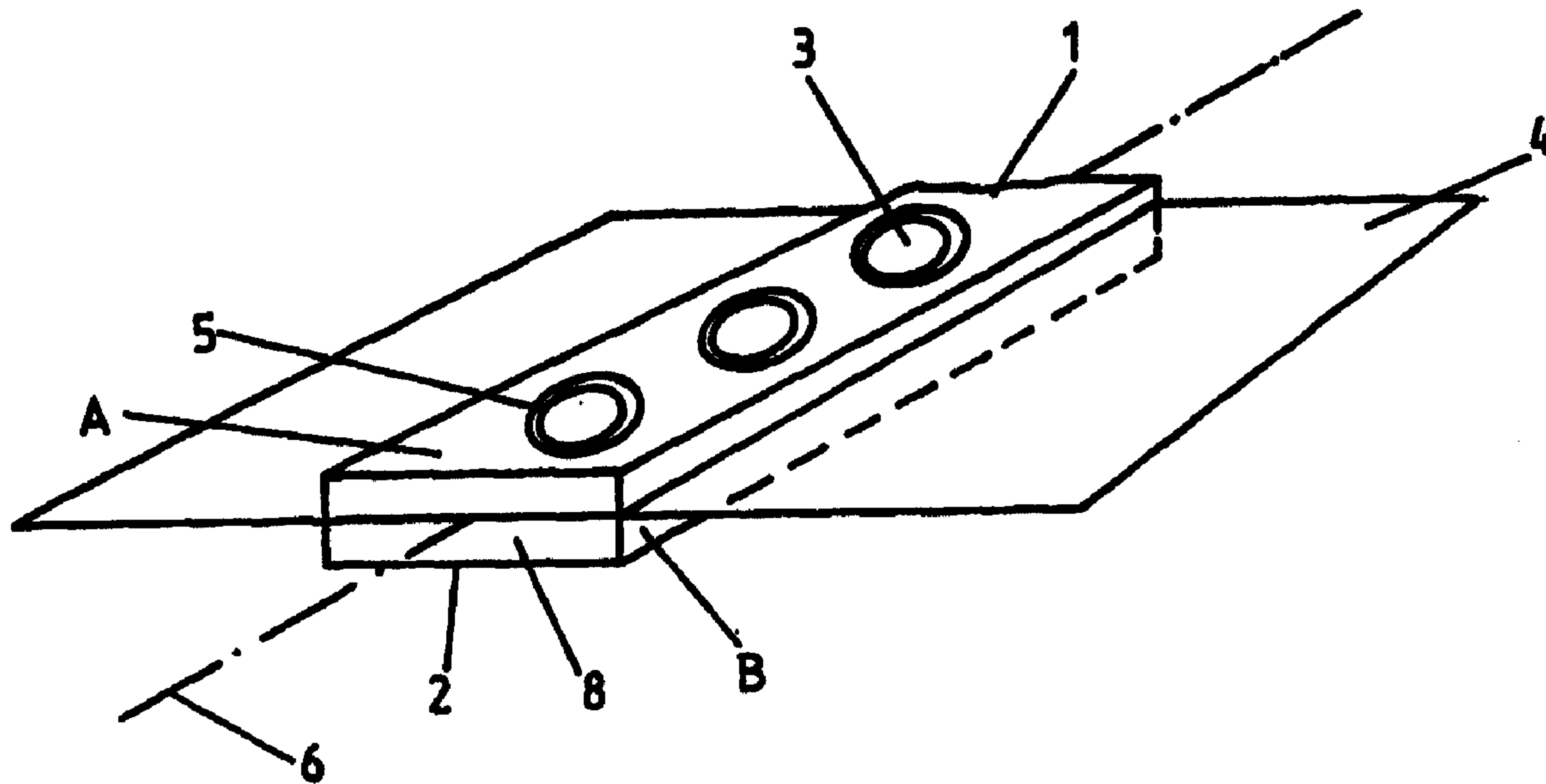




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(57) Abrégé/Abstract:

A bone plate has a longitudinal axis (6), two surfaces (1, 2) and several bores (3) which extend between the two surfaces (1, 2) for receiving bone screws. The bone plate is substantially symmetrical about a middle plane (4) extending between the two surfaces (1, 2). This makes it possible to set the bone plate on and screw it to the bone with its bottom or top side, with identical clinical results.



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<p>(54) Bezeichnung: SYMMETRISCHE KNOCHENPLATTE</p>		
<p>(57) Abstract</p>		
<p>A bone plate has a longitudinal axis (6), two surfaces (1, 2) and several bores (3) which extend between the two surfaces (1, 2) for receiving bone screws. The bone plate is substantially symmetrical about a middle plane (4) extending between the two surfaces (1, 2). This makes it possible to set the bone plate on and screw it to the bone with its bottom or top side, with identical clinical results.</p>		

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SYMMETRICAL BONE PLATE

This invention concerns a bone plate according to the definition of the species of Patent Claim 1.

French Patent No. 2,642,958 A formally discloses a generic bone plate, but the advantages of the symmetrical design were not recognized; the plate described there as the preferred embodiment has a longitudinal curvature and is therefore asymmetrical.

French Patent No. 2,680,673 A also formally discloses a generic bone plate. The bone plate, which is illustrated as symmetrical in the drawings, contradicts the type of use given in the description for the lumbar spine, which would require an anatomical curvature of approximately 158° . Here again, the advantages of the symmetrical design were thus not recognized.

The disadvantages of an asymmetrical design of bone plates include the fact that it is essential for such plates to be screwed to the bone with the proper side facing the bone, i.e., with the bottom side facing the bone, to achieve optimum results. However, clinical experience has shown that especially when working with miniature plates and when in a hurry, the sides can be mixed up, so that bone plates are occasionally

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applied to the bone with the wrong side, i.e., the top side facing the bone.

Another disadvantage of the bone plates known from French Patent No. 2,642,958 A and French Patent No. 2,680,673 A is due to their rectangular profile.

The present invention seeks to remedy this situation. The object of this invention is to create a bone plate which can be attached with either its bottom side or its top side facing the bone with identical clinical results. For special clinical situations, the possibility of attaching the same plate to two

bone fragments with the top side at one end and the bottom side at the other end should also be available. Together with the screws, the plate then forms a "Z" shape. Such an application is of interest when half of the plate is completely compressed in one segment and the other segment is attached to the outside of the corticalis, or in the case of an osteotomy, when a shift by one entire bone width is to be achieved. Thus, the implant serves as an extra-medullary and intra-medullary device (nail + plate).

According to one aspect of the present invention, there is provided a bone plate having a longitudinal axis and comprising first and second surfaces, a middle plane extending between the first and second surfaces and a plurality of plate holes extending from the first surface to the second surface for receiving a fastener, wherein the bone plate has an oval cross section and is configured and dimensioned to be substantially symmetrical about the middle plane, and wherein the first and second surfaces are concave along the longitudinal axis in an area between consecutive plate holes.

According to a further aspect of the present invention, there is provided a method for fixing a bone with a bone plate having first and second surfaces and at least one plate hole extending from the first surface to the second surface for receiving a fastener, the method comprising the steps of attaching the bone plate to a first portion of the bone such that the first surface of the bone plate faces the first portion of the bone, and attaching the bone plate to a second portion of the bone such that

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the second surface of the bone plate faces the second portion of the bone, wherein the bone plate has an oval cross section and wherein the first and second surfaces are adapted and configured for contact with an external bone surface.

According to another aspect of the present invention, there is provided a method for fixing a bone having a cortex and a medullary canal with a bone plate having first and second surfaces and at least one plate hole extending from the first surface to the second surface for receiving a fastener, the method comprising the steps of inserting a first portion of the bone plate into the medullary canal of the bone, and attaching a second portion of the bone plate to the cortex of the bone outside the medullary canal, wherein either the first or second surface of the second portion can face the cortex of the bone, and both the first and second portions of the bone plate have at least one plate hole for receiving a fastener.

Thanks to the symmetrical design of the bone plate according to this invention, there can no longer be any confusion of the top side with the bottom side, thus greatly increasing security in use.

A preferred refinement of this invention consists of the fact that the bores in the plate are designed with a round cylindrical shape. This has the advantage that the weakened part of the plate is minimized.

In another embodiment, the bores in the plate become wider toward both surfaces, preferably in the form of a cone. This has the advantage that the screw head can be countersunk, and the edge of the bore is minimized.

The profile of the bone plate running perpendicular to the longitudinal axis is either rectangular or oval according to this invention. The two surfaces are preferably planar.

In the area between the bores in the plate, the two surfaces may be planar or concave in the direction of the longitudinal axis. A concave design permits the additional advantage that the rigidity of the implant in the area of the plate bores is the same as that in the area between the bores. This achieves the result that rigidity is proportional to strength against fatigue.

Minor deviations from the symmetry of halves A and B of the bone plate bordered by the plane of symmetry are allowed, but volumes V_a and V_b which differ slightly should be in the range of $0.98 < V_a/V_b < 1.02$, preferably $0.99 < V_a/V_b < 1.01$.

The advantages achieved through this invention can essentially be seen as the following due to the bone plate:

- a high versatility is achieved;
- a maximum range of different bone fractures can be treated with the same implant;
- the design of the implant is simplified; and
- the screws for fixation and the screws for locking the plate are the same.

This invention and refinements of this invention are explained in greater detail below on the basis of the partially schematic diagrams of several embodiments, showing:

Figure 1 a perspective view of a bone plate according to this invention having a rectangular profile;

Figure 2 a longitudinal section through a bone plate according to this invention;

Figure 3 a longitudinal section through a bone plate according to this invention with slightly countersunk bores in the plate;

Figure 4 a longitudinal section through a bone plate according to this invention with greatly countersunk bores in the plate and two types of screws;

Figure 5 a perspective view of a bone plate according to this invention having an oval profile.

The bone plate according to this invention illustrated in Figure 1 has a longitudinal axis 6, two surfaces 1, 2 and several bores 3 in the plate connecting the two surfaces 1, 2. Bores 3 in the plate serve to accommodate bone screws 7 (Figure 5). Middle plane 4 which divides the bone plate into two essentially symmetrical halves A and B runs between the two surfaces 1 and 2.

As shown in Figure 2, bores 3 in the plate may be designed so they are round and cylindrical.

With other embodiments, e.g., according to Figures 3 and 4, the bores 3 in the plate are widened toward the two surfaces 1, 2 namely in the form of a cone 5. The profile 8 running perpendicular to the longitudinal axis 6 is rectangular as shown in Figure 1. However, it may also be oval as shown in Figure 5.

The two surfaces 1, 2 may be designed to be planar, as shown in Figure 1, in particular in the area between bores 3 in the plate.

In the embodiment shown in Figure 5, however, the two surfaces 1 and 2 are each designed to be concave in the area between bores 3 in the plate, thus achieving a uniform rigidity of the bone plate.

Figure 4 shows two types of bone screws 7 and 11 having different functions. Bone screw 7 shown at the left of the figure is a screw for fixation of the bone plate. The diameter of its thread is smaller than the narrowest point in the bore 3 in the plate, so that it does not engage with plate bore 3. Bone screw 11 shown at the right in the figure is a screw for locking the bone place. The diameter of its thread is larger than the narrowest point in plate bore 3, so that it engages laterally in plate bore 3.

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Head 12 of bone screw 7 is spherical in shape, so that it can slide optimally on the cone 5 of plate bore 3 serving as a sliding path.

Figure 5 shows one application of the bone plate where the front part with one surface 2 is attached to the front bone fragment 9 by means of two bone screws 7, and the rear part with the other surface 1 is attached to the rear bone fragment 10 with two bone screws 7.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A bone plate having a longitudinal axis and comprising first and second surfaces, a middle plane extending between the first and second surfaces and a plurality of plate holes extending from the first surface to the second surface for receiving a fastener, wherein the bone plate has an oval cross section and is configured and dimensioned to be substantially symmetrical about the middle plane, and wherein the first and second surfaces are concave along the longitudinal axis in an area between consecutive plate holes.
2. The bone plate of claim 1, wherein at least one plate hole is cylindrical.
3. The bone plate of claim 1, wherein at least one plate hole has a relatively narrow central portion and end portions that widen as they extend toward the first and second surfaces.
4. The bone plate of claim 3, wherein at least one plate hole has a relatively narrow central portion and end portions that have a conical cross section extending toward the first and second surfaces.
5. The bone plate of claim 1, wherein the diameter of at least one plate hole in a direction parallel to the longitudinal axis is greater than the diameter in a direction perpendicular to the longitudinal axis.

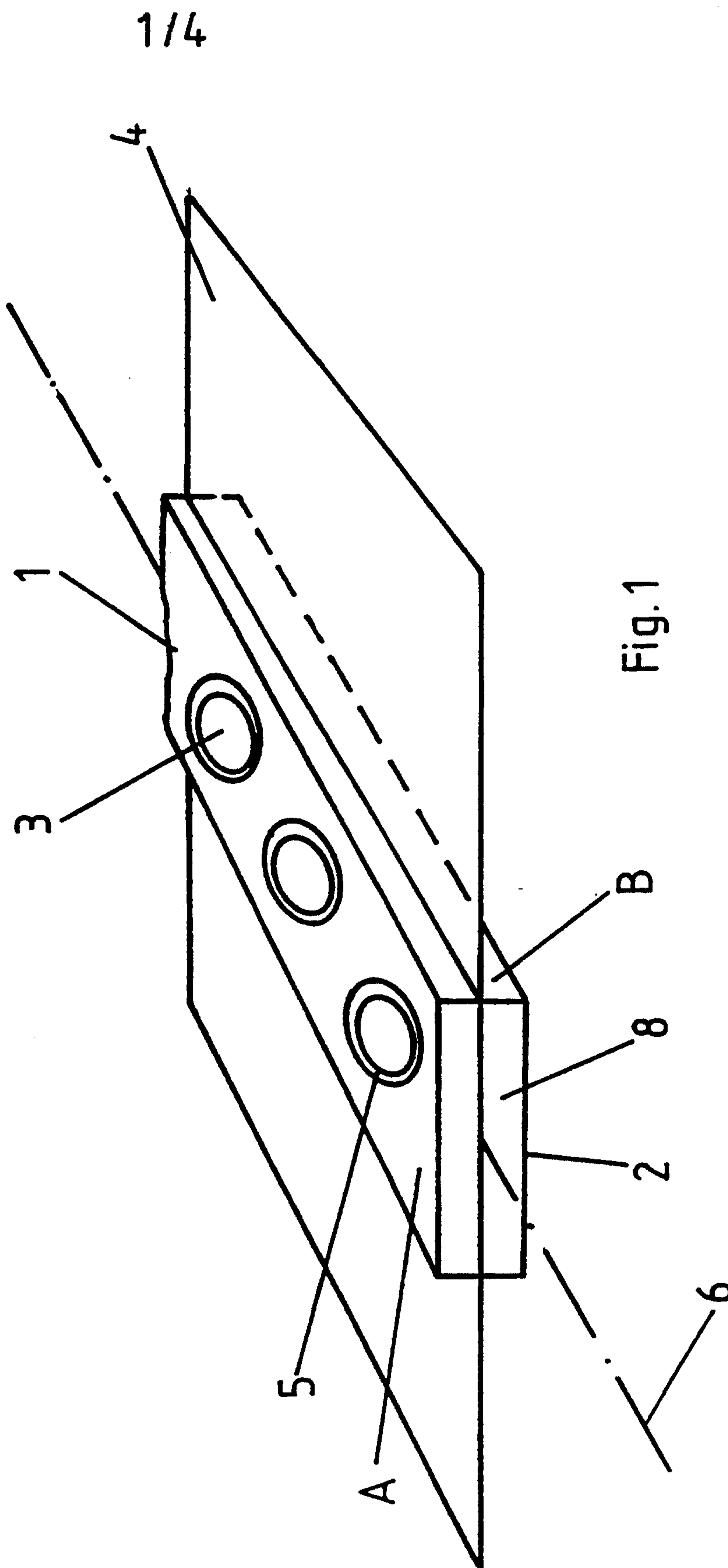
6. The bone plate of claim 5, wherein at least one plate hole has an oval shape.

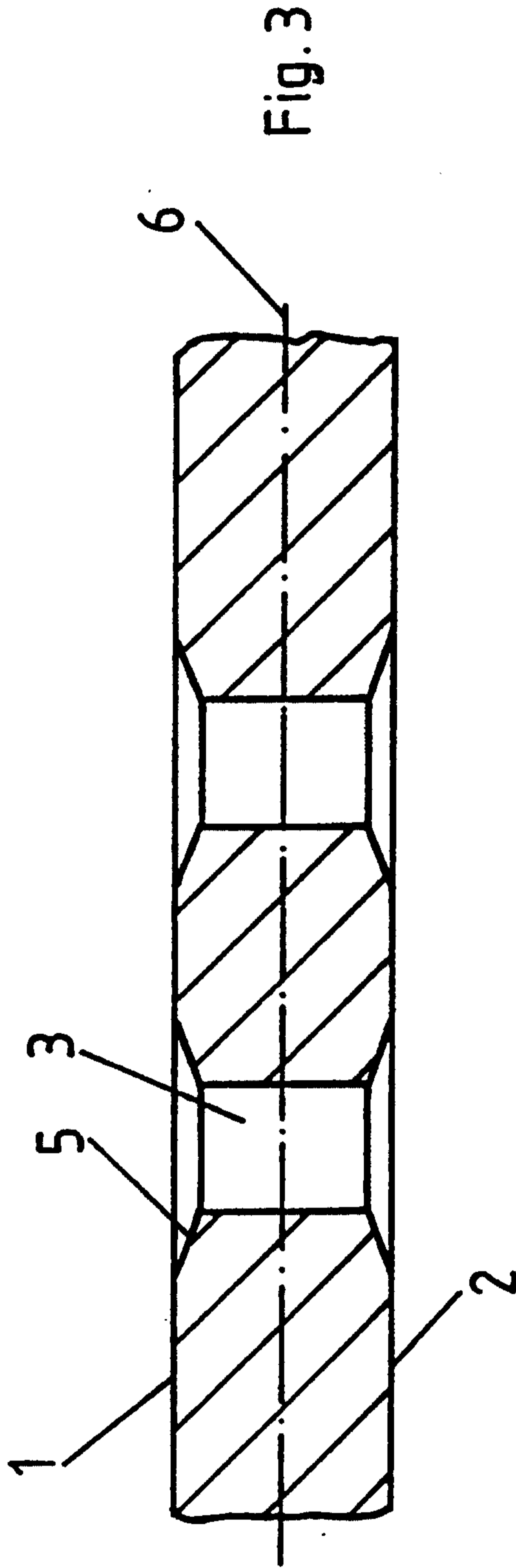
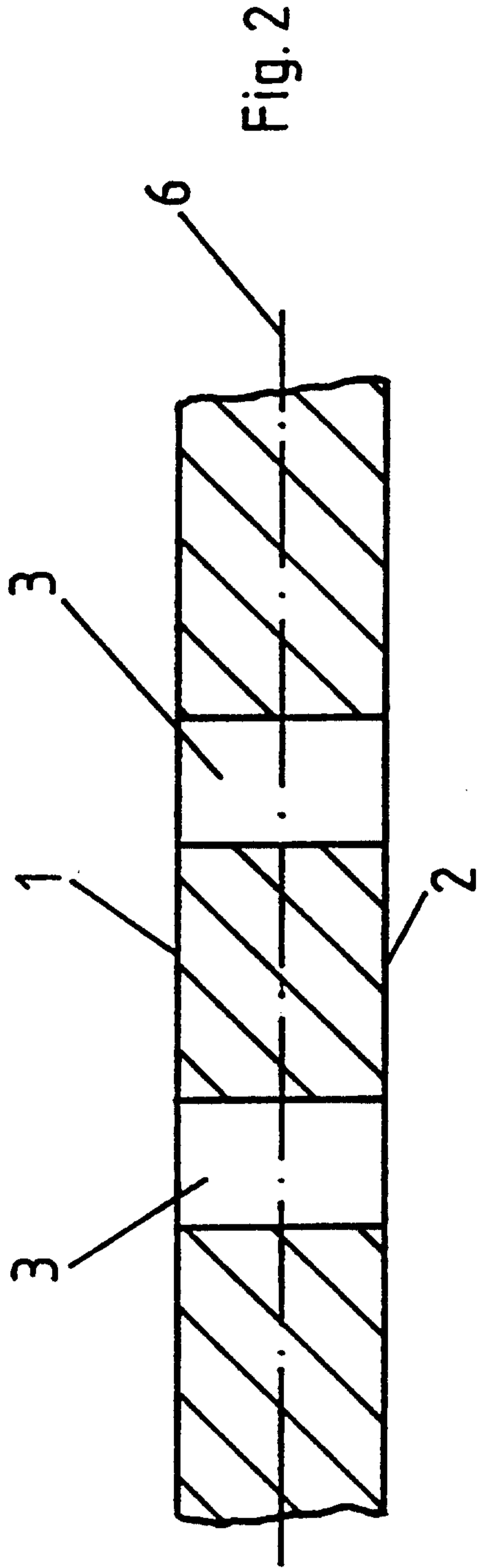
7. The bone plate of any one of claims 1 to 6, wherein a first volume (V_a) defined by a portion of the bone plate from the first surface to the middle plane and a second volume (V_b) defined by a portion of the bone plate from the second surface to the middle plane are configured and dimensioned such that V_a / V_b is between about 0.98 and 1.02.

8. The bone plate of any one of claims 1 to 7, in combination with a bone screw fastener.

9. The bone plate of claim 8, wherein the bone screw has a spherical head for slidably engaging at least one plate hole.

10. The bone plate of claim 8, wherein the bone screw has a thread engaging at least one plate hole for locking the bone screw to the bone plate.





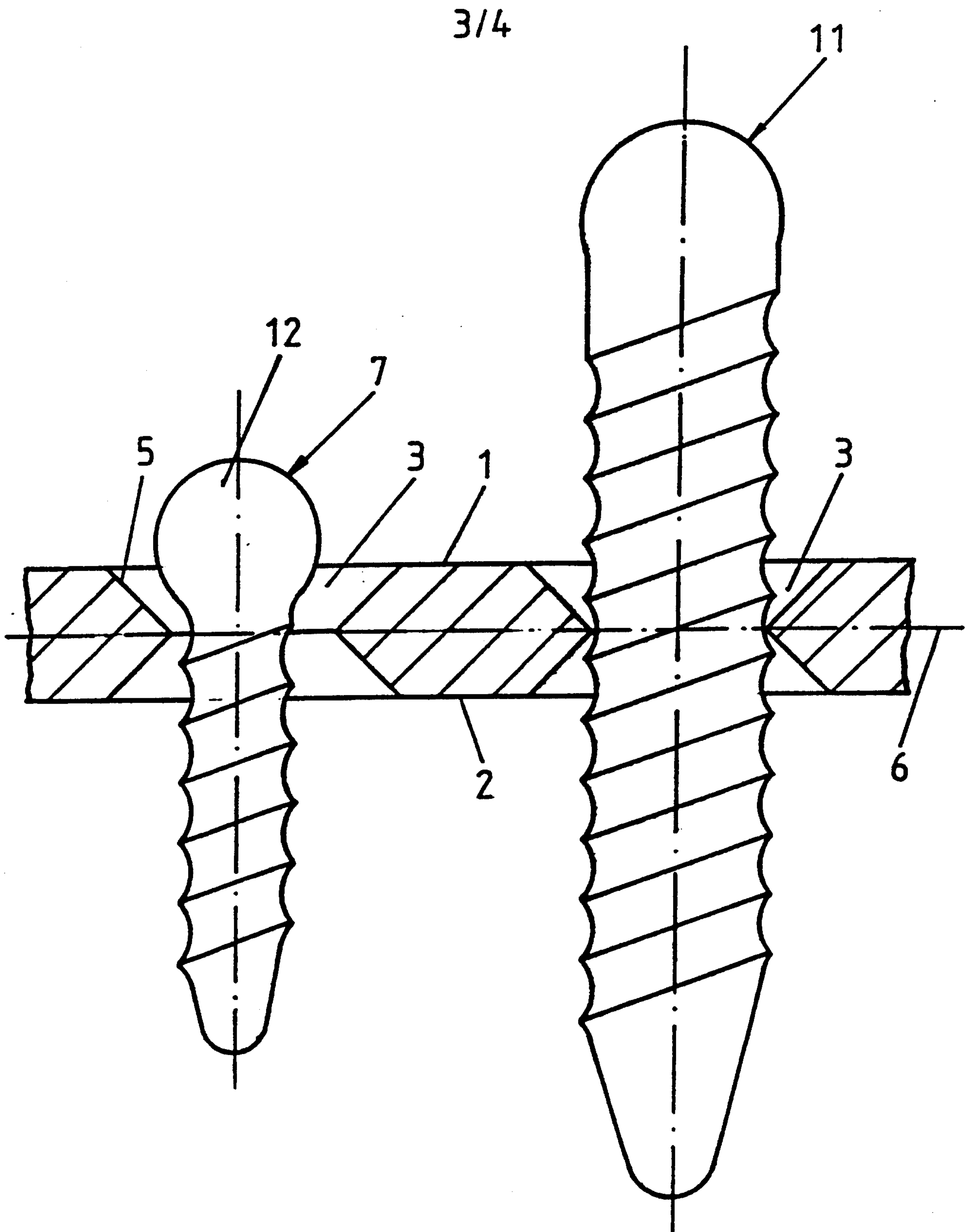


Fig.4

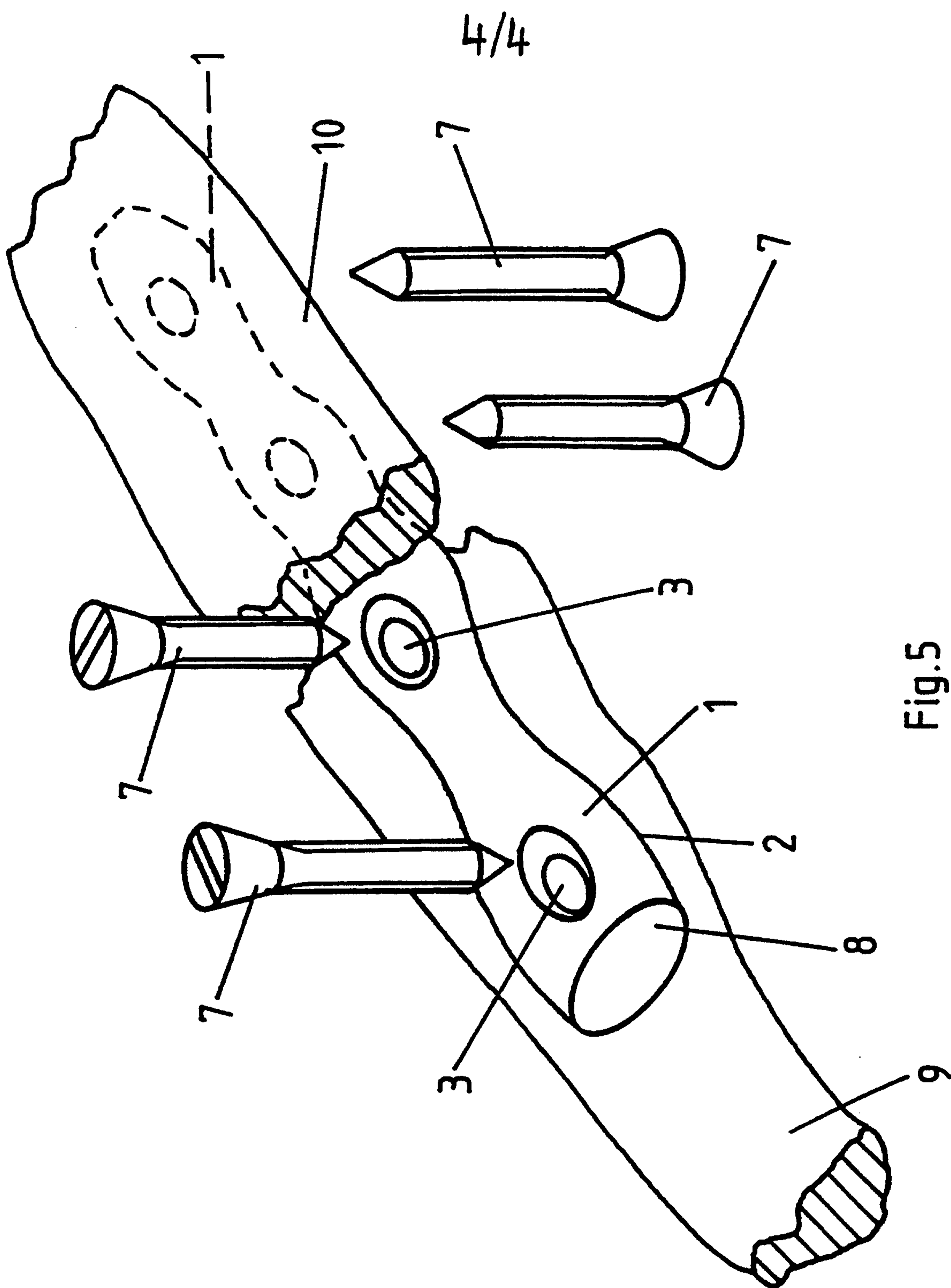


Fig.5

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