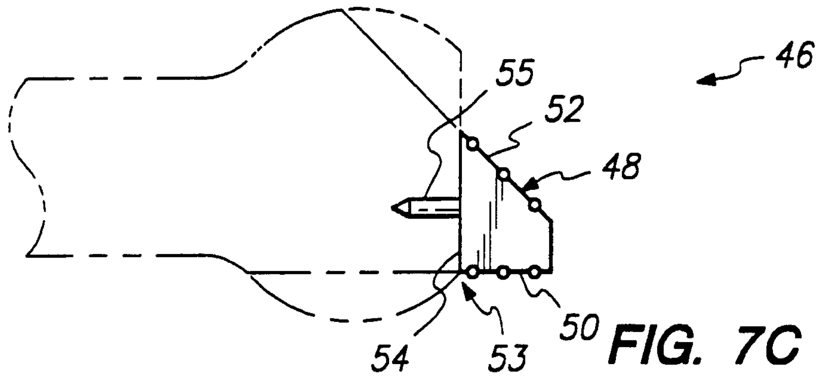

FIG. 7C

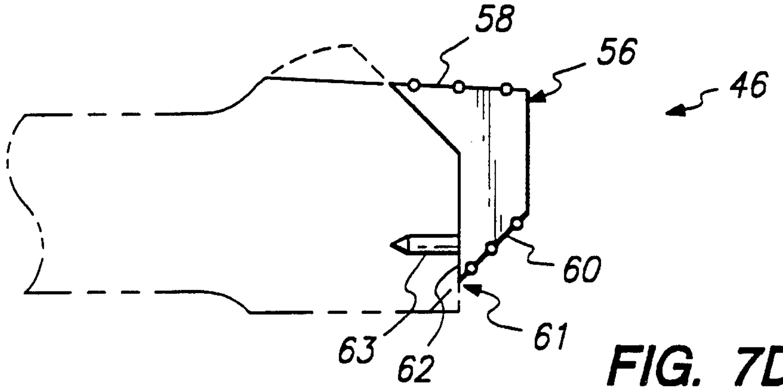

FIG. 7D

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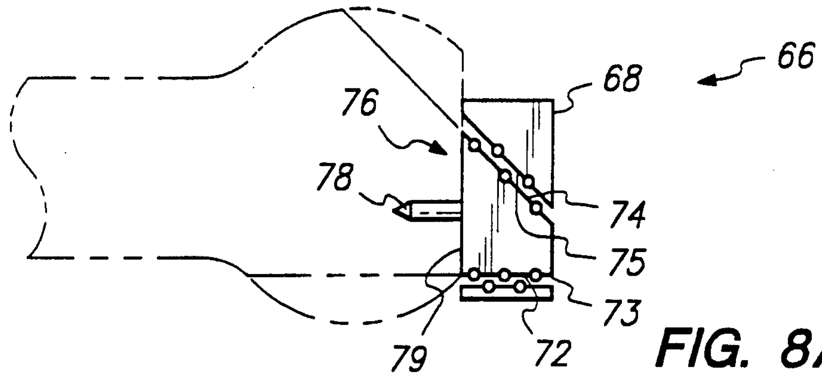

FIG. 8A

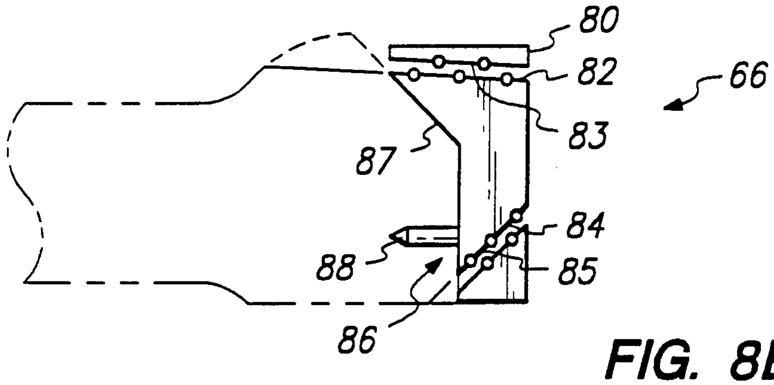

FIG. 8B

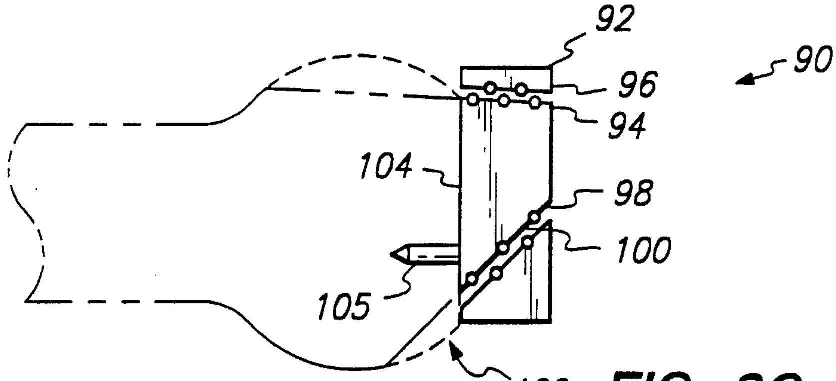

FIG. 8C

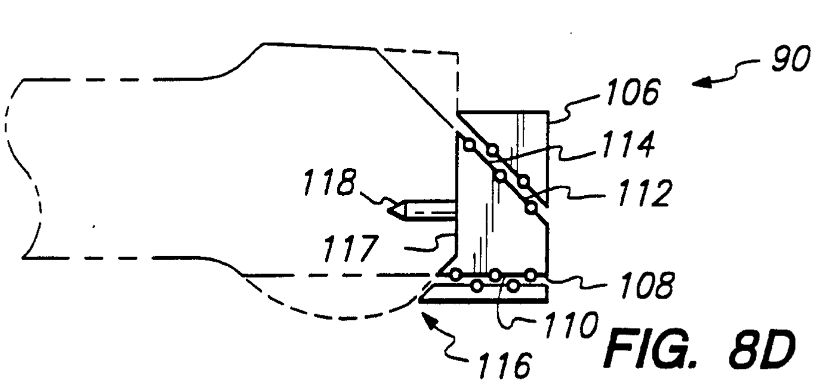

FIG. 8D

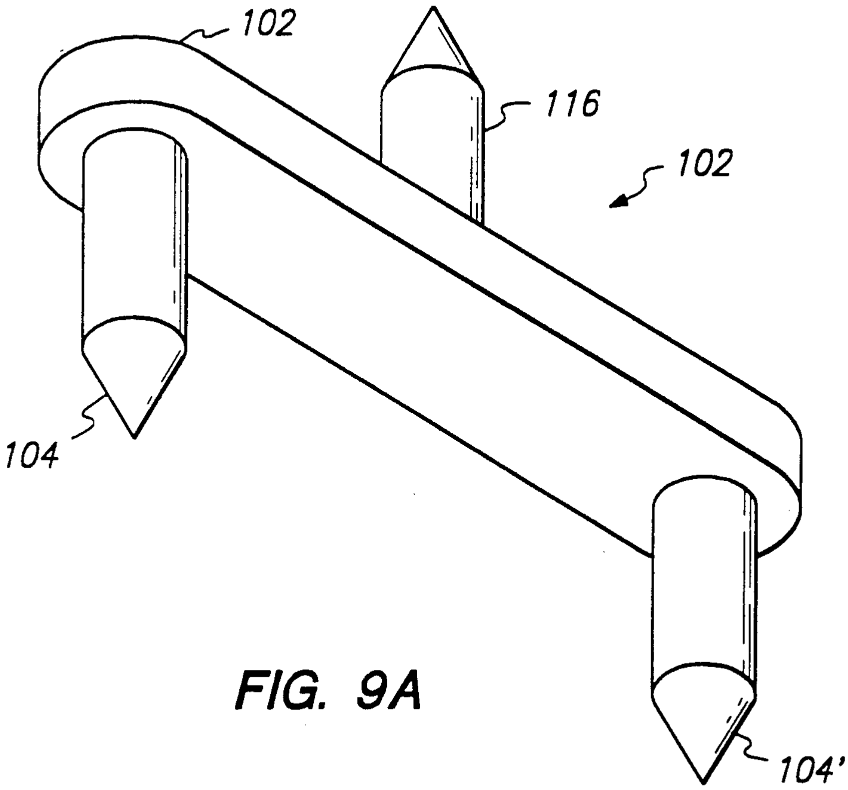

FIG. 9A

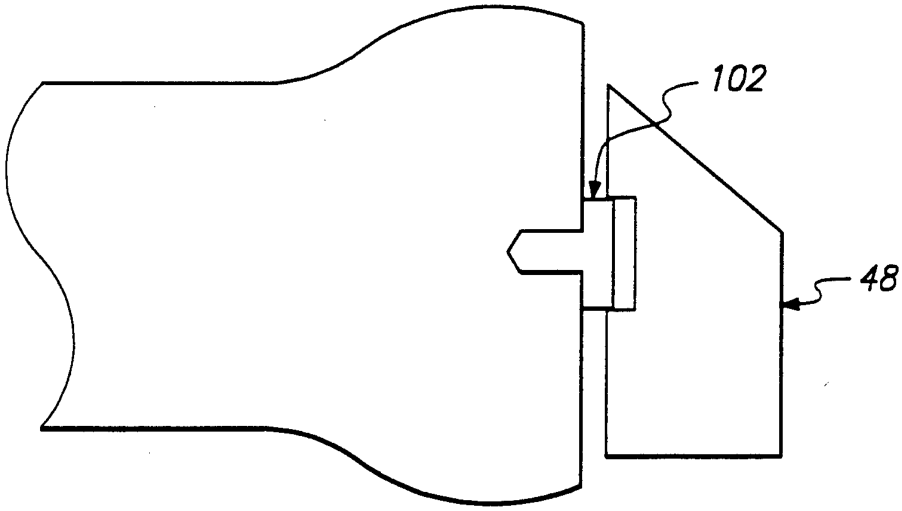

FIG. 9B

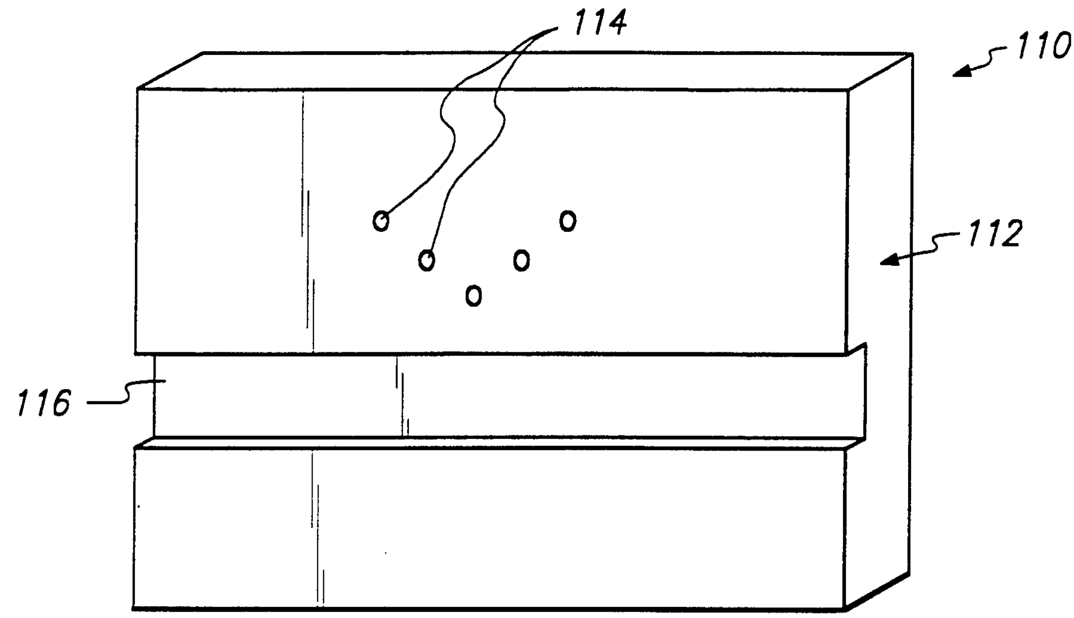

FIG. 10A

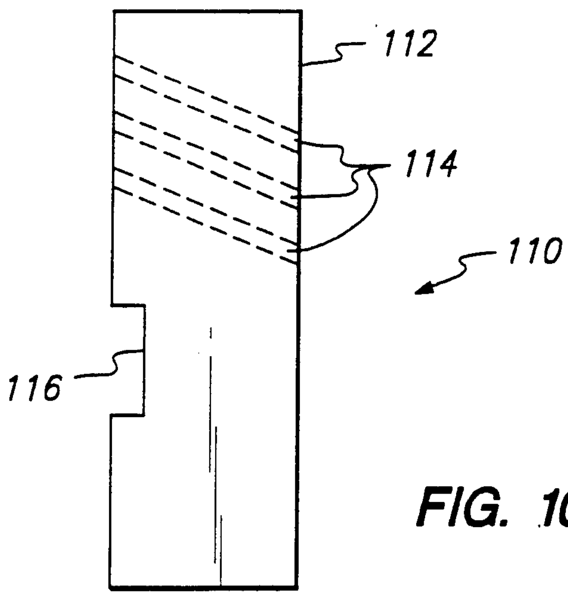

FIG. 10B