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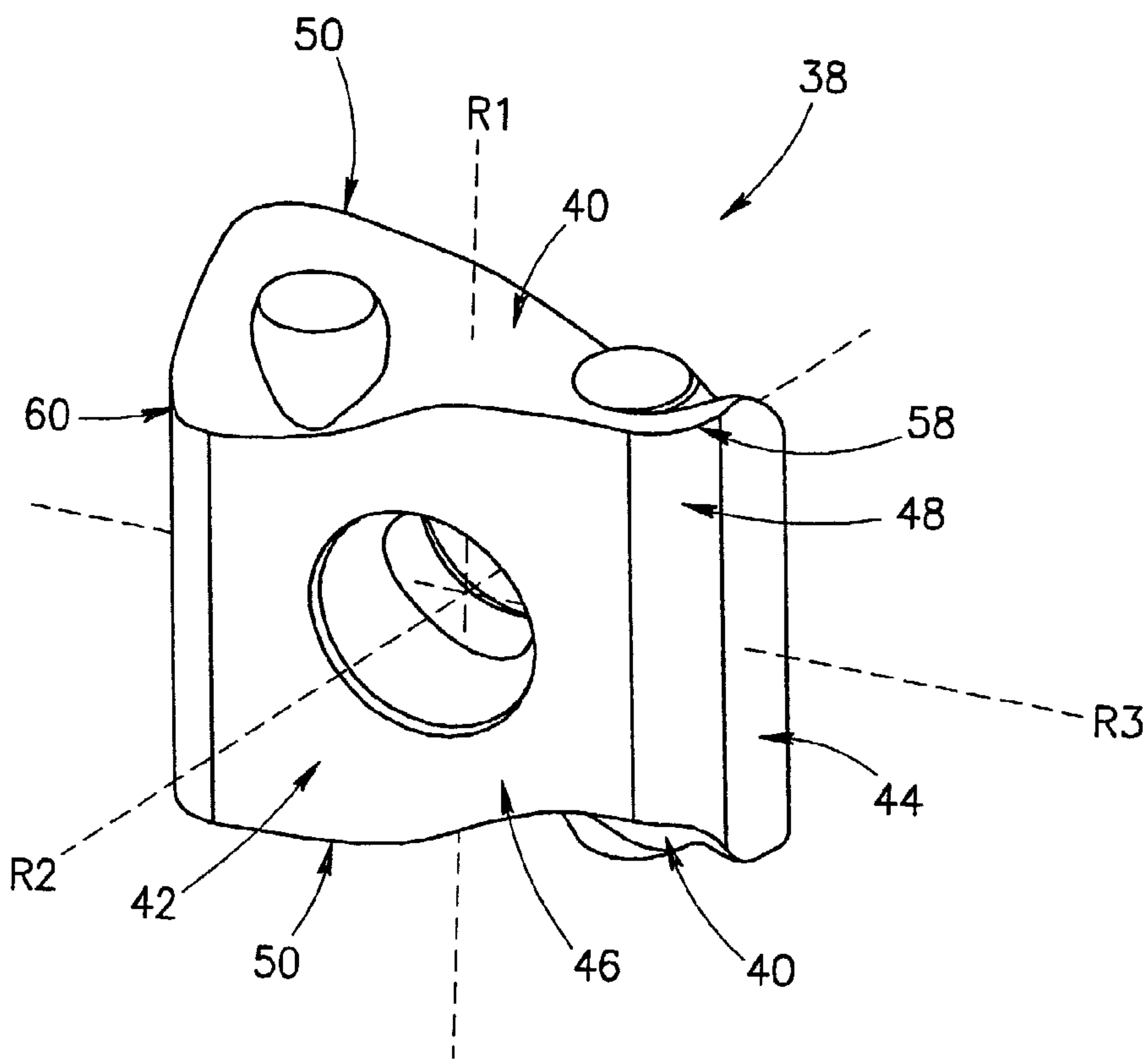

(57) Abrégé/Abstract:
The present invention provides a tangential indexable cutting insert for use in metal cutting processes in general and for radial and axial turning of a stepped square shoulder in particular. The cutting insert exhibits 180° rotational symmetry about three mutually perpendicular axes. The cutting insert has generally "S"-shaped cutting edges extending between raised and lowered corners. The cutting edges and side surfaces are concave in an end view of the cutting insert. The cutting insert enables radial and axial turning operations of a square shoulder with unlimited depth of cut.

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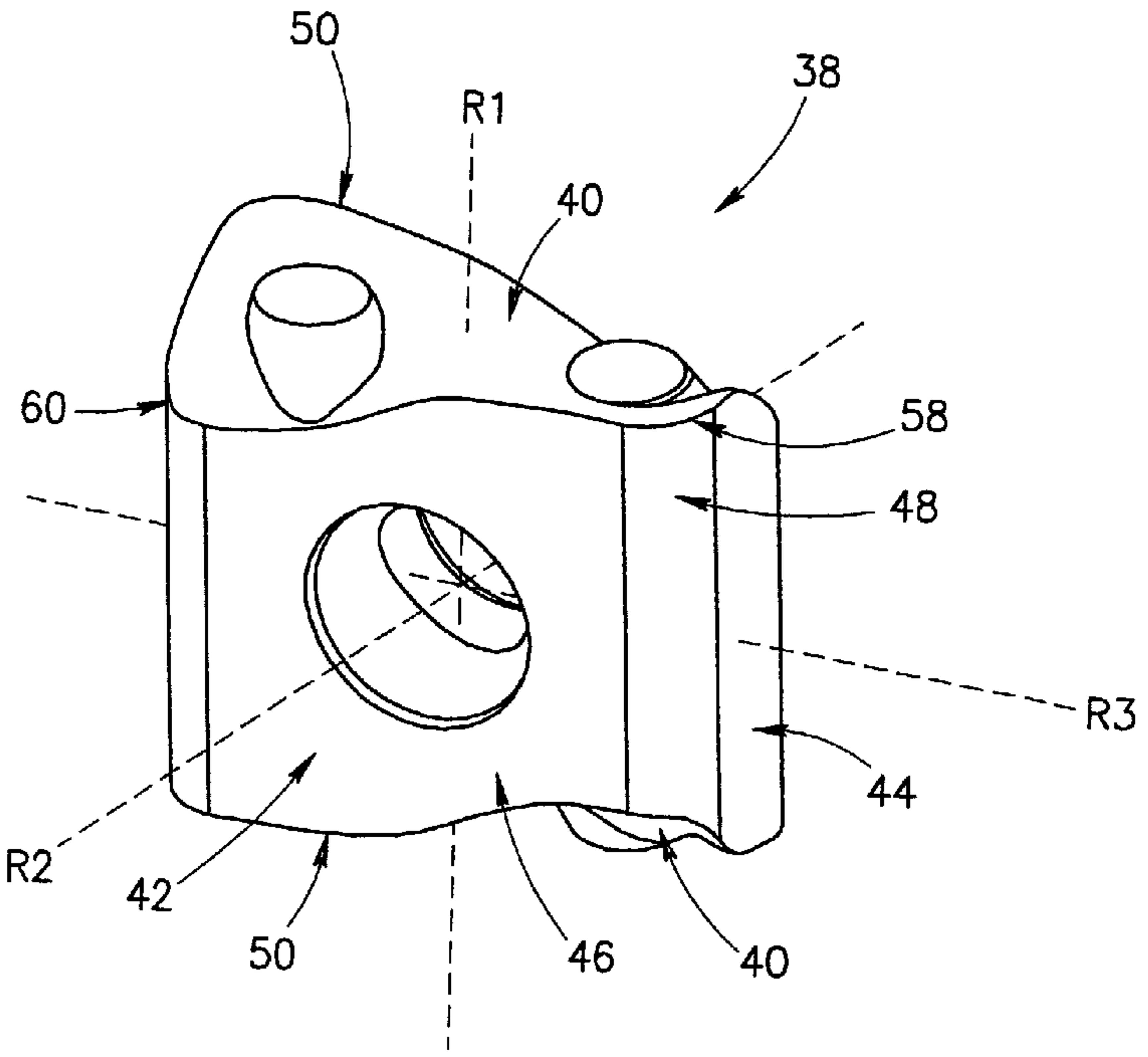

(57) Abstract: The present invention provides a tangential indexable cutting insert for use in metal cutting processes in general and for radial and axial turning of a stepped square shoulder in particular. The cutting insert exhibits 180° rotational symmetry about three mutually perpendicular axes. The cutting insert has generally "S"-shaped cutting edges extending between raised and lowered corners. The cutting edges and side surfaces are concave in an end view of the cutting insert. The cutting insert enables radial and axial turning operations of a square shoulder with unlimited depth of cut.

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TANGENTIAL CUTTING INSERT AND INSERT HOLDER

FIELD OF THE INVENTION

The present invention relates to a tangential indexable cutting insert for use in metal cutting processes in general and for radial and axial turning of a stepped square shoulder in particular.

BACKGROUND OF THE INVENTION

Tangential cutting inserts, also known as on-edge, or lay down, cutting inserts, are oriented in an insert holder in such a manner that during a cutting operation on a workpiece the cutting forces are directed along a major (thicker) dimension of the cutting insert. An advantage of such an arrangement being that the cutting insert can withstand greater cutting forces than when oriented in such a manner that the cutting forces are directed along a minor (thinner) dimension of the cutting insert. Another advantage of such an arrangement is that with the minor dimension directed perpendicular to the cutting forces it is possible to manoeuvre the cutting insert between obstacles close to the workpiece.

For turning a stepped square shoulder on a workpiece, a cutting tool assembly requires a cutting insert with an acute operative insert cutting corner, a tool back clearance angle along its inoperative cutting edge and an obtuse entering angle along its operative cutting edge. Such an entering angle enables an outwardly directed feed out movement to square out a shoulder, in particular, an outwardly directed radial feed out movement in the case of external axial turning operations and an outwardly directed axial feed out movement in the case of radial turning operations.

In view of these restrictions, cutting inserts for turning stepped square shoulders are usually either rhomboidal or triangular; thereby having respectively, two or three indexable insert cutting corners for single-sided cutting inserts. Such cutting inserts are, for example, as illustrated and described in US 4,632,608, each insert cutting corner being formed as a protruding nose portion at the junction between centrally depressed insert sides. The cutting inserts are preferably double sided so as to be respectively formed with four or six indexable insert cutting corners.

With a view to increasing the number of cutting corners, a fully indexable non-tangential cutting insert is described in US 6,074,137. The cutting insert comprises four substantially concave side edges extending between substantially square opposing upper and lower surfaces. Adjacent side edges meet at a cutting corner having an angle in the range of about $83° \pm 5°$. Although the cutting insert is substantially square and although it offers eight cutting corners, its depth of cut is limited. In fact, the maximal depth of cut is limited to less than the length of a side of an imaginary square, in which the insert is inscribed, in a top view of the insert. Furthermore, it is not a tangential cutting insert.

Figs. 1 and 2, show a cutting tool **20** with a tangentially seated cutting insert **22** for both axial and radial turning operations, also known as longitudinal and face turning operations. The cutting insert **22** is oriented with relief angles **γ1** and **γ2** for radial and axial turning operations, respectively. The cutting insert **22** has one operative cutting corner **24**, a first trailing non-operative cutting corner **26** during axial turning operations and a second trailing non-operative cutting corner **28** during radial turning operations. Major and minor cutting edges **30**, **32** extend between the operative cutting corner **24** and non-operative cutting corners **28**, **26**.

Fig. 3 is an illustrative drawing showing the cutting tool **20** during either radial or axial turning operations of a workpiece **33**. Dashed lines **34** show an ideal square shoulder and the dash-dot line **35** is an imaginary extension of the worked face **36** of the workpiece **33**. As can be seen, for a radial turning operation, the second trailing non-operative cutting corner **28** and a portion of the major cutting edge **30** are oriented such that they "extend beyond" the imaginary extension **35** of the worked face **36** and would engage the workpiece **33** if an attempt were made to increase the depth of cut beyond a depth of cut, **d**, where the dashed line intersects the major cutting edge **30**. Thus, the depth of cut is limited during radial turning of a square shoulder. For axial turning in the configuration shown in Fig. 3, the depth of cut is also limited to **d**. Any increase in the depth of cut would lead to a non-square shoulder. Similarly, the insert could be configured with an orientation such that for an axial turning operation, the first trailing non-operative cutting corner **26** and a portion of the minor cutting edge **32** are disposed such that they so that it has limited depth of cut. Likewise, the insert could be configured with an orientation so that it has a limited depth of cut for both axial and radial turning operations due both to the first trailing non-operative cutting corner **26** and a portion of the minor cutting edge **32** and also to the second trailing non-operative cutting corner **28** and a portion of the major cutting edge **30**.

It is an object of the present invention to provide a tangential cutting insert, having an unlimited depth of cut for radial and axial turning of a stepped square shoulder in a workpiece.

It is a further object of the present invention to provide an insert holder for retaining the tangential cutting insert.

SUMMARY OF THE INVENTION

In accordance with the present invention there is provided an indexable cutting insert, for use in a cutting tool for turning operations, comprising:

two identical opposing end surfaces having 180° rotational symmetry about a first axis (R1) passing therethrough,

a peripheral side surface extending between the two opposing end surfaces, and

a peripheral edge formed at the intersection of each end surface and the peripheral side surface, at least two sections of each peripheral edge constituting cutting edges;

the peripheral side surface comprising:

two identical opposing major side surfaces having 180° rotational symmetry about a second axis (R2) passing therethrough, the second axis (R2) being perpendicular to the first axis (R1);

two identical opposing minor side surfaces having 180° rotational symmetry about a third axis (R3) passing therethrough, the third axis (R3) being perpendicular to the first axis (R1) and the second axis (R2);

a major plane (P2) defined by the first axis (R1) and the second axis (R2);

a minor plane (P1) defined by the first axis (R1) and the third axis (R3);

a median plane (M) being defined by the second axis (R2) and the third axis (R3);

each end surface having four corners, two lowered corners and two raised corners, the lowered corners being closer to the median plane (M) than the raised corners ;

in a side view of one of the minor side surfaces, all four corners are equidistant from the minor plane (P1);

in a side view of one of the major side surfaces, all four corners are equidistant from the major plane (P2).

In accordance with the present invention, the cutting insert has a maximum distance D1 between the minor side surfaces that is greater than a maximum distance D2 between the major side surfaces.

In accordance with the present invention, in an end view of the cutting insert, each major side surface is recessed.

In accordance with the preferred embodiment of the present invention, in an end view, the distance between the opposing major side surfaces varies from the maximum distance D2 adjacent the corners of the cutting insert to a minimum distance d2 at the intersection of the major side surface with the major plane (P2).

In accordance with a specific application of the present invention, the minimum distance d2 is given by $d2 = D2 - t$, where the value t is given by $0.3\ \text{mm} \leq t \leq 0.4\ \text{mm}$.

In accordance with the present invention, in an end view of the cutting insert, each minor side surface is recessed.

In accordance with the preferred embodiment of the present invention, in an end view, the distance between the opposing minor side surfaces varies from the maximum distance D1 adjacent the corners of the cutting insert to a minimum distance d1 at the intersection of the minor side surfaces with the minor plane (P1).

In accordance with a specific application of the present invention, the minimum distance d1 is given by $d1 = D1 - s$, where the value s is given by $0.05\ \text{mm} \leq s \leq 0.25\ \text{mm}$.

In accordance with the present invention, each minor side surface merges with an adjacent major side surface at a corner side surface, wherein each corner side surface extends between a given raised corner of one of the two opposing end surfaces and a given lowered corner of the other of one of the two opposing end surfaces.

In accordance with the preferred embodiment of the present invention, each cutting edge comprises a major edge, a minor edge and a corner edge, therebetween.

In accordance with the present invention, each major edge, corner edge, and minor edge is formed at the intersection of adjacent major side surface, corner side surface, and minor side surface, respectively with an adjacent end surface .

In accordance with the preferred embodiment of the present invention, the major edges are recessed in an end view.

In accordance with the preferred embodiment of the present invention, the distance between the opposing major edges varies from the maximum distance D2 adjacent the corner edges to the minimum distance d2 at the intersection of the major edges with the major plane (P2).

In accordance with the preferred embodiment of the present invention, the minor edges are recessed in an end view.

In accordance with the preferred embodiment of the present invention, the distance between the opposing minor edges varies from the maximum distance D1 adjacent the corner edges to the minimum distance d1 at the intersection of the minor edges with the minor plane (P1).

In accordance with the preferred embodiment of the invention, each raised corner forms a corner cutting edge and adjacent major and minor edges form major and minor cutting edges, respectively.

Generally, the major cutting edge has a length L1 that is greater than half the distance D1.

Generally, the minor cutting edge has a length L2 that is approximately half the distance D2.

In accordance with the preferred embodiment of the present invention, the cutting insert further comprises an insert through bore extending between the major side surfaces and having a bore axis coinciding with the second axis (R2).

In accordance with the present invention there is provided a cutting tool comprising: the cutting insert in accordance with the present invention, a shim, and an insert holder having an insert pocket in which the shim and the cutting insert are securely retained;

the insert pocket comprising: a base surface, the base surface being abutted by a given major side surface of the cutting insert, a first side wall extending uprightly from the base surface, the first side wall being abutted by a given minor side surface of the cutting insert, and a second side wall extending uprightly from the base surface, the first side wall being adjacent the major side surface and transverse thereto;

the shim comprises a top surface that is abutted by a non-operative end surface of the cutting insert, an opposing bottom surface that abuts the first side wall, and a perimeter surface extending therebetween;

a shim screw, extending through the shim through bore and threadingly engaged with a threaded second bore of the second side wall, secures the shim to the insert pocket; and

a securing screw, extending through the insert through bore, threadingly engaged with a threaded receiving bore of the base surface, secures the cutting insert to the insert pocket.

If desired, each end surface of the cutting insert further comprises two frustums extending away from the median plane (M) located on either side of the major plane (P2), and the top surface of the shim, in accordance with the present invention, further comprises a raised area being a portion of the top surface of the shim protruding from the top surface of the shim; wherein

the two frustums of the non-operative end surface abut the raised area of the top surface of the shim..

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding, the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is of a side view of a typical prior art cutting tool;

Fig. 2 is an end view of the cutting tool in Fig 1;

Fig. 3 is a plan view of the cutting tool in Fig. 1 in a turning operation.

Fig. 4 is a perspective view of the cutting insert in accordance with the present invention;

Fig. 5 is a first side view of the cutting insert in Fig. 4;

Fig. 6 is a second side view of the cutting insert shown in Fig. 4;

Fig. 7 is a cross-sectional view of the cutting insert shown in Fig. 6 taken along C-C;

Fig. 8 is an end view of the cutting insert shown in Fig. 4;

Fig. 9 is a side view of a cutting tool in accordance with the present invention;

Fig. 10 is an end view of the cutting tool in Fig 9;

Fig. 11 is a plan view of the cutting tool in accordance with the present invention in an axial turning operation;

Fig. 12 is a detailed view of Fig. 11;

Fig. 13 is a plan view of the cutting tool in accordance with the present invention in a radial turning operation;

Fig. 14 is a detailed view of Fig. 13;

Fig. 15 is a perspective exploded view of cutting tool in accordance with the present invention; and

Fig. 16 is an end view of a cutting insert shown insert in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Attention is first drawn to Figs. 4 to 8, showing a tangential indexable cutting insert **38** in accordance with present invention. The cutting insert **38** is generally manufactured by form pressing and sintering a cemented carbide, such as tungsten carbide, and can be coated or uncoated. The cutting insert **38** is generally rectangular in an end view and comprises two identical end surfaces **40**, and a peripheral side surface **42** extending between the end surfaces **40**. The cutting insert **38** and the end surfaces **40** have 180° rotational symmetry about a first axis **R1** of that passes through the end surfaces **40**. Since the end surfaces **40** are identical, only one will be described, it being understood that the other end surface **40** has identical structure.

The peripheral side surface **42** comprises two opposed identical minor side surfaces **44**, two opposed identical major side surfaces **46**, and four opposed corner side surfaces **48**. Adjacent major and minor side surfaces **46, 44** merge at a common corner side surface **48**. The cutting insert **38** and the major side surface **46** have 180° rotational symmetry about a second axis **R2** perpendicular to the first axis of rotational symmetry **R1** and passing through the major side surfaces **46**. The cutting insert **38** and the minor side surface **44** also has 180° rotational symmetry about a third axis **R3** that passes through the minor side surfaces **44** and is perpendicular to both the first and second axis of 180° rotational symmetry **R1, R2**.

The peripheral side surface **42** intersects each end surface **40** at a peripheral edge **50**. The peripheral edge **50** comprises two identical opposed major edges **52**, two identical opposed minor edges **54**, and four opposed corner edges **56**. Adjacent major and minor edges **52, 54** merge at a common corner edge **56**. The major edges **52** are formed at the intersection of the major side surfaces **46** with the end surfaces **40**, the minor edges **54** are formed at the intersection of the minor side surfaces **44** with the end surfaces **40**, and the corner edges **56** are formed at the intersection of the corner side surfaces **48** with the end surfaces **40**.

For further description of the geometrical properties of the cutting insert **38**, a minor plane **P1**, to which the major edges **52** are generally parallel in an end view of the cutting insert **38,** is defined by the first and third axis of rotational symmetry **R1, R3**. A major plane **P2**, to which the minor edges **54** are generally parallel in an end view of the cutting insert **38**, is defined by the first and second axis of rotational symmetry **R1**, **R2**. A median plane **M**, which is perpendicular to both the first and major plane **P1**, **P2**, is defined by the second and third axis of rotational symmetry **R2**, **R3**. A width dimension **D1** of the cutting insert **38** is defined as a maximum distance dimension between the minor side surfaces **44** measured parallel to the third axis **R3**. A length dimension **D2** of the cutting insert **38** is defined as a maximum distance dimension between the major side surfaces **46** measured parallel to the second axis **R2**. For the tangential cutting insert **38**, the width dimension **D1** is greater than the length dimension **D2**.

Associated with each of the four corner edges **56** of a given end surface are four corners comprising two diametrically opposed raised corners **58** and two diametrically opposed lowered corners **60**. The lowered corners **60** are closer to the median plane **M** than are the raised corners **58**. In a side view of either of the minor side surfaces **44**, all four corners **58**, **60** are equidistant from the minor plane **P1**. In a side view of either of the major side surfaces **46**, all four corners **58**, **60** are equidistant from the major plane **P2**. Each corner side surfaces **48** extends between a given raised corner **58** of one end surface **40** and an adjacent lowered corner **60** on the opposing end surface **40**. Each corner side surface **48** has uniform radius of curvature along its length, and typically forms an arc angle of 95° ± 3°. The alternating raised and lowered corners **58**, **60** enable the cutting insert **38** to have four same-handed raised corners **58** for indexing.

Adjacent major and minor edges **52**, **54** extend from the corner edge **56** of a given raised corner **58** with a variable slope to a respective lowered corner **60**. In a side view of the cutting insert **38**, adjacent each raised corner **58**, the slope of each major edge **52** (see Fig. 6) is generally constant with the major edge **52** substantially parallel to the median plane **M**. Moving along the major edge **52** towards an adjacent lowered corner **60**, the slope gradually increases and finally decreases adjacent the lowered corner **60**. As can be seen in Fig. 5 each minor edge **54** has a generally similar form to that of the major edges **52**. Thus in a respective side view, each major and minor edge **52, 54**, has a similar wavy elongated "S"-shape.

In an end view of the cutting insert **38**, the major edges **52** are concave. In other words, the major edges **52** are recessed in an end view wherein, the distance between the opposed major edges **52** varies from approximately **D2** adjacent the corner edges **56** to a minimum distance **d2** at the intersection of the major edges **52** with the major plane **P2**. The minimum distance **d2** is defined by **D2 – t.** In a non-binding example, **t** is greater than or equal to 0.3 mm and less than or equal 0.4 mm. In an end view of the cutting insert **38**, each major side surface **46** is also concave, being recessed in the same manner as its associated major edge **52**. It should be noted that the variation of the distance between the opposed major edges **52** (and likewise the opposed major side surfaces **46**) need not decrease uniformly from the maximum value **D2** to the minimum value **d2**.

In an end view of the cutting insert **38**, the minor edges **54** are also concave, in a similar manner to the major edges **52**. The distance between the opposed minor edges **54** in an end view, varies from approximately **D1** adjacent the corner edges **56** to a minimum distance **d1** at the intersection of the minor edges **54** with the minor plane **P1**. The minimum distance **d1** is defined by **D1 – s.** In a non-binding example, **s** is greater than or equal to 0.05 mm and less than or equal 0.25 mm. Likewise, in an end view of the cutting insert **38**, each minor side surface **44** is concave, being recessed in the same manner as its associated minor edge **54**. The variation of the distance between the opposed minor edges **54** (and likewise the opposed minor side surfaces **44**) need not decrease uniformly from the maximum value **D1** to the minimum value **d1**.

It will be appreciated that whereas the whole of the peripheral edge **50** can function as a cutting edge, in practice, sections of the peripheral edge **50** adjacent the lowered corners **60** will not function as cutting edges. In a accordance with a specific application of the present invention, each given peripheral edge **50** has an effective major cutting edge **66** that extends from an associated given raised corner **58** along the given corner edge **56** and the given major edge **52** for a given major cutting edge length **L1**, which is greater than one half the of the width dimension **D1**. Additionally, in accordance with the specific application of the present invention, each peripheral edge **50** has an effective minor cutting edge **68** that extends from an associated given raised corner **58** along the given corner edge **56** and the given minor edge **54** for a given minor cutting edge length, **L2**, which is approximately one half the of the length dimension **D2**.

Attention is now drawn to Figs. 9 and 10, showing side views of a cutting tool **70** in accordance with the present invention. The cutting insert **38** has relief angles **γ1, γ2** and presents an operative raised corner **58'** outwardly projecting from the cutting tool **70**.

Attention is now drawn to Figs. 11 and 12, showing the cutting insert **38** in an insert holder **72** in a plan view during an axial turning operation of a stepped square shoulder **74** of a workpiece **76** rotating about an axis **A**. Adjacent the stepped square shoulder **74** is an operative major edge **52'**, an operative corner edge **56'** of an operative raised corner **58'** an operative minor edge **54'**, and a trailing lowered corner edge **78'**. It will be appreciated that that an operative minor edge **54'** constitutes a secondary cutting edge or wiper and that only a small section of it adjacent the operative corner edge **56'** contacts the workpiece **76.** Due to the relief angles **γ1, γ2** and any other required orientation of the cutting insert **38**, an entering angle **K** is formed between the major edge **52** and the feed direction **F1**, and a back clearance angle **Kn** is formed between the operative minor edge **54'** and a cylindrical surface **80** of the workpiece **76**. As can be seen, the trailing lowered corner edge **78'** is completely relieved from the cylindrical surface **80** of the workpiece **76,** whereby the depth of cut for axial turning is unlimited.

Attention is now drawn to Figs. 13 and 14, showing the cutting insert **38** in an insert holder **72** in a plan view during an radial turning operation of a cylindrical surface **80** of a workpiece **76** rotating about an axis **A**. Adjacent the cylindrical surface **80** is an operative major edge **52'**, an operative corner edge **56'** of the operative corner edge **58'** an operative minor edge **54'**, and a trailing lowered corner edge **78"**. It will be appreciated that that an operative major edge **52'** constitutes a secondary cutting edge or wiper and that only a small section of it adjacent the operative corner edge **56'** contacts the workpiece **76.** Due to the relief angles **γ1, γ2**, and any other required orientation of the cutting insert **38**, an entering angle **K** is formed between the operative minor edge **54'** and the feed direction **F2**, and a back clearance angle **Kn** is formed between the operative major edge **52'** and a stepped square shoulder **74** of the workpiece **76**. As can be seen, the trailing lowered corner edge **78"** is completely relieved from the stepped square shoulder **74** of the workpiece **76,** whereby the depth of cut for radial turning is unlimited.

The seating and securing of the cutting insert **38** will now be described with reference to Fig. 15, showing various elements not mentioned above. These elements include two frustums **82** on each end surface **40**, an insert pocket **84** of the insert holder **72,** an insert through bore **86,** a securing screw **88,** a shim **90**, and a shim screw **92**.

The insert pocket **84** comprises first and second side walls **94, 96** uprightly extending from a base surface **98** of the insert pocket **84**. The shim **90** comprises a top surface **100**, a flat opposing bottom surface **102**, and a perimeter surface **104** extending therebetween. The top surface **100** of the shim **90** comprises a raised area **106** extending away from the bottom surface **102** of the shim **90.** A shim through bore **108** extends between the top surface **100** and the bottom surface **102**. The two frustums **82** of each end surface **40** extend away from the median plane **M** and are located on either side of the major plane **P2**. The frustums **82** are likely to impede chip flow, thereby limiting the lengths **L1**,

L2 of the major and minor cutting edges **66**, **68**.

The shim **90** is secured in the insert pocket **84** with its bottom surface **102** abutting the second side wall **96**. The shim screw **92**, extends through the shim through bore **108** and threadingly engages with a threaded second bore **110** passing through the second side wall **96**, securing the shim **90** to the insert pocket **84**. The cutting insert **38** is secured in the insert pocket **84** with a non-operative end surface **40** adjacent the top surface **100** of the shim **90**. The first side wall **94** abuts the minor side surface **44** of the cutting insert **38**, and the base surface **98** abuts the major side surface **46**. The two frustums **82** of a non-operative end surface **40** abut the raised area **106** of the top surface **100** of the shim **90**. The securing screw **88** extends through the insert through bore **86** and threadingly engages a threaded receiving bore **112** in the base surface **98** of the insert pocket **84**.

It will be appreciated that the particular form of the end surfaces **40** will depend on the design factors that take into account various working conditions. For example, in order to increase the effective cutting wedge angle, a land **114** is provided adjacent the peripheral edge **50** (see Fig. 7). A rake surface **116** slopes downwardly and inwardly from the land **114**. If desired the rake surface can be provided with suitable chip control elements.

It is advantageous to have recessed side surfaces and side edges to take into consideration manufacturing tolerances so that the sides will not become convex or partially convex, when viewed in an end view, and interfere with the workpiece. It is possible to use straight side edges, i.e. the major side surfaces **46** and the major edges **52** could be straight, as shown in Fig. 16, either by tight manufacturing tolerances during pressing and sintering or by additional steps of grinding.

Although the present invention has been described to a certain degree of particularity, it should be understood that various alterations and modifications could be made without departing from the spirit or scope of the invention as hereinafter claimed.

CLAIMS:

1. An indexable cutting insert (38) comprising:

two identical opposing end surfaces (40) having 180° rotational symmetry about a first axis (R1) passing therethrough,

a peripheral side surface (42) extending between the two opposing end surfaces (40), and

a peripheral edge (50) formed at the intersection of each end surface (40) and the peripheral side surface (42), at least two sections of each peripheral edge (50) constituting cutting edges;

the peripheral side surface (42) comprising:

two identical opposing major side surfaces (46) having 180° rotational symmetry about a second axis (R2) passing therethrough, the second axis (R2) being perpendicular to the first axis (R1); and

two identical opposing minor side surfaces (44) having 180° rotational symmetry about a third axis (R3) passing therethrough, the third axis (R3) being perpendicular to the first axis (R1) and the second axis (R2);

a major plane (P2) defined by the first axis (R1) and the second axis (R2);

a minor plane (P1) defined by the first axis (R1) and the third axis (R3);

a median plane (M) being defined by the second axis (R2) and the third axis (R3);

each end surface (40) having four corners (58, 58', 60), two lowered corners (60) and two raised corners (58, 58'), the lowered corners (60) being closer to the median plane (M) than the raised corners (58, 58');

in a side view of one of the minor side surfaces (44), all four corners (58, 58', 60) are equidistant from the minor plane (P1);

in a side view of one of the major side surface (46), all four corners (58, 58', 60) are equidistant from the major plane (P2).

2. An indexable cutting insert (38) according to claim 1 wherein, the cutting insert (38) has a maximum distance D1 between the minor side surfaces (44) that is greater than a maximum distance D2 between the major side surfaces (46).

3. An indexable cutting insert (38) according to claim 2 wherein, in an end view of the cutting insert (38), each major side surface (46) is recessed.

4. An indexable cutting insert (38) according to claim 3 wherein, in an end view, the distance between the opposing major side surfaces (46) varies from the maximum distance D2 adjacent the corners of the cutting insert (38) to a minimum distance d2 at the intersection of the major side surfaces (46) with the major plane (P2).

5. An indexable cutting insert (38) according to claim 4 wherein, the minimum distance d2 is given by $d2 = D2 - t$, where the value t is given by $0.3 \text{ mm} \leq t \leq 0.4$ mm.

6. An indexable cutting insert (38) according to claims 2 wherein, in an end view of the cutting insert (38), each minor side surface (44) is recessed.

7. An indexable cutting insert (38) according to claim 6 wherein, in an end view, the distance between the opposing minor side surfaces (44) varies from the maximum distance D1 adjacent the corners of the cutting insert (38) to a minimum distance d1 at the intersection of the minor side surfaces (44) with the minor plane (P1).

8. An indexable cutting insert (38) according to claim 7 wherein, the minimum distance d1 is given by $d1 = D1 - s$, where the value s is given by $0.05 \text{ mm} \leq s \leq 0.25$ mm.

9. An indexable cutting insert (38) according to claim 1 wherein, each minor side surface (44) merges with an adjacent major side surface (46) at a corner side surface (48), wherein each corner side surface (48) extends between a given raised corner (58, 58') of one of the two opposing end surfaces (40) and a given lowered corner (60) of the other of one of the two opposing end surfaces (40).

10. An indexable cutting insert (38) according to claim 9 wherein, each cutting edge comprises a major edge (52, 52'), a minor edge (54, 54') and a corner edge (56, 56') therebetween.

11. An indexable cutting insert (38) according to claim 10 wherein, each major edge (52, 52'), corner edge (56, 56'), and minor edge (54, 54') is formed at the intersection of adjacent major side surface (46), corner side surface (48), and minor side surface (44), respectively with an adjacent end surface (40).

12. An indexable cutting insert (38) according to claim 11 wherein, the major edges (52, 52') are recessed in an end view.

13. An indexable cutting insert (38) according to claims 4 and 12 wherein, the distance between the opposing major edges (52, 52') varies from the maximum distance D2 adjacent the corner edges (56, 56') to the minimum distance d2 at the intersection of the major edges (52, 52') with the major plane (P2).

14. An indexable cutting insert (38) according to claim 11 wherein, the minor edges (54, 54') are recessed in an end view.

15. An indexable cutting insert (38) according to claims 7 and 14 wherein, the distance between the opposing minor edges (54, 54') varies from the maximum distance D1 adjacent the corner edges (56, 56') to the minimum distance d1 at the intersection of the minor edges (54, 54') with the minor plane (P1).

16. An indexable cutting insert (38) according to claims 11 wherein, each raised corner (58, 58') forms a corner cutting edge (56') and adjacent major and minor edges (52, 52', 54, 54') form major and minor cutting edges (66, 68), respectively.

17. An indexable cutting insert (38) according to claim 16 wherein, the major cutting edge (66) has a length L1 that is greater than half the distance D1.

18. An indexable cutting insert (38) according to claim 17 wherein, the minor cutting edge (68) has a length L2 that is approximately half the distance D2.

19. An indexable cutting insert (38) according to claim 1 wherein, the cutting insert (38) further comprises an insert through bore (86) extending between the major side surfaces (46) and having a bore axis coinciding with the second axis (R2).

20. A cutting tool (70) comprising:

the cutting insert (38) according to claim 19;

a shim (90);

and an insert holder (72) having an insert pocket (84) in which the shim (90) and the cutting insert (38) are securely retained;

the insert pocket (84) comprising: a base surface (98), the base surface (98) being abutted by a given major side surface (46) of the cutting insert (38), a first side wall (94) extending uprightly from the base surface (98), the first side wall (94) being abutted by a given minor side surface (44) of the cutting insert (38), and a second side wall (96) extending uprightly from the base surface (98), the first side wall (94) being adjacent the major side surface (46) and transverse thereto;

the shim (90) comprises a top surface (100) that is abutted by a non-operative end surface (40) of the cutting insert (38), an opposing bottom surface (102) that abuts the first side wall (94), and a perimeter surface (104) extending therebetween;

a shim screw (92), extending through the shim through bore (108) and threadingly engaged with a threaded second bore (110) of the second side wall (96), secures the shim (90) to the insert pocket (84); and

a securing screw (88), extending through the insert through bore (86), threadingly engaged with a threaded receiving bore (112) of the base surface (98), secures the cutting insert (38) to the insert pocket (84).

21. A cutting tool (70) according to claim 18 wherein, each end surface (40) of the cutting insert (38) further comprises two frustums (82) extending away from the median plane (M) located on either side of the major plane (P2), and the top surface (100) of the shim (90), in accordance with the present invention, further comprises a raised area (106) being a portion of the top surface (100) of the shim (90) protruding from the top surface (100) of the shim (90); wherein

the two frustums (82) of the non-operative end surface (40) abut the raised area (106) of the top surface (100) of the shim (90).

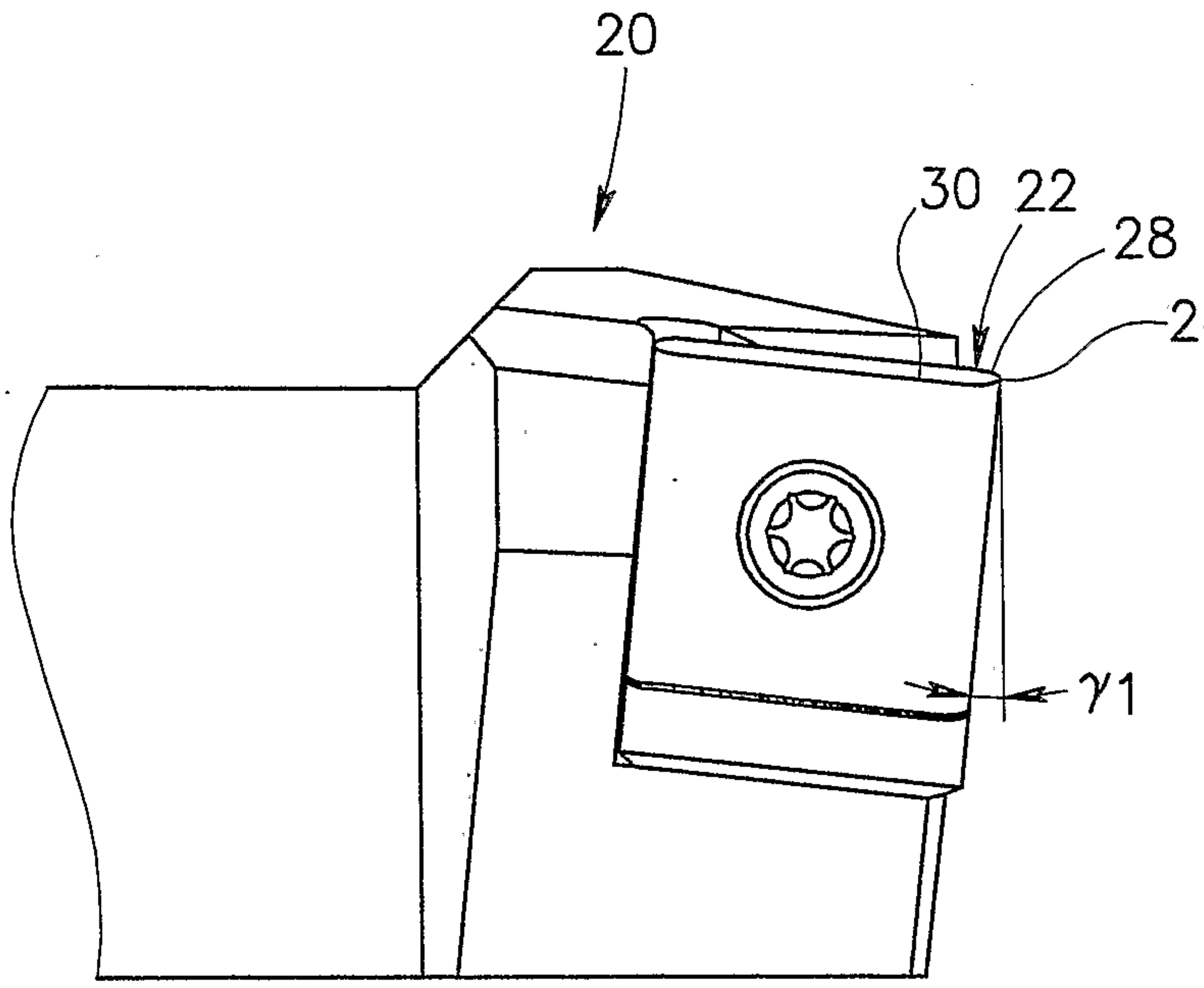

FIG.1

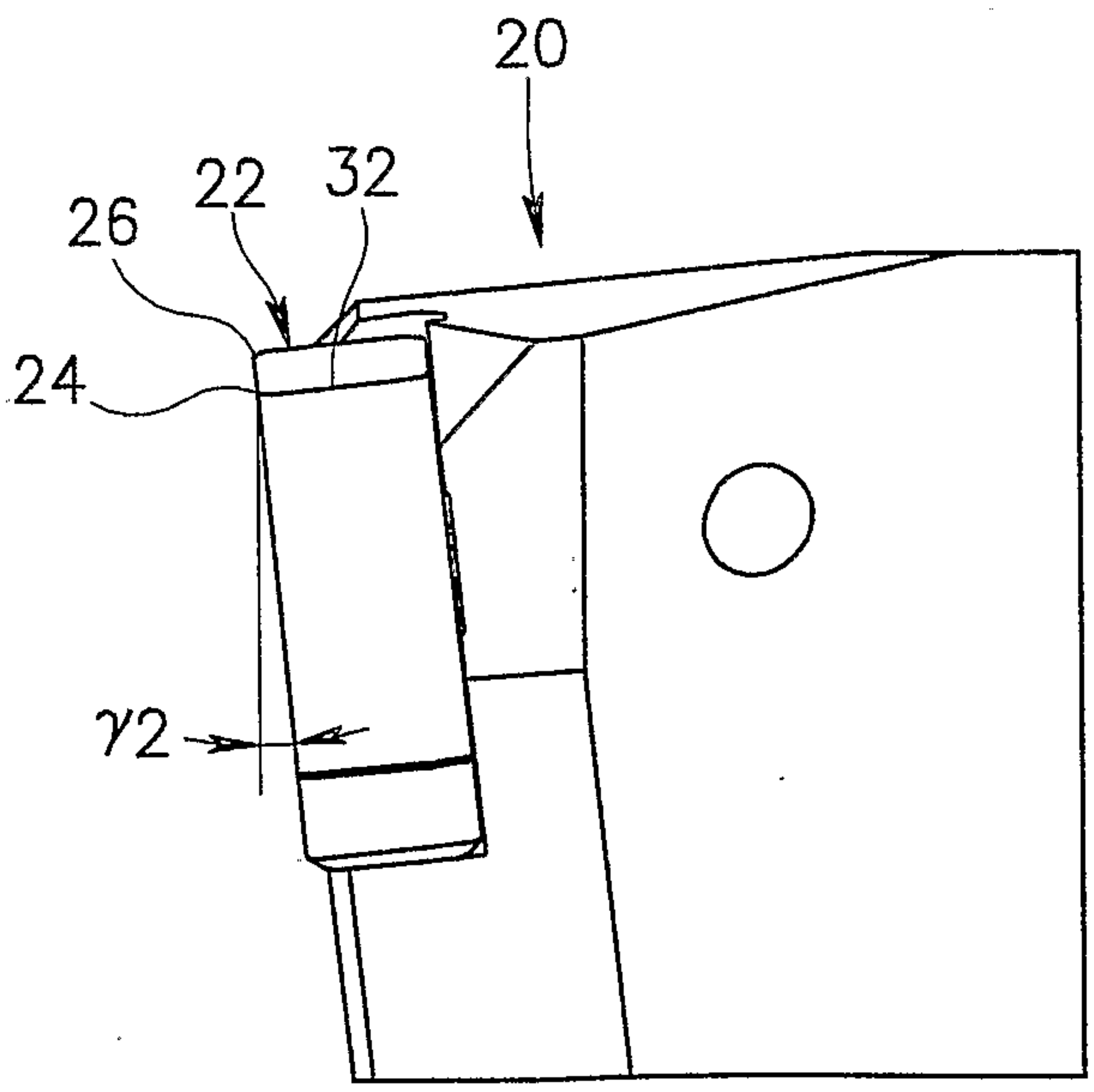

FIG.2

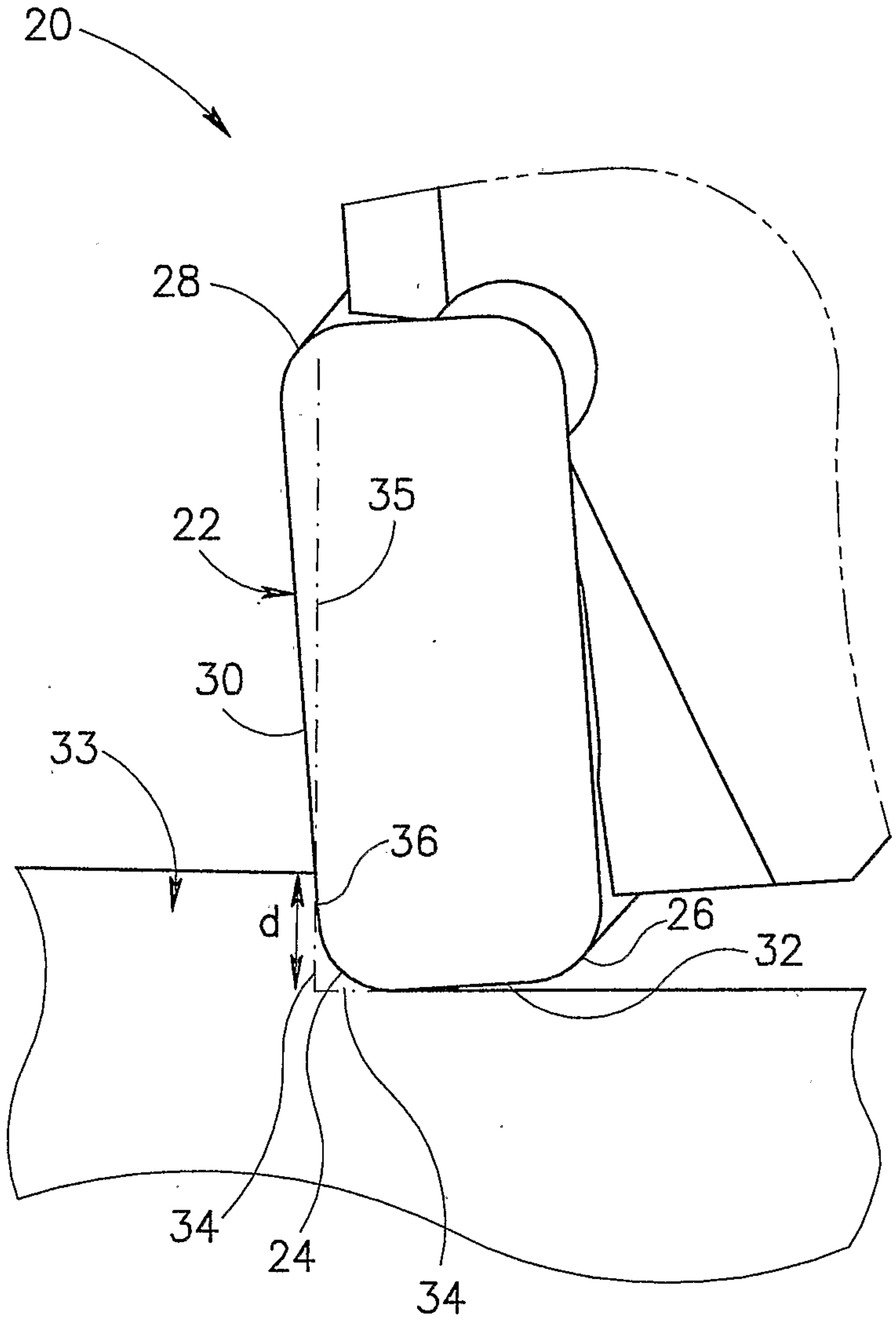

FIG.3

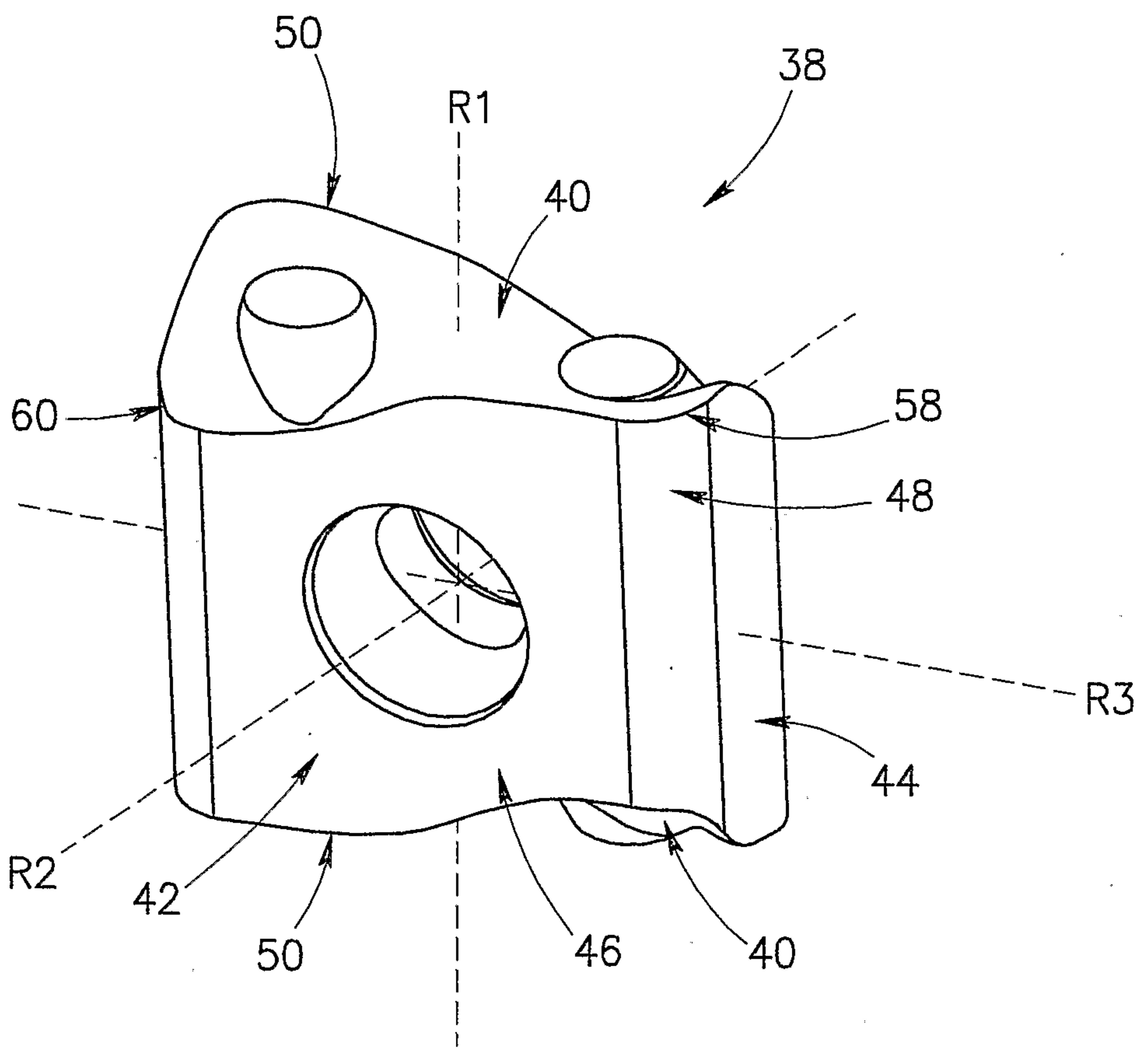

FIG.4

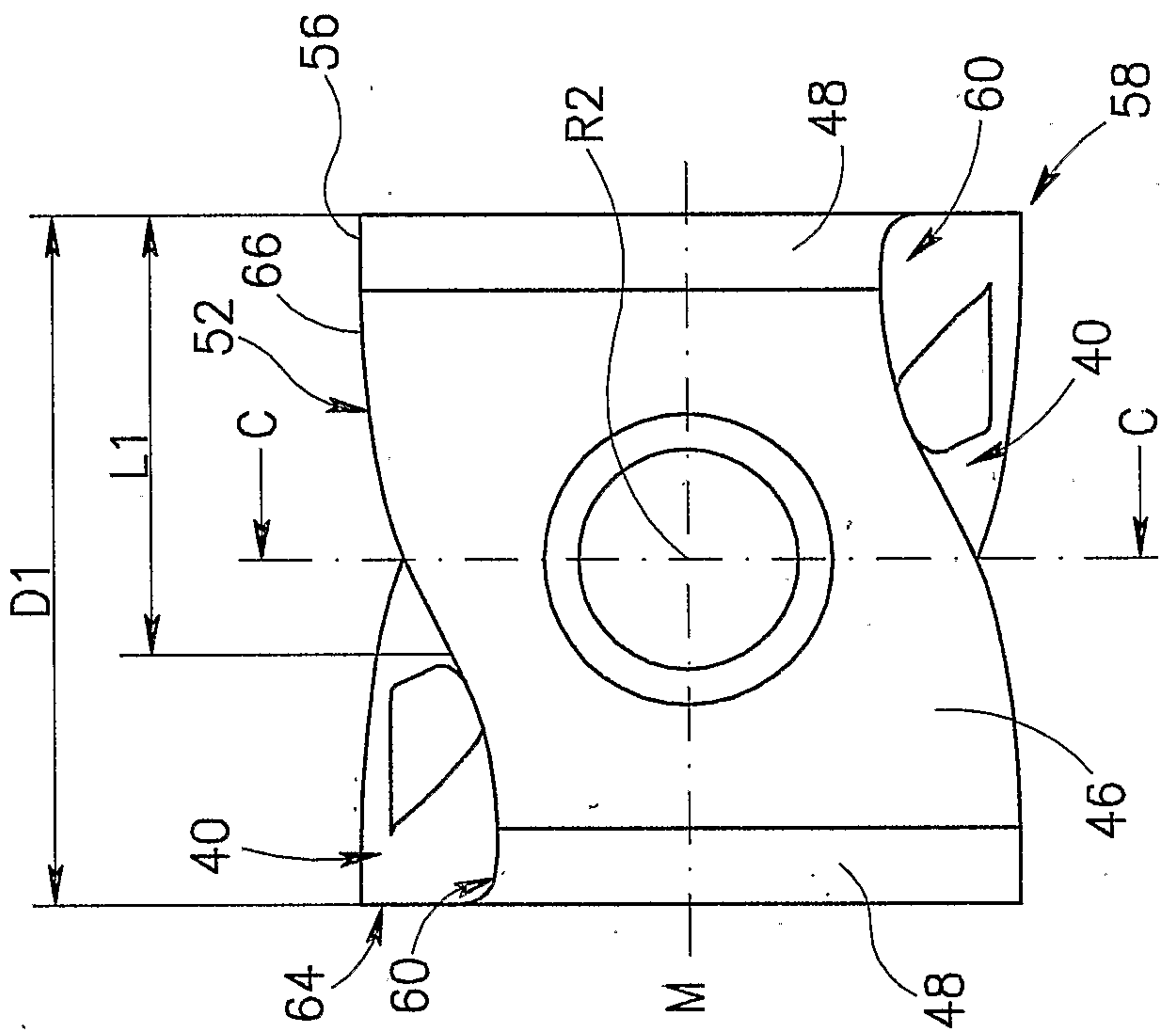
56
R2
48
60
58
66
52
40
C
L1
D1
C
46
40
64
60
M
48

FIG.6

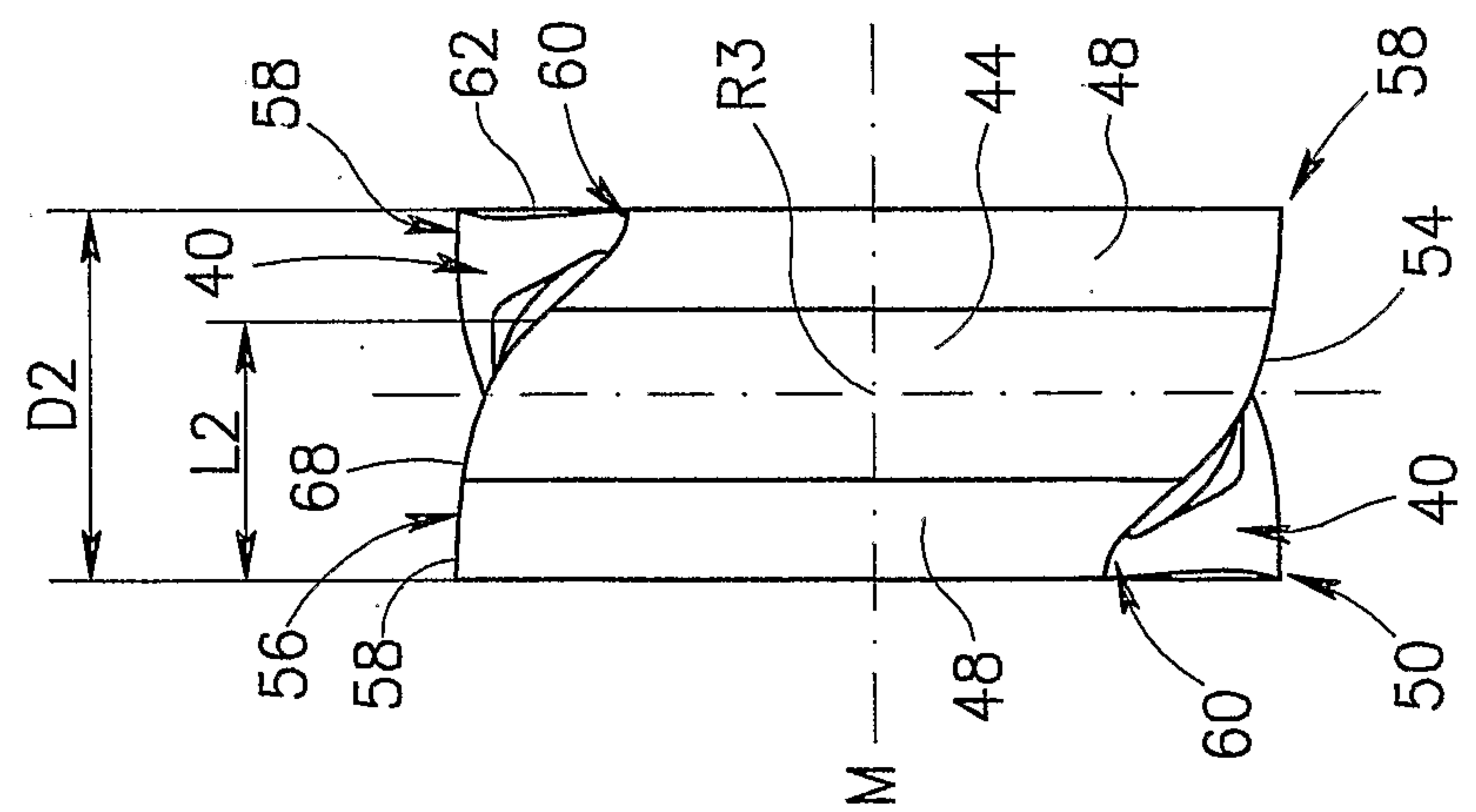
58
62
60
R3
44
48
58
40
54
D2
L2
68
40
56
58
48
M
60
50

FIG.5

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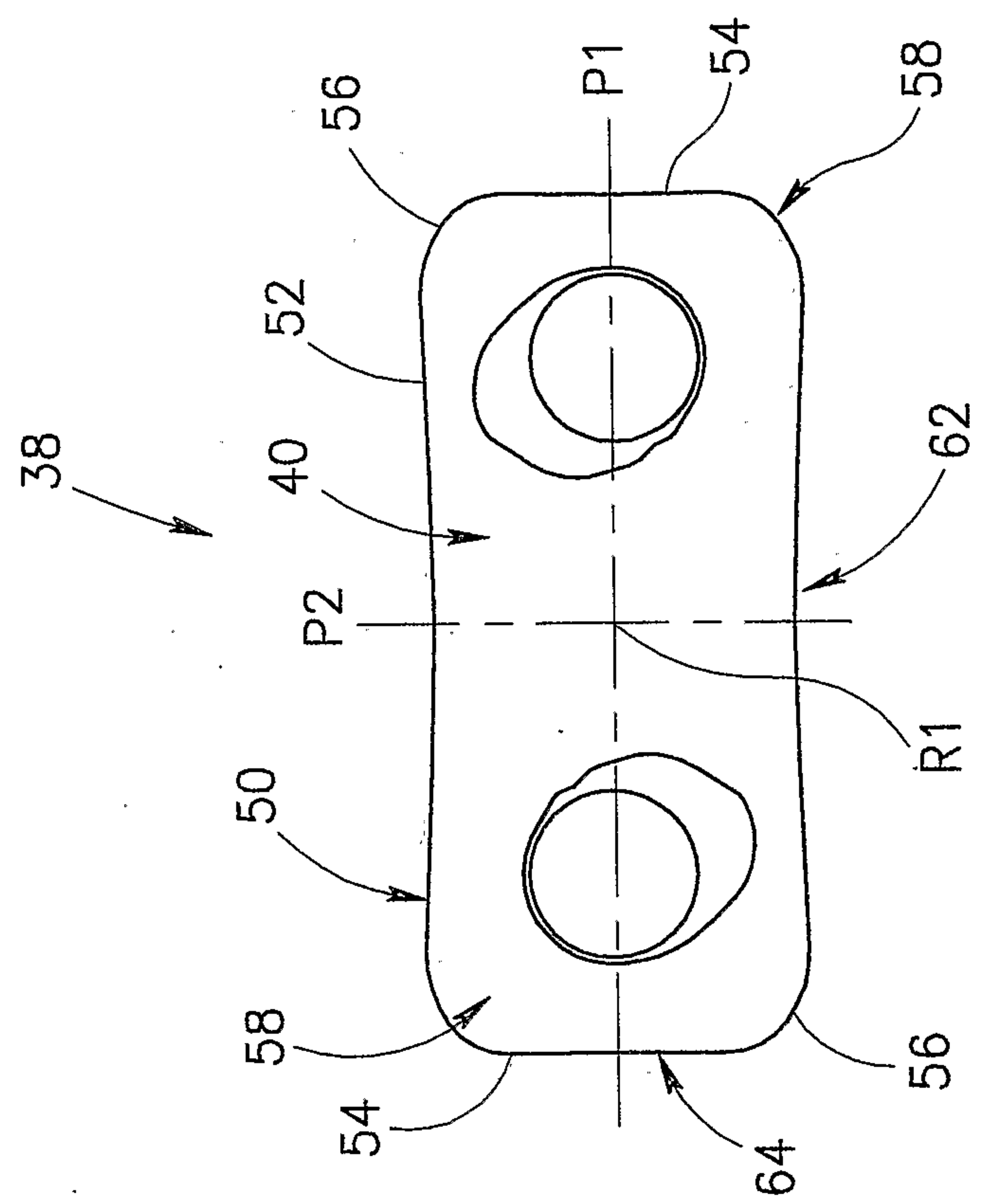

FIG.8

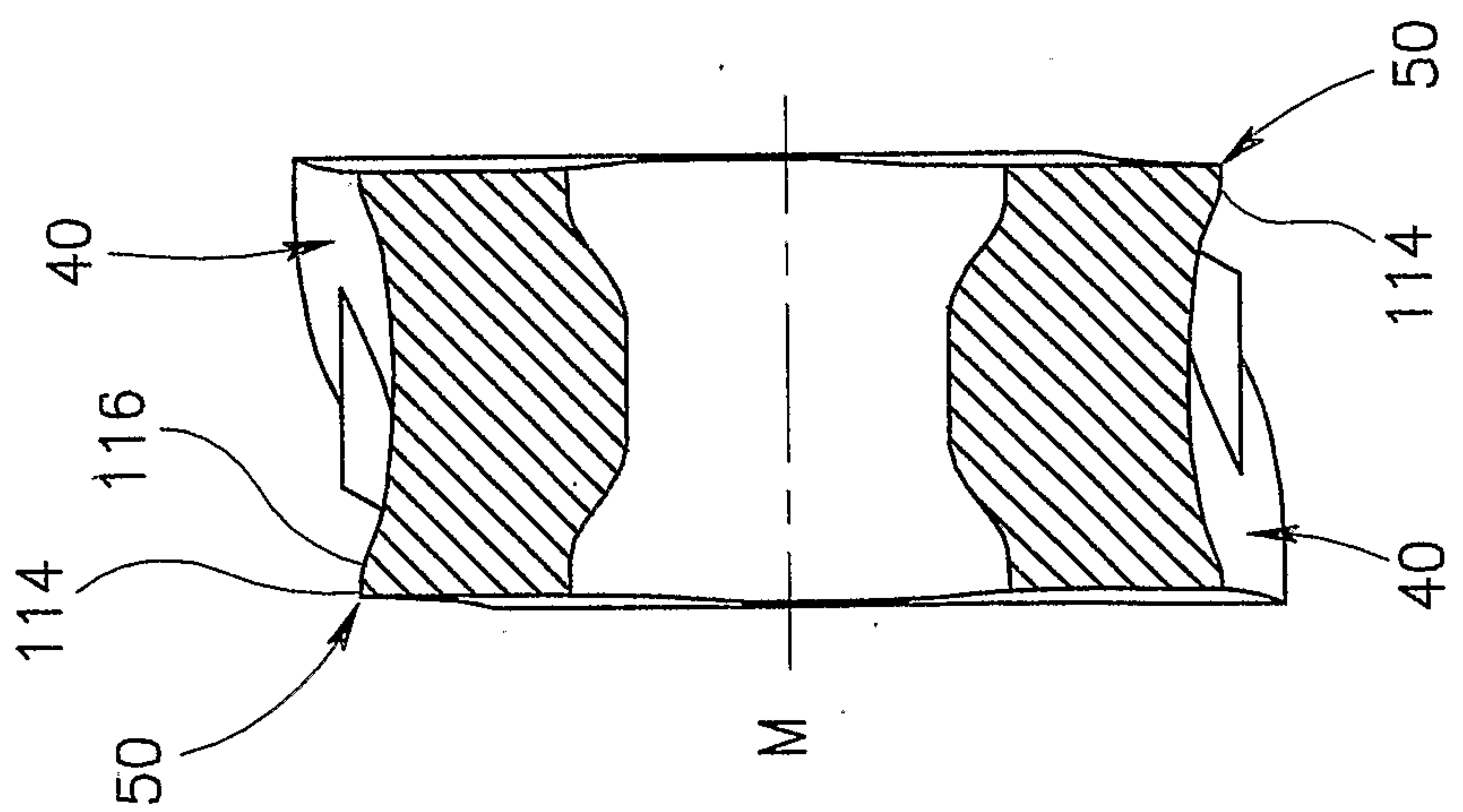

FIG.7

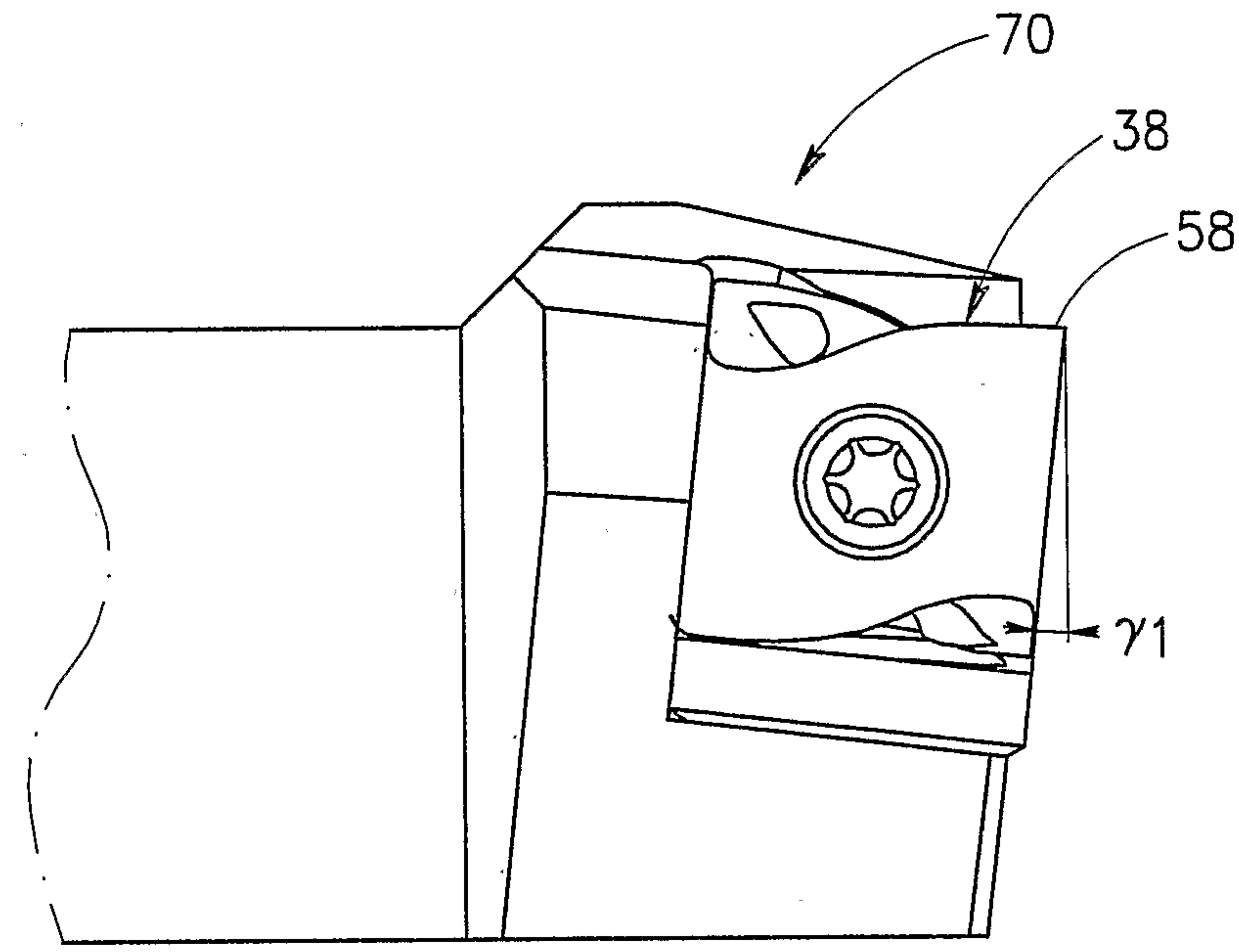

FIG.9

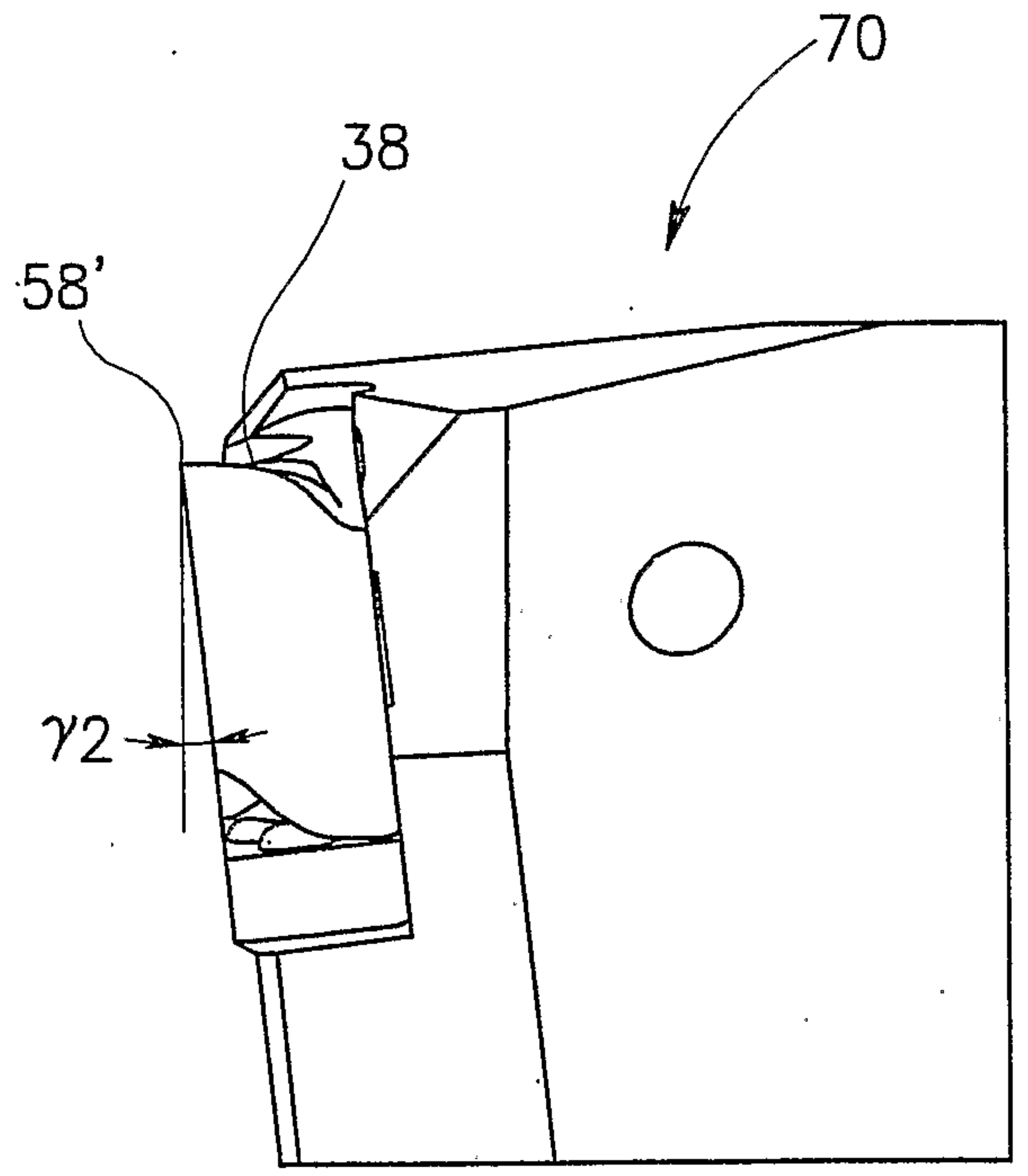

FIG.10

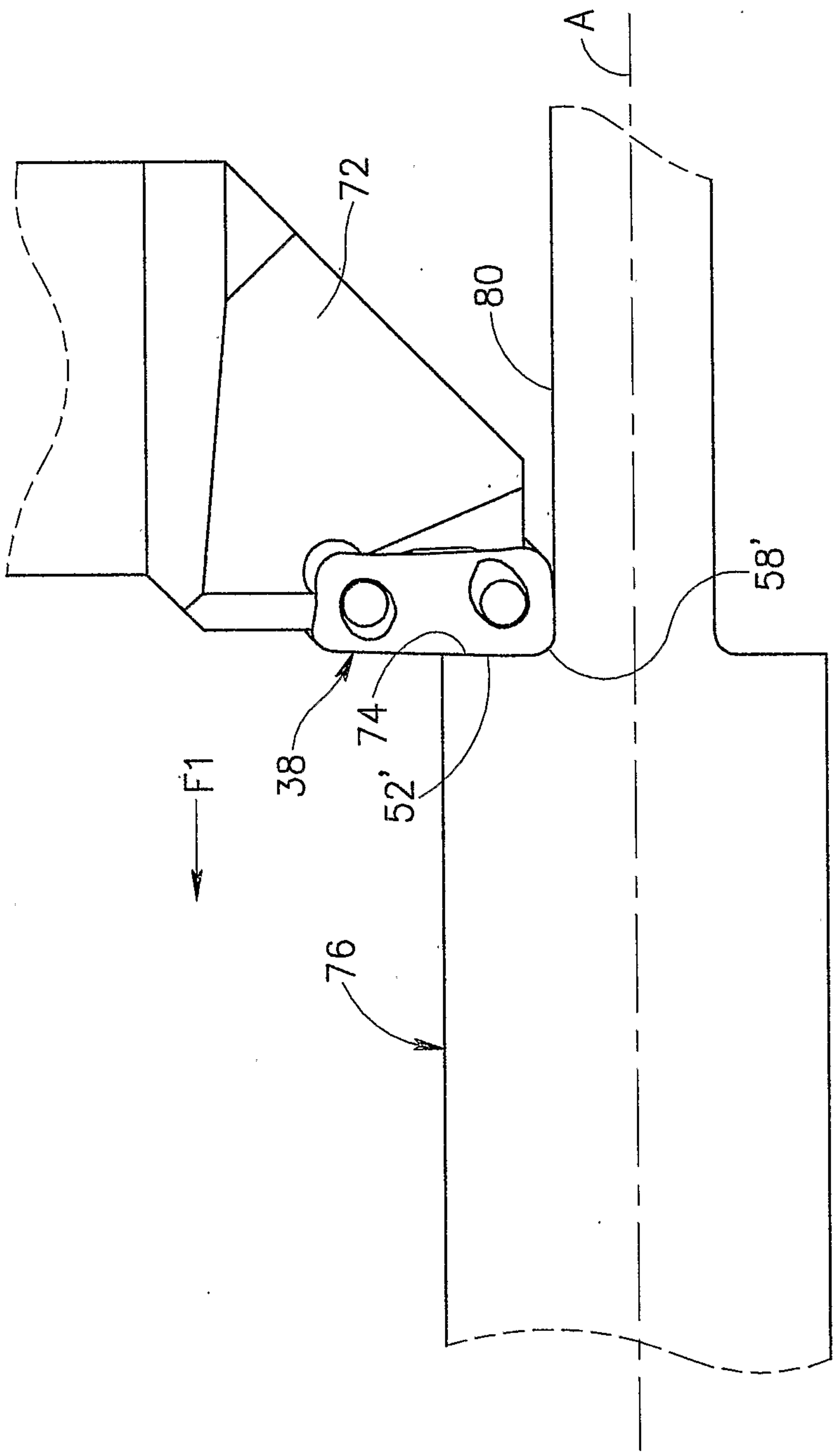

FIG.11

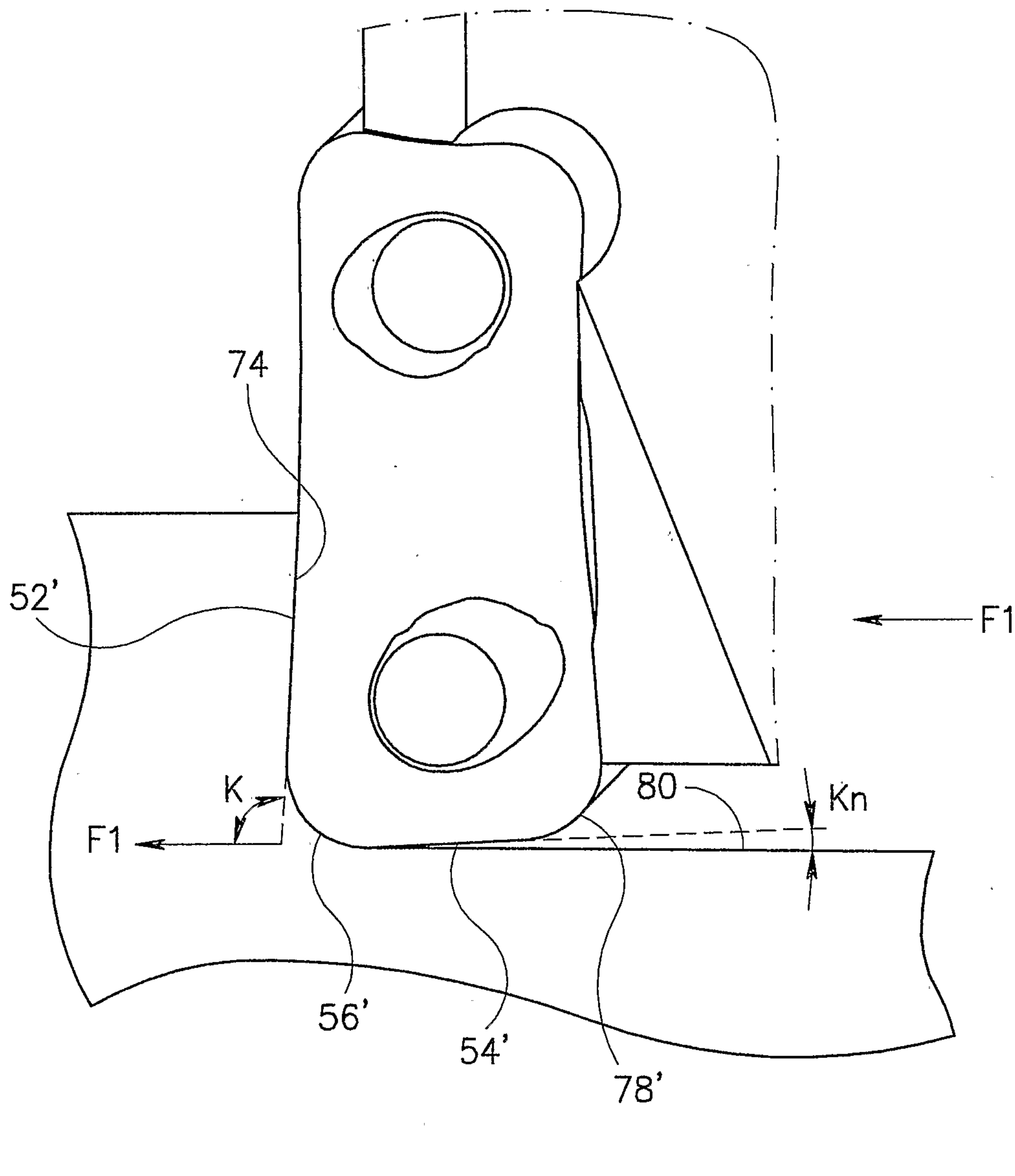

FIG.12

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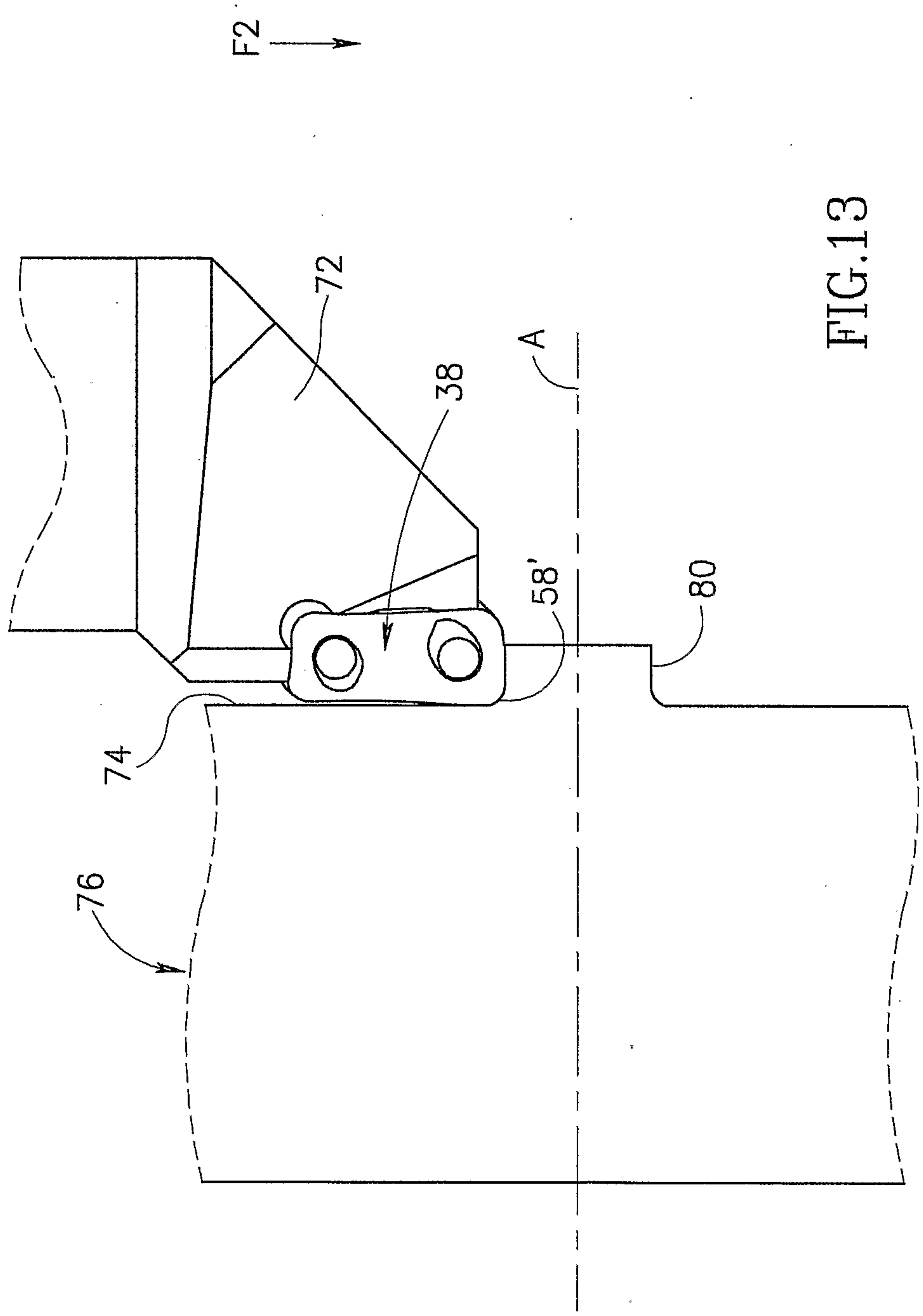

FIG.13

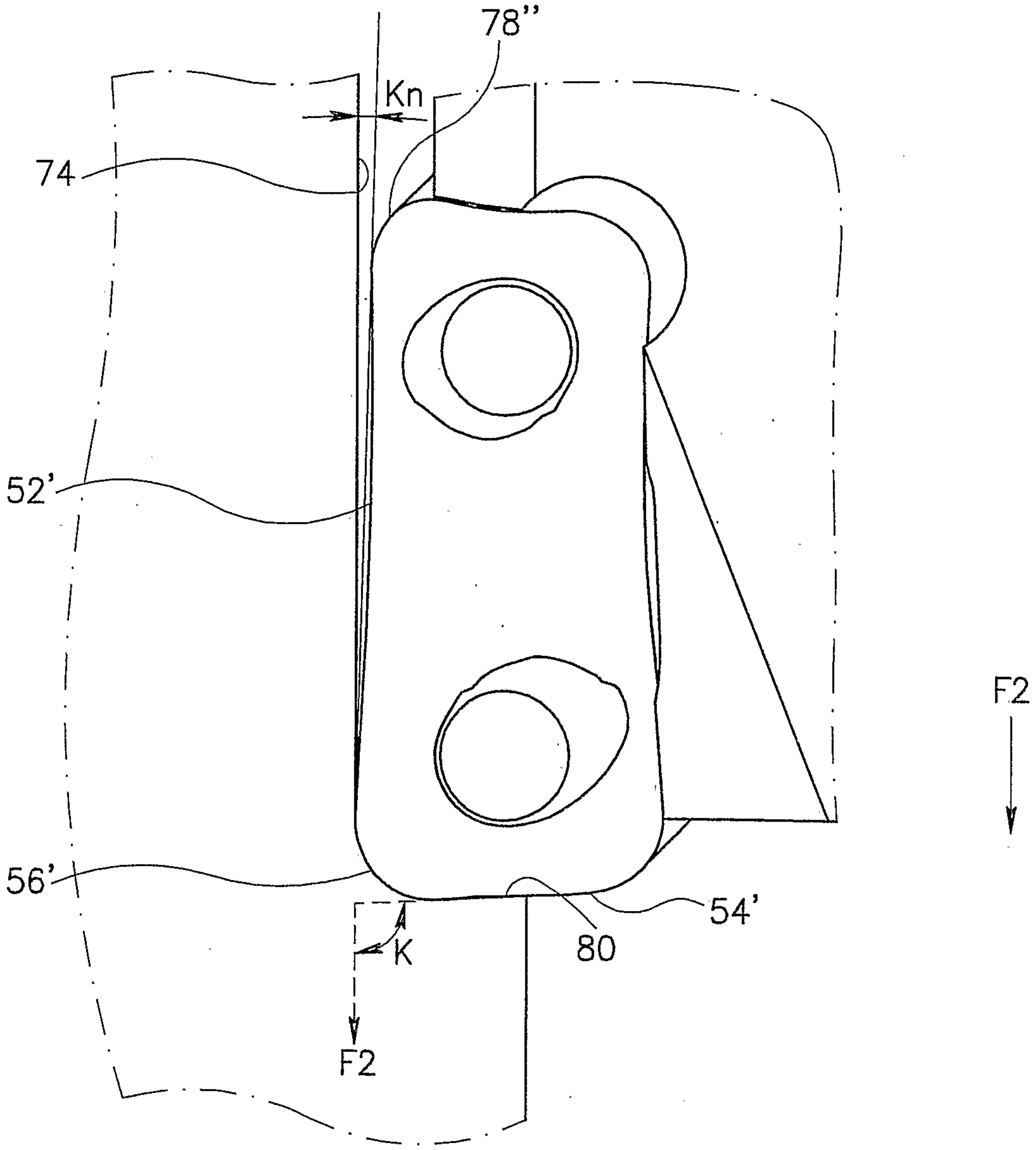

FIG.14

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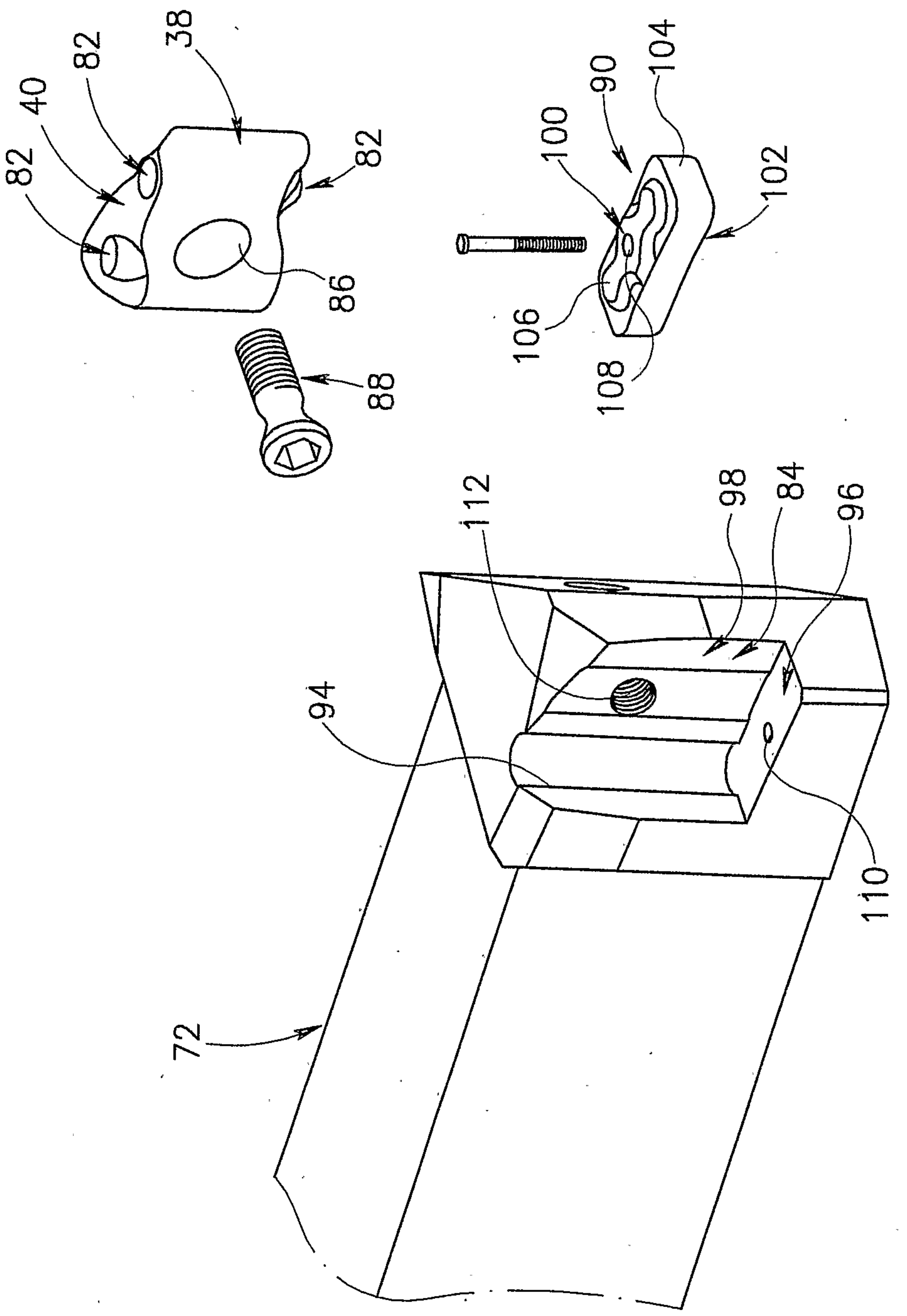


FIG.15

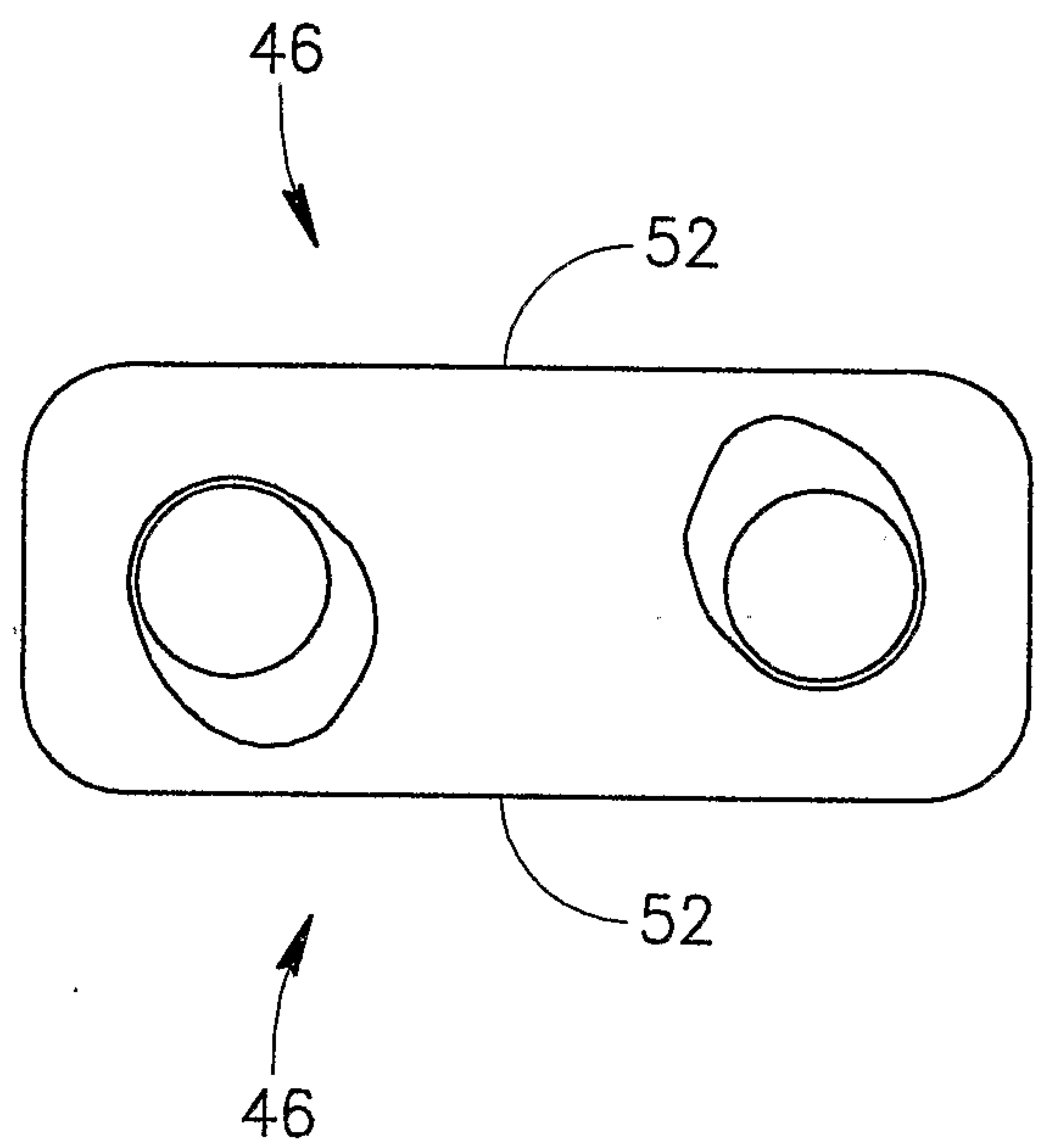
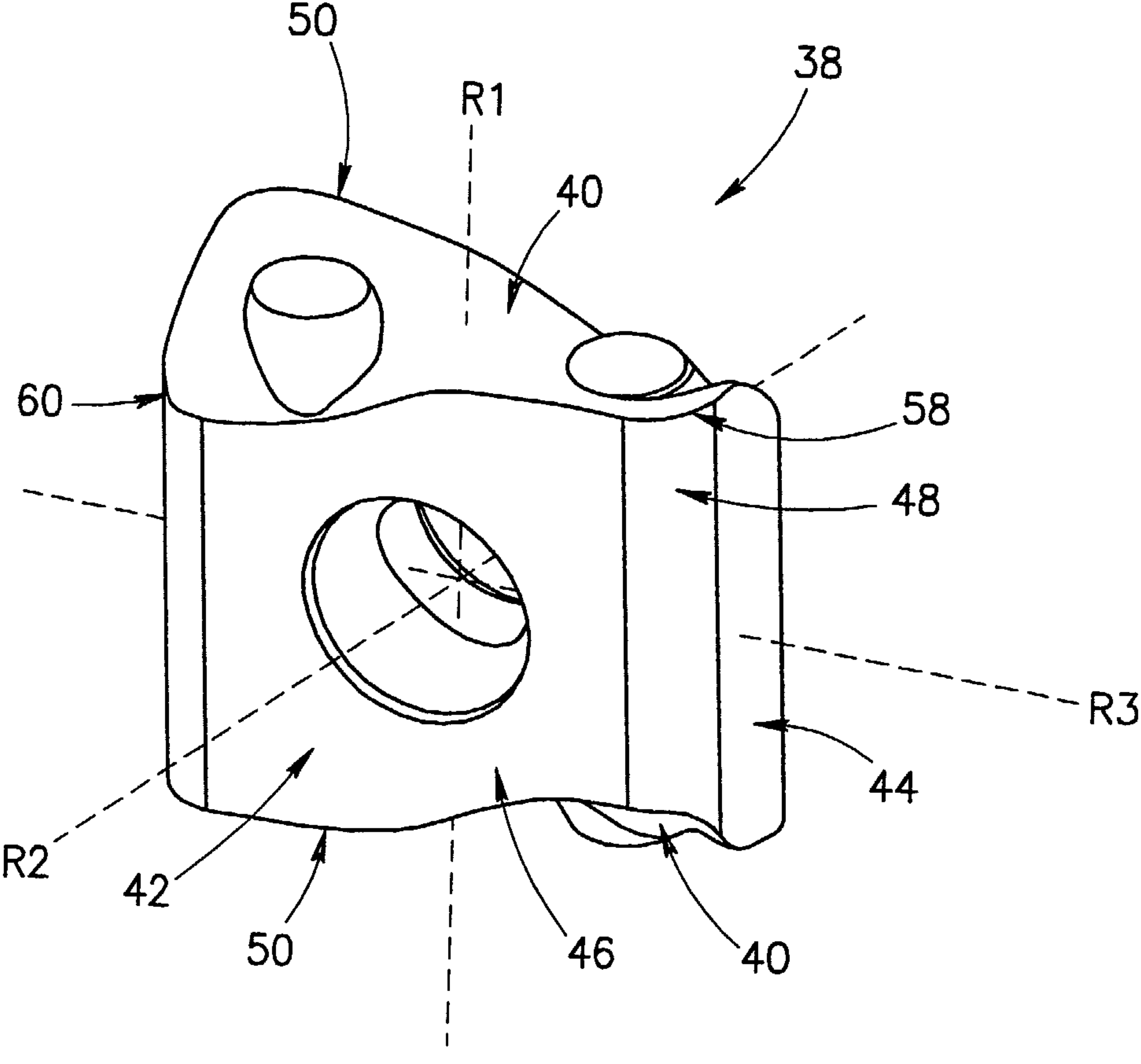


FIG.16


50
38
R1
40
60
58
48
R3
44
R2
42
50
46
40