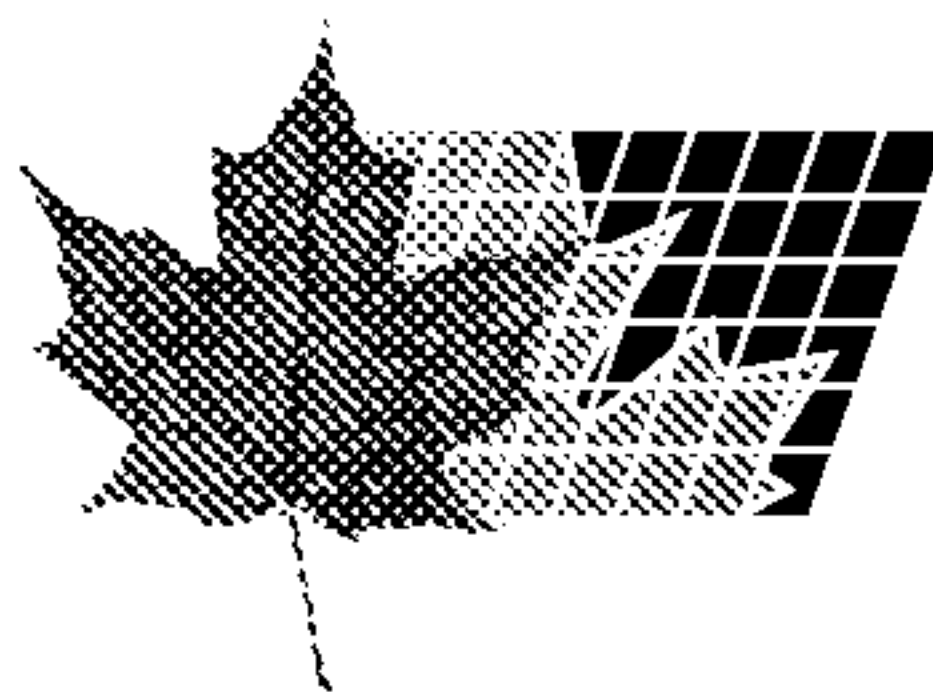
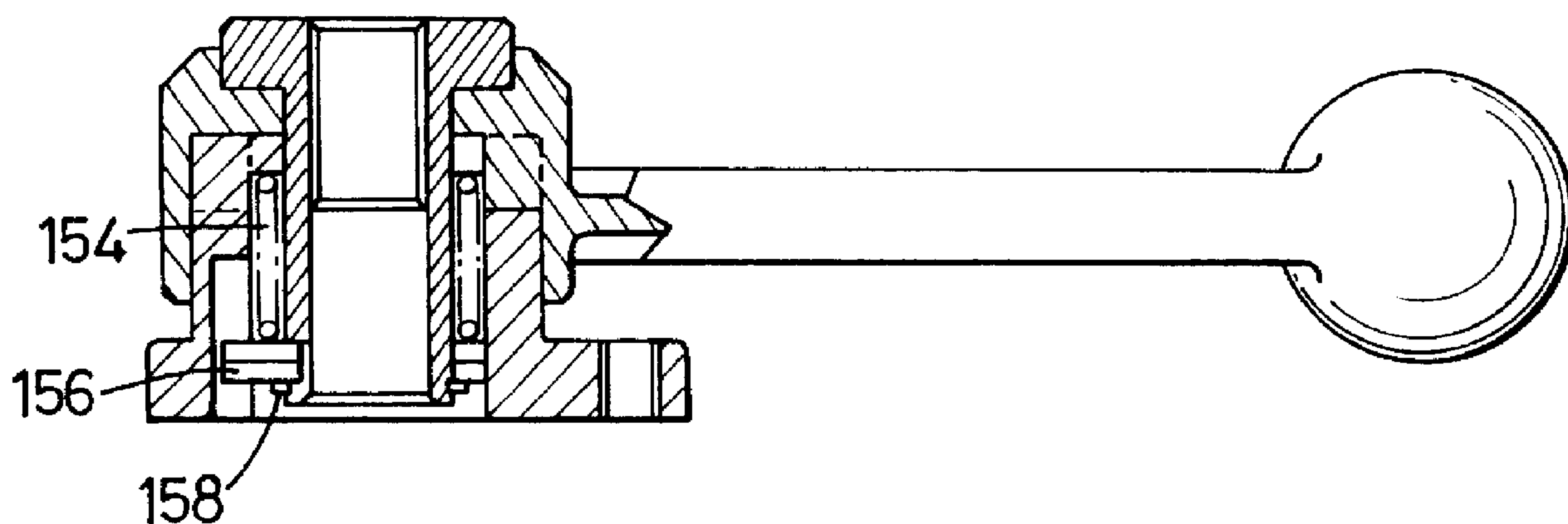




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(54) **MANDRIN POUR CAME**
(54) **CAM RAM**



(57) Un serre-joint pour assujettir une pièce à travailler, comprenant une base (101), une unité de serrage (103) montée sur la base pour permettre un mouvement linéaire par rapport à ladite base (101), et un élément d'entraînement (102) monté, lui aussi, à la base pour permettre un déplacement rotatif par rapport à la base. Les premier et deuxième éléments de la came (114, 138), qui constituent des cames confrontées et dont au moins un comporte au moins une des parties à pas différent, figurent sur le mécanisme d'entraînement et sur la base. Cette disposition permet à une rotation de l'élément d'entraînement (102) relative à la base (101) d'imprimer un mouvement linéaire à l'unité de serrage (103), relativement à la base.

(57) A clamp for clamping a workpiece comprises a base member (101), a clamping member (103) mounted on the base member for linear movement relative thereto and a drive member (102) mounted on the base member for rotary movement relative thereto. First and second cam elements (114, 138) comprising a face cam are provided on the drive member and the base member, at least one of said cam elements including at least two portions of different pitch. The arrangement is such that rotation of the drive member (102) relative to the base member (101) causes linear movement of the clamping member (103) relative to the base member.

Abstract

CLAMP

5 A clamp for clamping a workpiece comprises a base member
(101), a clamping member (103) mounted on the base member
for linear movement relative thereto and a drive member
(102) mounted on the base member for rotary movement
relative thereto. First and second cam elements (114, 138)
10 comprising a face cam are provided on the drive member and
the base member, at least one of said cam elements
including at least two portions of different pitch. The
arrangement is such that rotation of the drive member (102)
relative to the base member (101) causes linear movement of
15 the clamping member (103) relative to the base member.

FIGURE 2

CLAMP

The present invention relates to a clamp. In particular,
5 but not exclusively, the invention relates to a clamp for
exerting a pushing or pulling force on a workpiece.

An example of a clamp for exerting a pushing or pulling
force on a workpiece is that sold by HMC-Brauer Limited
10 under the model numbers CP1005 to CP1008. This clamp has
a roller cam comprising a pair of rollers mounted on spur
axles that engage helical tracks provided in the inner
cylindrical surface of the clamp body. Rotating a handle
causes the rollers to move along the helical tracks, which
15 drives a clamping member in the axial direction of the
clamp. The helical tracks include portions of steep and
shallow pitch, which allow the clamping member to be
brought rapidly into engagement with the workpiece before
the clamping force is applied. The clamp is very quick and
20 simple to apply, with a single movement of the handle
providing both the initial fast travel of the clamping
member and also the final clamping force.

The main problem with the clamp described above is that
25 axles of the roller bearings may shear or be distorted if
an excessive force is applied. The nominal maximum holding
force of the clamp is therefore only 500daN, which can
easily be applied with a hand impact on the handle. In
practice in the workshop, the clamps are often mistreated
30 and a mallet may be used to increase the clamping force.
This frequently leads to damage to the clamp.

The above mentioned problem is compounded by the fact that
travel of the clamping member is limited by the length of
35 the helical tracks. If the rollers reach the ends of the
tracks before a sufficient clamping force has been applied,
there will be a temptation to apply the clamp harder as
there is no clear indication that the point of maximum
travel has been reached. This is again likely to cause

damage to the clamp.

A further disadvantage of the clamp is that it is relatively complicated and expensive to manufacture.

5

It is an aim of the present invention to provide a clamp that mitigates at least some of the above-mentioned disadvantages.

10 According to the present invention there is provided a clamp for clamping a workpiece, the clamp comprising a base member, a clamping member mounted on the base member for linear movement relative thereto, a drive member mounted on the base member for rotary movement relative thereto, a
15 first cam element provided on the drive member and a second cam element provided on either the base member or the clamping member and engaging the first cam element, said first and second cam elements comprising a face cam, at least one of said cam elements including at least two
20 portions of different pitch, the arrangement being such that rotation of the drive member relative to the base member causes linear movement of the clamping member relative to the base member.

25 The use of a face cam rather than roller cams ensures that the cam elements are always in compression, which allows far higher clamping forces to be applied. All clamping elements of the clamp are, in fact, solely in compression during use, and this means that the clamp is extremely
30 robust. The use of a mallet to apply the clamping force is therefore permissible.

Because the cam includes two portions of different pitch, the clamp can provide a fast initial travel followed by a
35 high clamping force. As with the prior art clamp described above, both the initial travel and the clamping force are applied with a single movement of the handle and this makes

the clamp very quick and simple to use.

It is possible to form the face cams integrally with the drive member and the handle member or the base member, for example by investment casting. This makes the clamp very simple and inexpensive to manufacture and assemble.

Advantageously, at least one of said cam elements includes a portion of shallow pitch and a portion of steep pitch. Preferably, at least one of said cam elements includes upper and lower portions of shallow pitch and an intermediate portion of steep pitch.

The shallow pitch of the cam surfaces is such that the clamp does not release itself.

The first and second cam elements are advantageously matched substantially to one another. This maximises the contact area of the cam elements, so reducing friction and minimising wear on the cam surfaces.

The clamp may include a resilient member arranged to resiliently oppose linear movement of said clamping member in a first direction. The resilient member, which may be a spring, may be employed to ensure rapid return of the clamping element when the clamp is released. The resilient member advantageously biases said first and second cam elements towards one another.

The first and second cam elements are advantageously arranged to permit continuous rotation of said drive member in the clamping direction. This prevents the clamp being damaged in an attempt to force the handle beyond a fixed stop. If the handle is rotated beyond the point corresponding to maximum travel of the cam elements, which is indicated by alignment of marks on both the base member and the drive member, the clamp is released and incomplete

clamping is indicated audibly and visually.

The cam elements may include stop surfaces to limit rotation of said drive member in a second direction of rotation. This ensures that the handle always returns to the same position when the clamp is released.

The clamp may include means for preventing rotation of the clamping member relative to the base member, thereby preventing damage to the surface of the workpiece.

Alternatively, the clamp may include a lost motion mechanism to allow limited rotational movement of said clamping member relative to said base member. Rotation of the clamping member may be useful for providing additional clearance for insertion or removal of a workpiece. Such a lost motion mechanism is described in the applicant's co-pending British patent application No. , filed on even date herewith, the contents of which are incorporated herein by reference.

The drive member may include a handle for manual rotation thereof.

Advantageously, the clamping member is arranged to engage the workpiece at a point substantially aligned with the axis of rotation of the drive member and to exert a clamping force on the workpiece substantially in the direction of that axis.

30

Advantageously, the base member and the drive member comprise metal castings.

An embodiment of the invention will now be described, by way of example, with reference to the accompanying drawings, of which:

Fig. 1 is a side view of the clamp;

Fig. 2 is a side view of the clamp partly in cross-section;

5 Fig. 3 is a bottom view of the clamp;

Fig. 4 is a top view of the base;

Fig. 5 is a side view of the base;

10

Fig. 6 is a bottom view of the base;

Fig. 7 is a side view of the base in cross-section;

15 Fig. 8 is a schematic representation of the profile of the
base cam surface;

Fig. 9 is a top view of the handle;

20 Fig. 10 is a side view of the handle;

Fig. 11 is a bottom view of the handle;

Fig. 12 is a side view of the handle partly in cross
25 section;

Fig. 13 is a schematic representation of the profile of the
handle cam surface;

30 Fig. 14 is a side view of the clamping member;

Fig. 15 is a side view of the clamping member in cross
section;

35 Fig. 16 is a bottom view of the clamping member, and

Fig. 17 is a bottom view of the washer.

An embodiment of the clamp, which may be described as a cam ram, is shown in Figs. 1 to 3. The clamp comprises a base 101, a handle 102 and a clamping member 103.

5 The base 101, which is shown in more detail in Figs. 4 to 8, comprises a substantially triangular base plate 105 and a substantially cylindrical body member 106 of outside radius R_0 that extends perpendicularly to the plane of the base plate 105. Three holes 108 are provided in the base
10 plate 105, one adjacent each corner, which receive bolts for mounting the clamp in use on a work bench or machine tool. Three index marks 109 are provided around the circumference of the body member 106.

15 A cylindrical bore 110 of radius R_1 extends axially through the body member 106. Rectangular recesses 112 that extend from the lower surface of the base 101 to approximately two-thirds its height are formed in opposite sides of the cylindrical wall of the bore 110.

20

The upper face of the cylindrical body member 106 is formed as a cam surface 114. The profile of the cam surface 114 is shown in Fig. 8 and comprises three identical equi-
angularly spaced portions, each of which includes a shallow
25 pitch lower section 116, a steep pitch middle section 118 and a shallow pitch upper section 120. In the embodiment shown in the drawings, the lower and upper sections 116, 120 each extend through an arc of approximately 50° and have a pitch at the outside edge of the cam surface producing a
30 rise of 1mm. The middle sections 118 each extend through an arc of approximately 20° and have a pitch at the outside edge producing a rise of 6mm. The total rise of the cam surface is approximately 8mm. The ends of adjacent portions of the cam surface 114 are connected by
35 substantially vertical walls that form stop surfaces 121.

The upper sections 120 of the cam surface 114 extend

radially inwards, forming lugs 122. The inner edges of the lugs 122 are coincident with an imaginary concentric circle of radius R_2 where $R_2 < R_1$.

5 The handle 102, which is shown in more detail in Figs. 9 to 13, comprises a substantially cylindrical body member 124 and a handle member 126 that extends substantially radially therefrom. The handle member 126 has an H-shaped cross-section and tapers towards its remote end. At the remote
10 end of the handle member 126 there is provided a hand grip 128 in the form of a spherical ball.

The upper and lower edges of the cylindrical handle body member 124 are chamfered, as shown in the drawings. An
15 index mark 129 is provided on the cylindrical surface of the body member 124, at a point displaced at an angle of 180° to the longitudinal axis of the handle member 126.

A cylindrical bore extends through the handle body member
20 124, the bore comprising a lower portion 130 of radius R_3 , a middle portion 132 of radius R_4 and an upper portion 134 of radius R_5 , where $R_4 = R_2$, R_3 is slightly larger than R_0 and $R_3 > R_5 > R_4$. The body member 124 therefore includes an inwardly-extending circular flange 136, defined by the
25 portion of the bore having a radius R_3 .

Provided on the lower surface of the flange 136 is a cam surface 138. The profile of the cam surface 138 is shown in Fig. 13 and is matched to that of the base body member
30 cam surface 114. The cam surface thus comprises three identical equi-angularly spaced portions, each of which includes a shallow pitch lower section 116a, a steep pitch middle section 118a and a shallow pitch upper section 120a. The ends of adjacent portions of the cam surface 138 are
35 connected by substantially vertical walls that form stop surfaces 121a. The cam surface 138 extends radially inwards from the cylindrical wall of the lower bore section

130 to a radius R_6 , where $R_3 > R_6 > R_4$ and R_6 is approximately equal to R_1 .

The handle 102 is mounted for rotation on base body 101,
5 with the upper part of the base body member 106 extending into the bore lower portion 130. The cam surfaces 114, 138 of the body member 106 and the handle 102 engage one another.

10 The clamping member 103, which is shown in more detail in Figs. 14 to 16, comprises a substantially cylindrical body member 140 of radius R_7 and a circular disc 142 of radius R_8 at the upper end thereof, where R_8 is slightly less than R_5 and R_7 is slightly less than R_4 . The upper edge of the
15 disc 142 is chamfered and the upper face 144 of that disc forms the work engaging face of the clamp.

A plain cylindrical bore 146 of radius R_9 extends axially through the body member 140 and the disc 142. Optionally,
20 the bore 146 may be provided with a screw thread 147 to permit a force transmitting rod or an alternative work engaging face (neither shown) to be attached to the clamp. At the lower end of the body member 140 there are provided two rectangular cut outs 148. A peripheral groove 150 is
25 formed in the cylindrical wall of the body member 140, adjacent its lower end.

A compression spring 154 is seated within the base bore lower portion 106 and abuts at its upper end the lower
30 surfaces of the lugs 122. The lower end of the spring engages a pair of washers 156 that surround the lower end of the clamping member 103 and are held in position by a circlip 158 that engages the peripheral groove 150.

35 Each washer 156, shown in more detail in Fig. 17, includes two pairs of radially inwards- and outwards-extending tabs 160, 162 that engage respectively the cut outs 148 of the

clamping member 103 and the rectangular recesses 112 of the base 101. This prevents rotation of the clamping member 103 with respect to the base 101 but allows linear axial relative movement thereof. The spring 154 serves to bias the clamping member 103 axially downwards (i.e. towards the base plate 105).

The base 101 and the handle 102 are manufactured from alloy steel, for example nickel carbon steel, by investment casting (e.g. by lost wax casting). Precision casting techniques are employed, providing tolerances of ± 0.005 " per inch (± 0.12 mm per 25mm). This precision allows the parts to be assembled with almost no machining. The castings are case hardened to provide a high surface hardness for the cams and a tough core for compressive strength. The castings are finished with manganese phosphate, which provides corrosion resistance. The clamping member 103 is machined from carbon nickel alloy barstock.

20

Operation of the clamp will now be described with reference to Figs. 1 to 3. In the rest position as shown in those drawings, the cam surfaces 114,138 are held in full mating engagement by the biasing force of the spring 154. In this position, the clamping member 103 is clear of the workpiece, which allows the workpiece to be placed in position.

As the handle is rotated in the direction of the arrow A (clockwise when seen from above), the mutual engagement of the steep pitch middle portions 118,118a of the cam surfaces 114,138 causes the clamping member 103 to rise rapidly into a position where it is nearly in engagement with the workpiece. In the embodiment, a fast rise of 6.0mm is provided.

When the handle has rotated through an angle of

approximately 20°, the steep pitch middle portions 118, 118a reach the end of their travel and the lower cam sections 116a of the handle 102 come into engagement with the upper cam sections 120 of the base 101. These cam sections have a shallow pitch and it is therefore possible to apply a large clamping force to the workpiece by rotation of the handle 102. In the embodiment, the handle may be rotated through a further 100°, producing a clamping rise of 2.0mm. Throughout both fast and clamping travel of the clamping member, rotation of the clamping member is prevented, so avoiding damage to the surface of the workpiece. The limits of the fast and clamping travel movements are indicated by alignment of the index marks 109,129 on the base 101 and the handle 102.

15

In order to release the clamp, the handle 102 is rotated back in the anti-clockwise direction until the cam surfaces 114,138 are once again in full mutual engagement. Further anti-clockwise rotation of the handle beyond this point is prevented by the engagement of the substantially vertical stop surfaces 121,121a. The clamping member 103 is driven back to its rest position under the biasing force of the spring 154.

25 The clamping force exerted on the workpiece is, of course, dependent on the force applied to the handle 102. The clamp is designed to be able to withstand the use of a mallet to apply and release the clamp.

30 If the clamp is over tightened, there is a possibility that the cam surfaces may be left at the very limit of their travel. Such a situation is potentially dangerous since it is possible that cams could slip over onto the next surface, thereby releasing the clamp.

35

In order to reduce this danger, the limit of acceptable tightening is indicated by alignment of the index marks

109,129 on the base 101 and the handle 102. If the handle is rotated in the clockwise direction through more than 120° from the rest position, the lower cam sections 116a of the handle 102 will slip off the ends of the upper cam sections 120 of the base 101 and the clamping member will be driven back to the rest position by the spring 154. This produces an audible clicking noise, which warns the operator that the clamp has not been successfully applied.

10 As will be apparent from the above description, the clamp can be applied and released with only single movements of the handle 102. The clamp is therefore very quick and easy to use. The clamp is also capable of applying very high clamping forces, since all the force transmitting parts of, 15 the clamp are in compression.

Various modifications of the clamp are envisaged. For example, the slope of the cam sections may be reversed, so that clamping is produced by anti-clockwise rather than 20 clockwise rotation of the handle 102, and the mutually engaging cam surfaces 114,138 may be provided on the handle 102 and the clamping member 103, instead of the base 101 and the handle 102. Further, by providing a connecting rod that is attached to the clamping member 103 and extends 25 downwards through the bore 146 and out through the base plate 105, the clamp may be used to provide a pulling force rather than a pushing force. Alternatively, a pulling force may be provided by switching the relative positions of the handle 102 and the clamping member 103. If the 30 clamping member is provided with a radially-extending arm, the clamp may be employed as a down-thrust clamp.

Whilst the profile of the cam surfaces 140,172 that is described above is preferred, it is envisaged that the cam 35 surfaces may take other forms: for example, the pitches and lengths of the steep pitch and shallow pitch sections may be varied. It is, however, important that the pitch of the

shallow pitch sections is large enough to produce sufficient axial travel, whilst being small enough to produce the required clamping force and to prevent the clamp releasing itself.

5

Although it is preferred that the two cam surfaces should be matched to one another, this is not essential. Instead, a cam and cam follower arrangement could be provided.

10

Claims

1. A clamp for clamping a workpiece, the clamp comprising
a base member, a drive member mounted on the base member
5 for rotary movement relative thereto about an axis of
rotation, a clamping member mounted on the base member for
linear movement relative thereto in the direction of said
axis of rotation, at least one engaging element having
parts fitted in corresponding portions of the clamping
10 member and the base member, wherein the engaging element is
constructed and arranged to prevent relative rotation
between the clamping and the base members while permitting
said linear movement, said clamping member having a
workpiece engaging portion for engaging a workpiece at a
15 point substantially aligned with said axis of rotation and
exerting a clamping force on the workpiece substantially in
the direction of said axis of rotation, a first cam element
provided on the drive member and a second cam element
provided on either the base member or the clamping member
20 and engaging the first cam element, said first and said
second cam elements comprising a face cam, at least one of
said cam elements including at least two portions of
different pitch, wherein rotation of the drive member
relative to the base member causes linear movement of the
25 clamping member relative to the base member in the
direction of said axis rotation.

2. A clamp according to claim 1, in which at least one of
said cam elements includes a portion of shallow pitch and
30 a portion of steep pitch.

3. A clamp according to claim 2, in which at least one of
said cam elements includes upper and lower portions of
shallow pitch and an intermediate portion of steep pitch.

4. A clamp according to claim 1, in which the first and second cam elements are matched substantially to one another.

5 5. A clamp according to claim 1, including a resilient member arranged to resiliently oppose linear movement of said clamping member in a first direction.

6. A clamp according to claim 5, wherein said resilient member biases said first and second cam elements towards one another.

7. A clamp according to claim 1, wherein said first and second cam elements are arranged to permit continuous rotation of said drive member in a first direction of rotation.

8. A clamp according to claim 1, wherein said cam elements include stop surfaces to limit rotation of said drive member in a second direction of rotation.

9. A clamp according to claim 1, including means for preventing rotation of the clamping member relative to the base member.

25

10. A clamp according to claim 1, including a lost motion mechanism to allow limited rotational movement of said clamping member relative to said base member.

30 11. A clamp according to claim 1, wherein said drive member includes a handle for manual rotation thereof.

12. A clamp according to claim 1, wherein the base member and the drive member comprise metal castings.

35

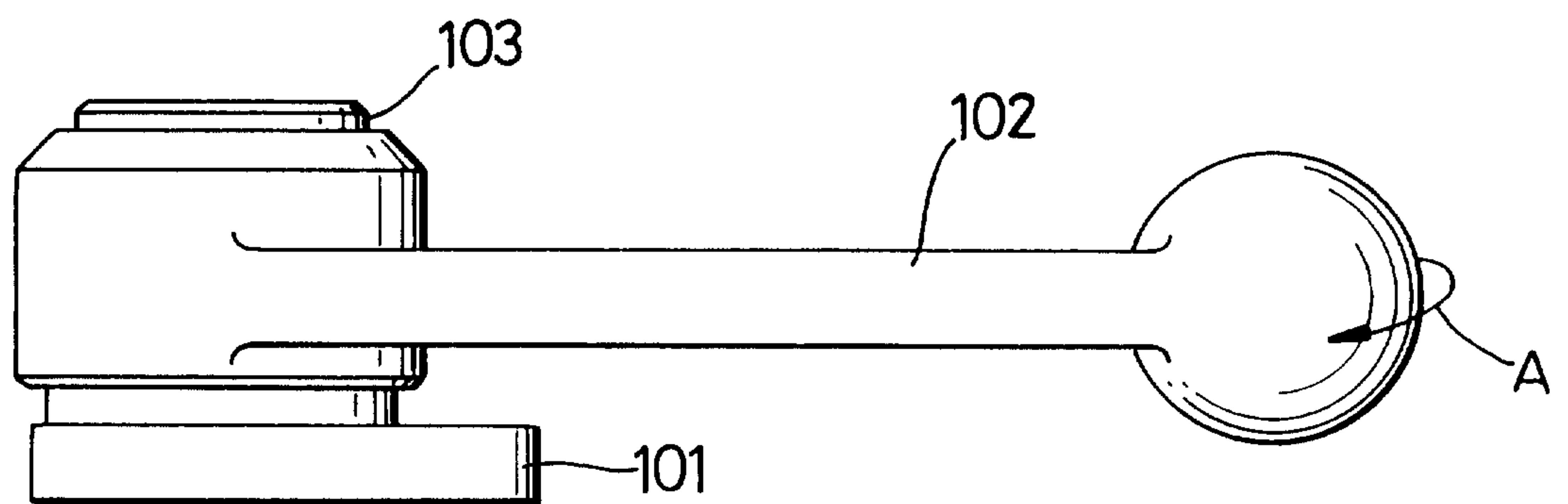


Fig. 1

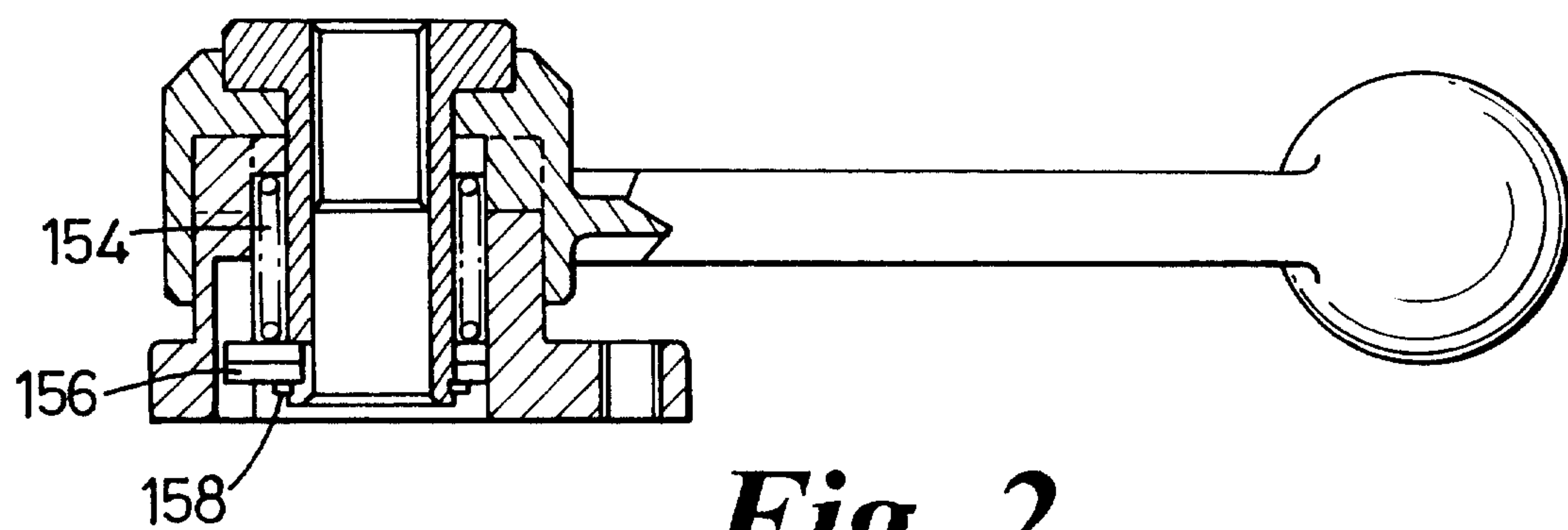


Fig. 2

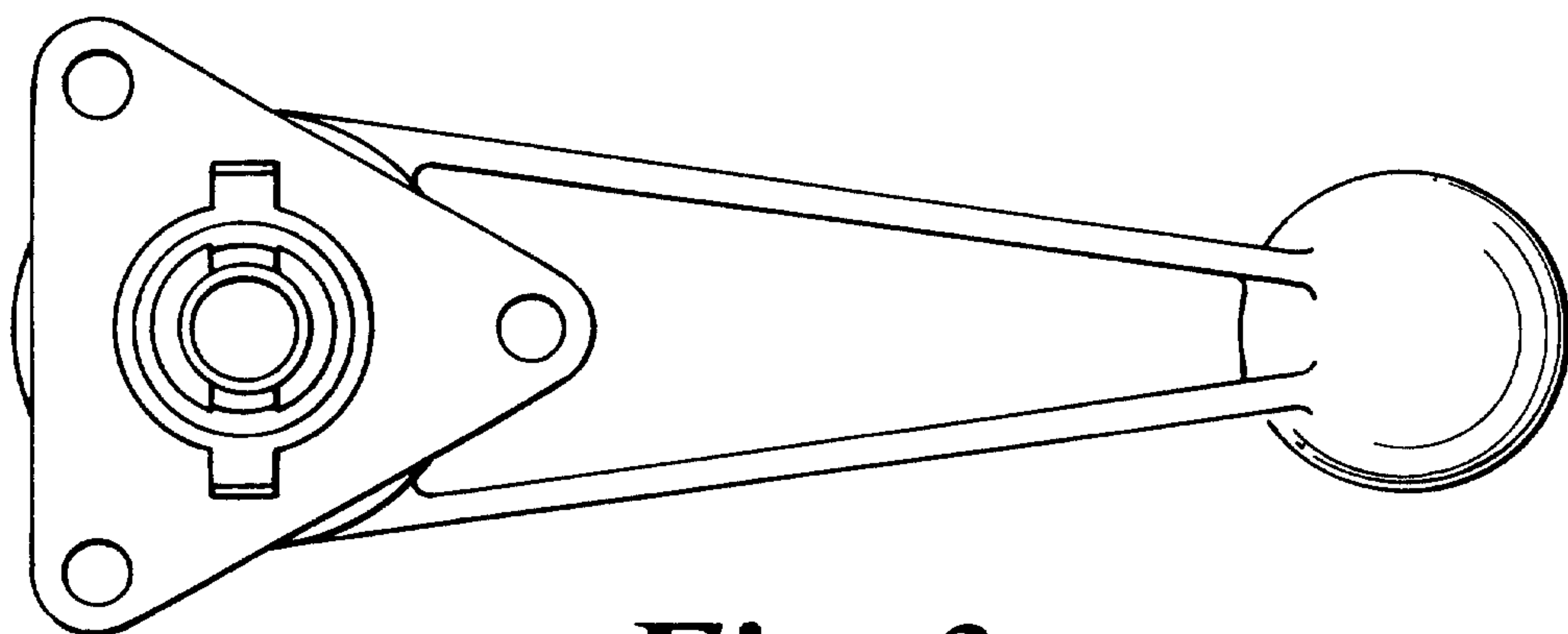


Fig. 3

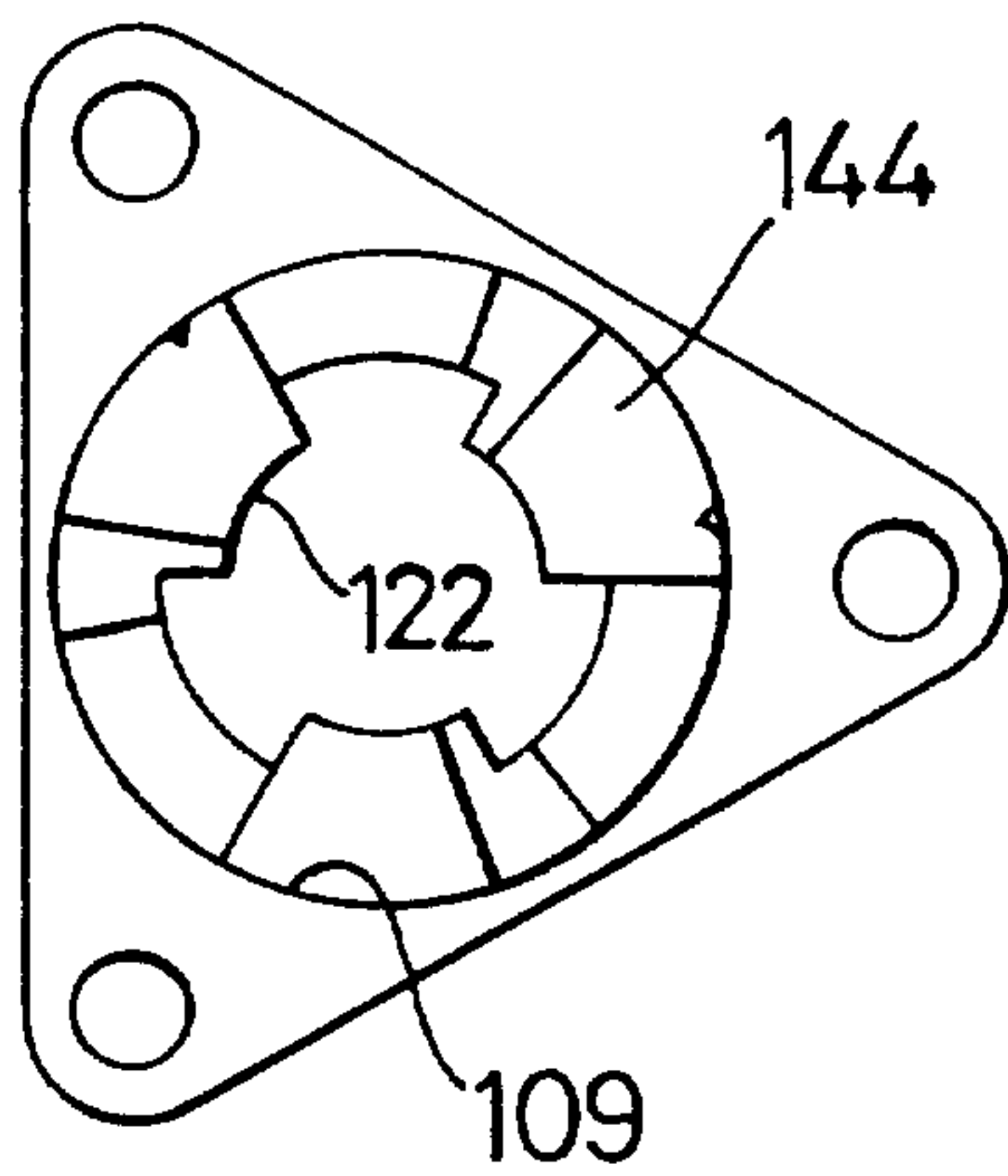


Fig. 4

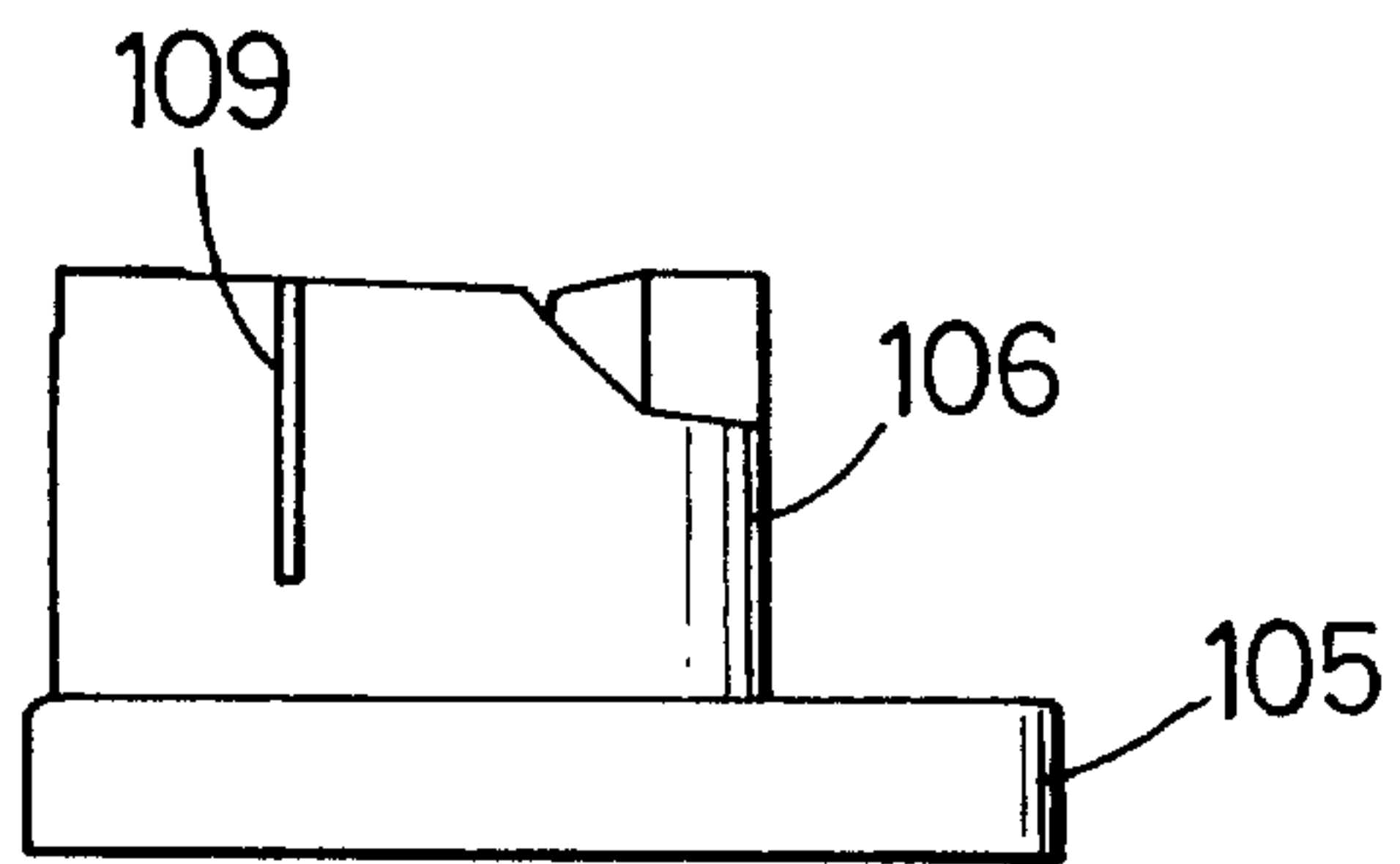


Fig. 5

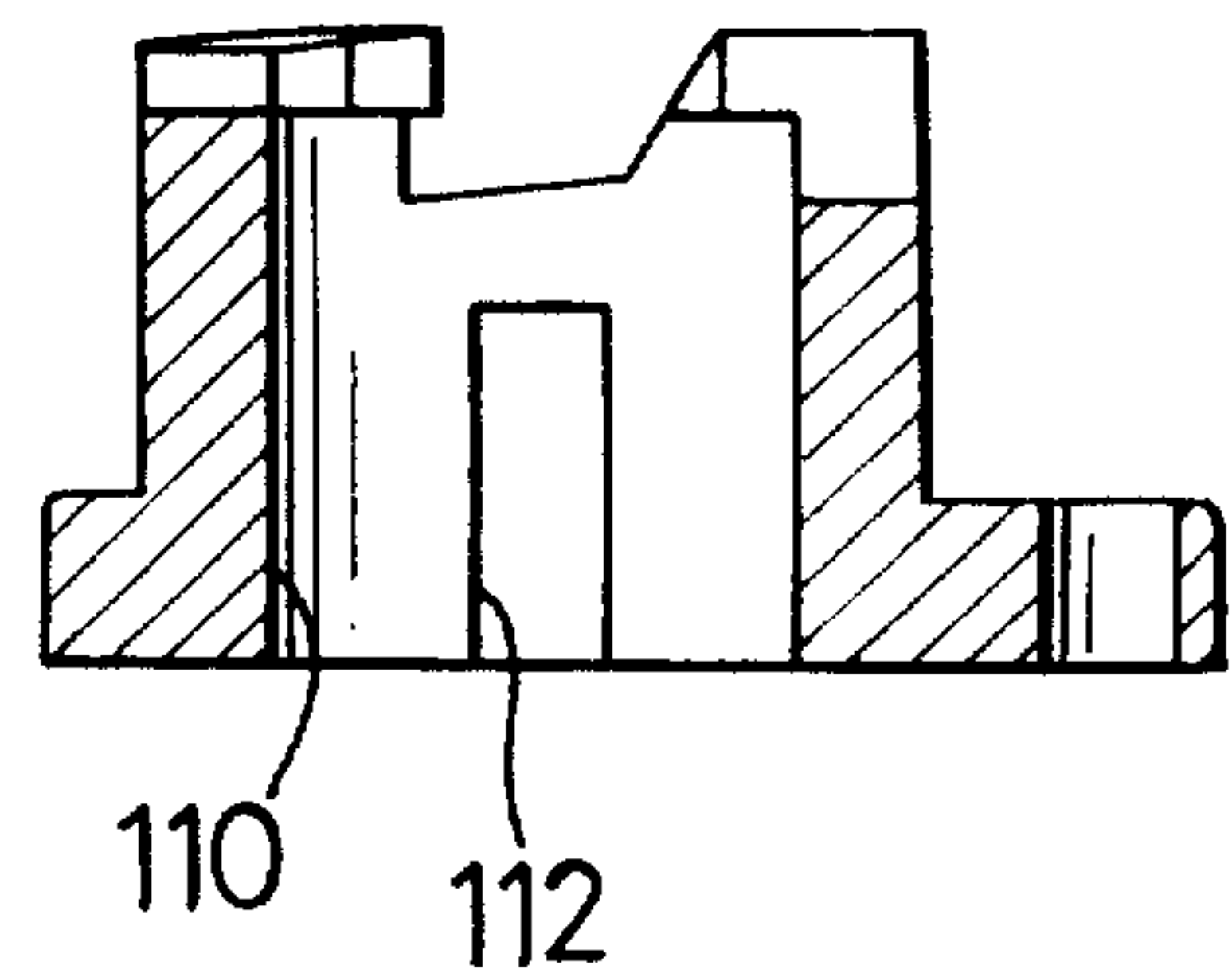


Fig. 7

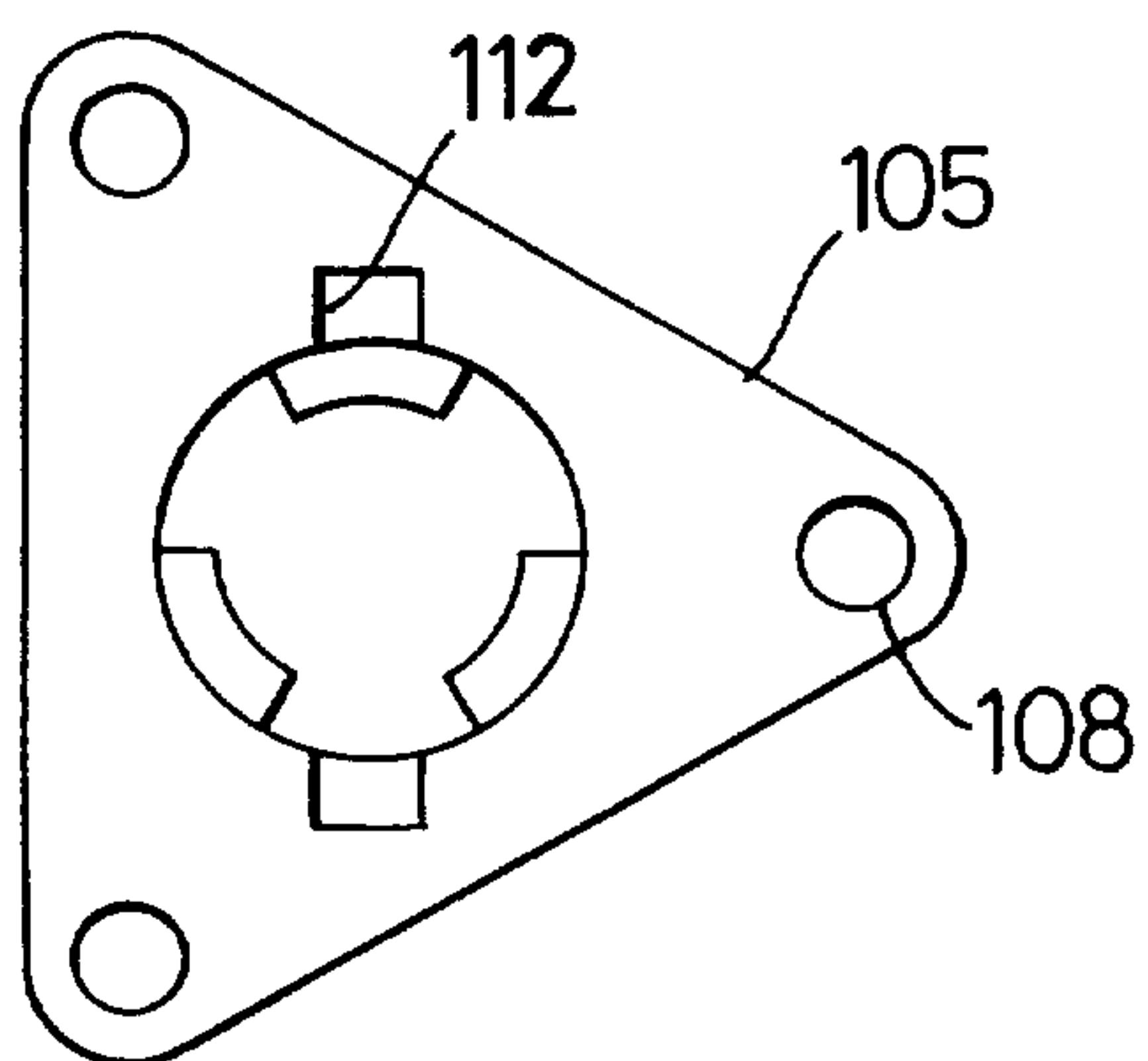


Fig. 6

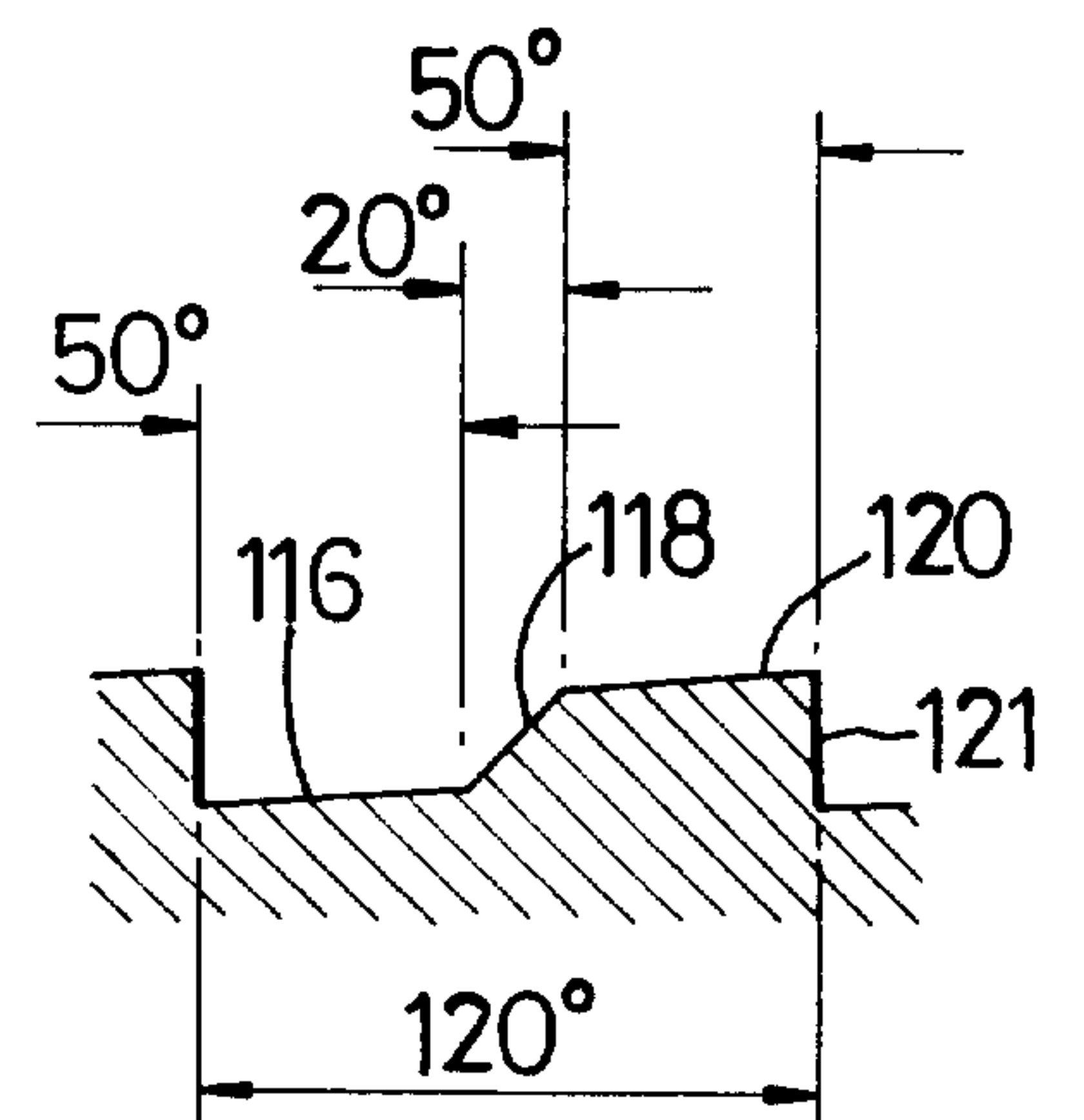


Fig. 8

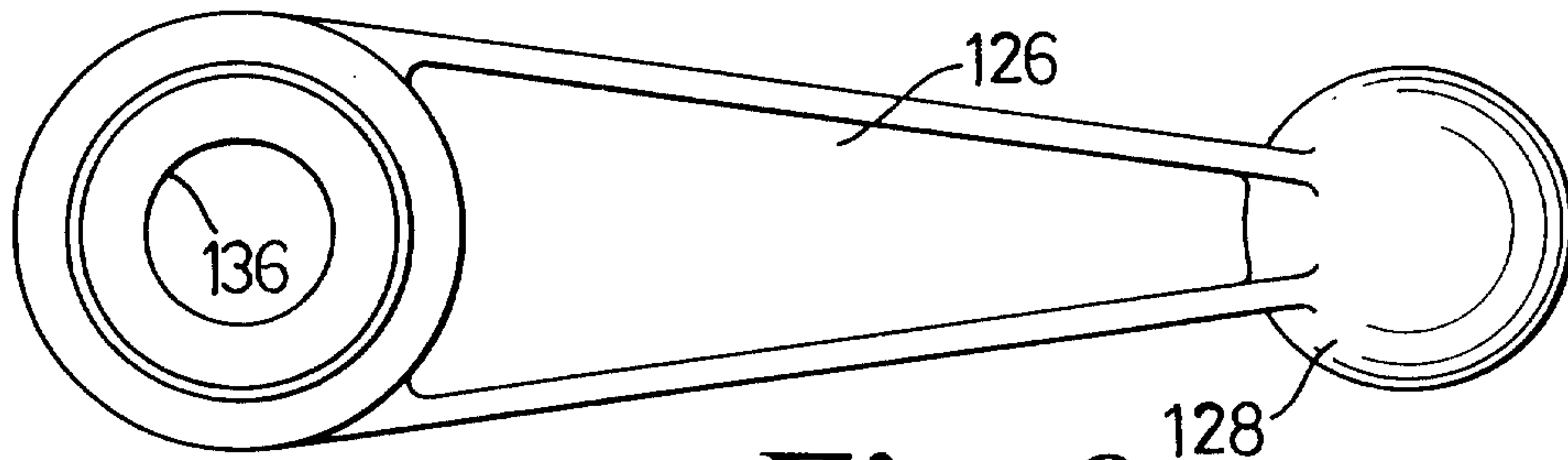


Fig. 9

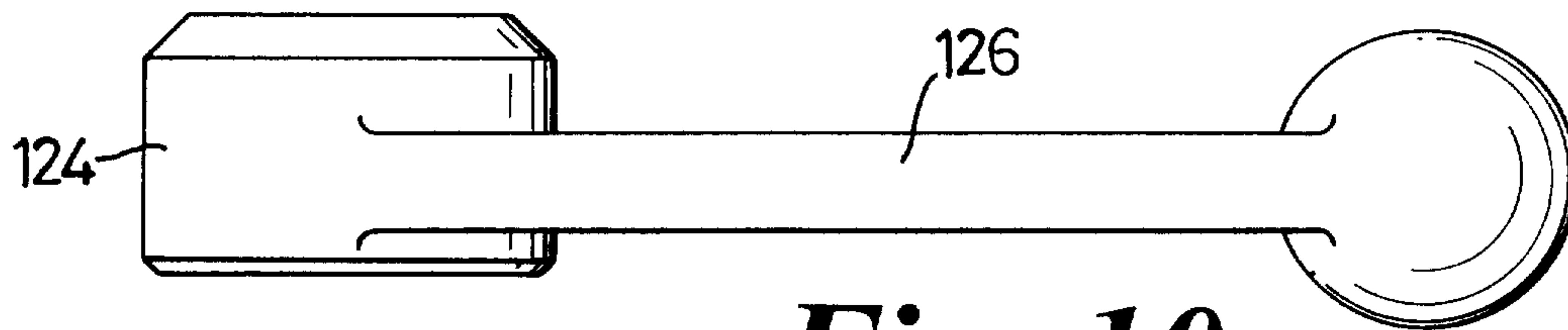


Fig. 10



Fig. 11

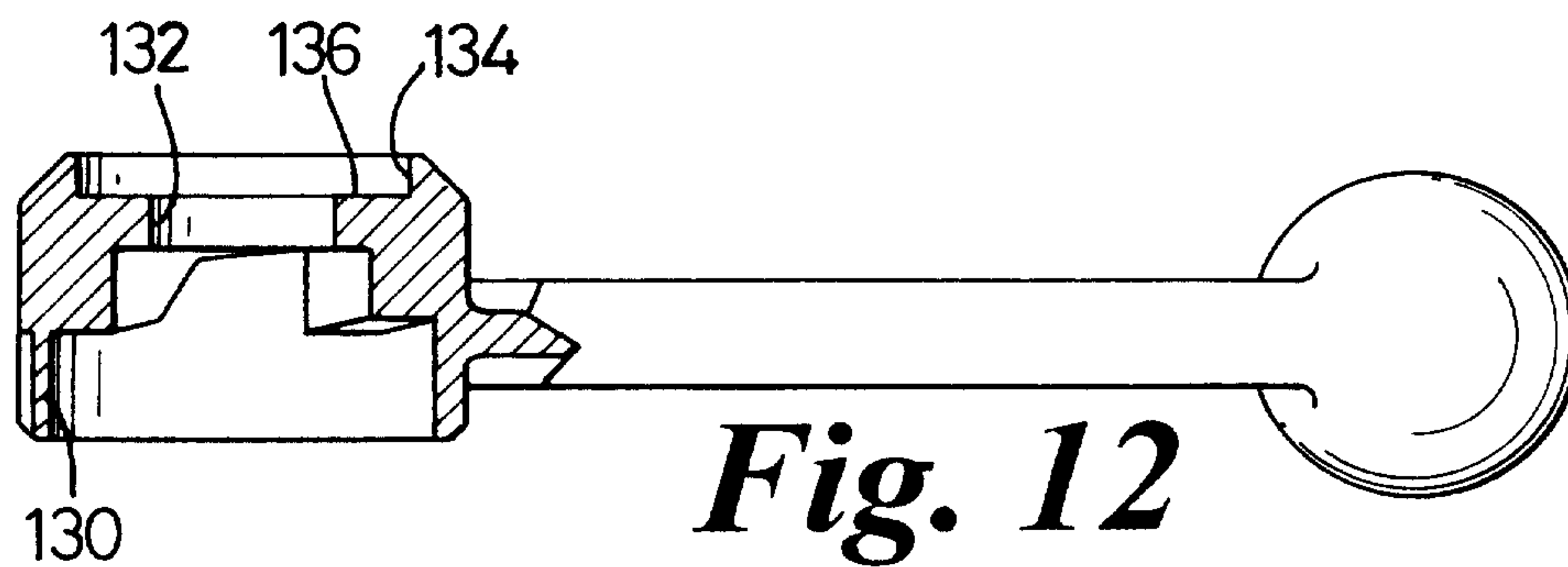


Fig. 12

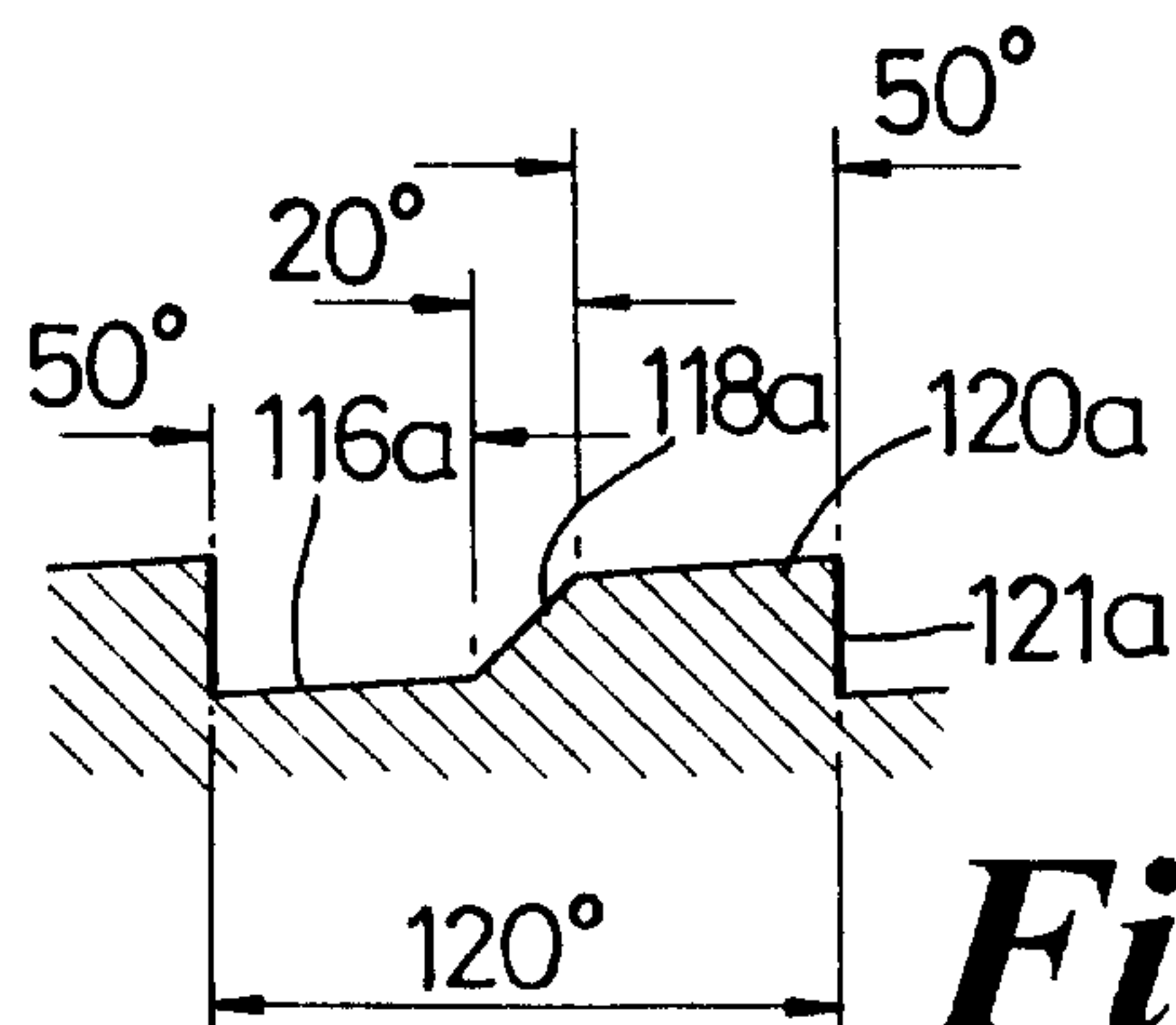


Fig. 13

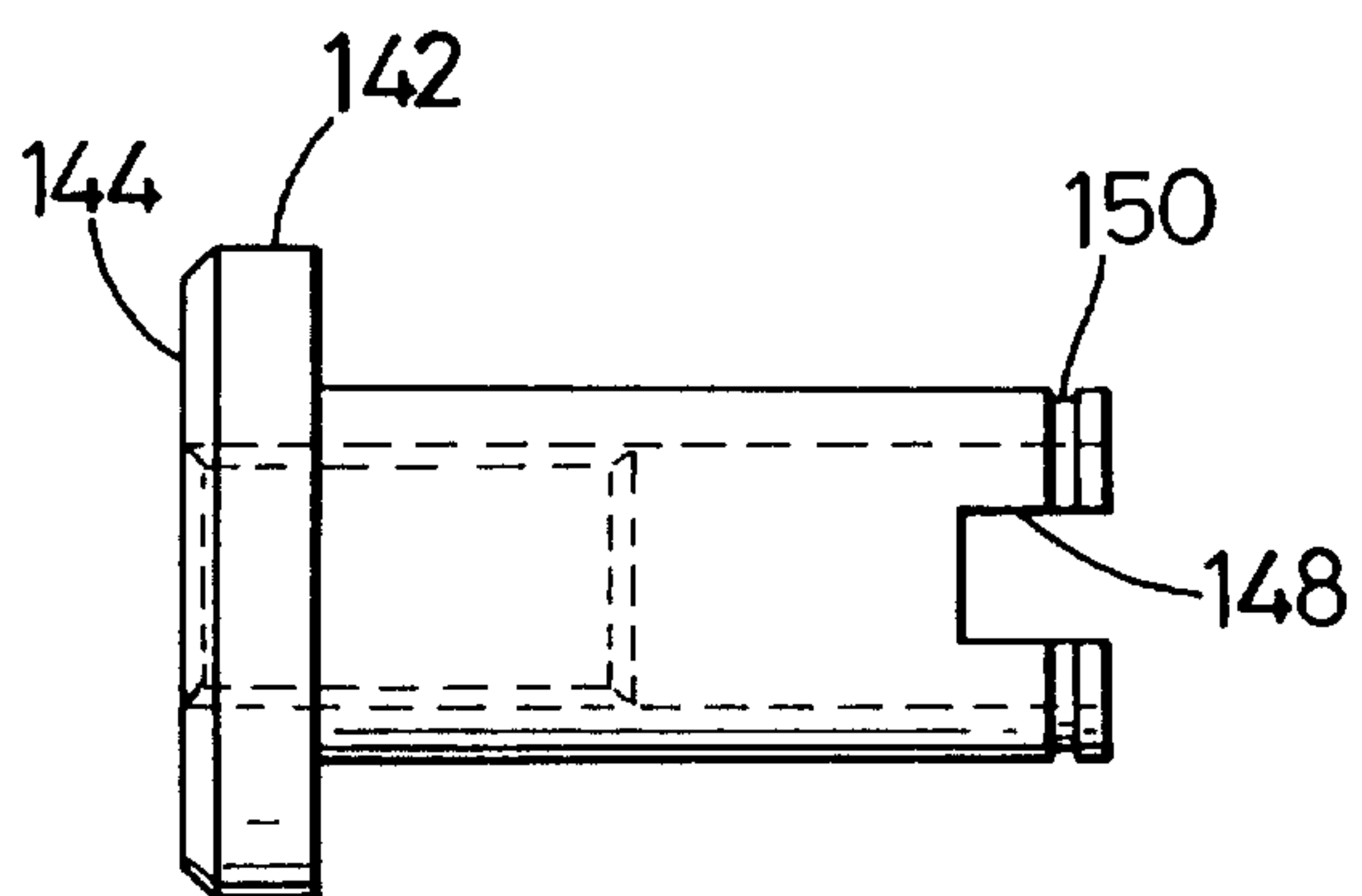


Fig. 14

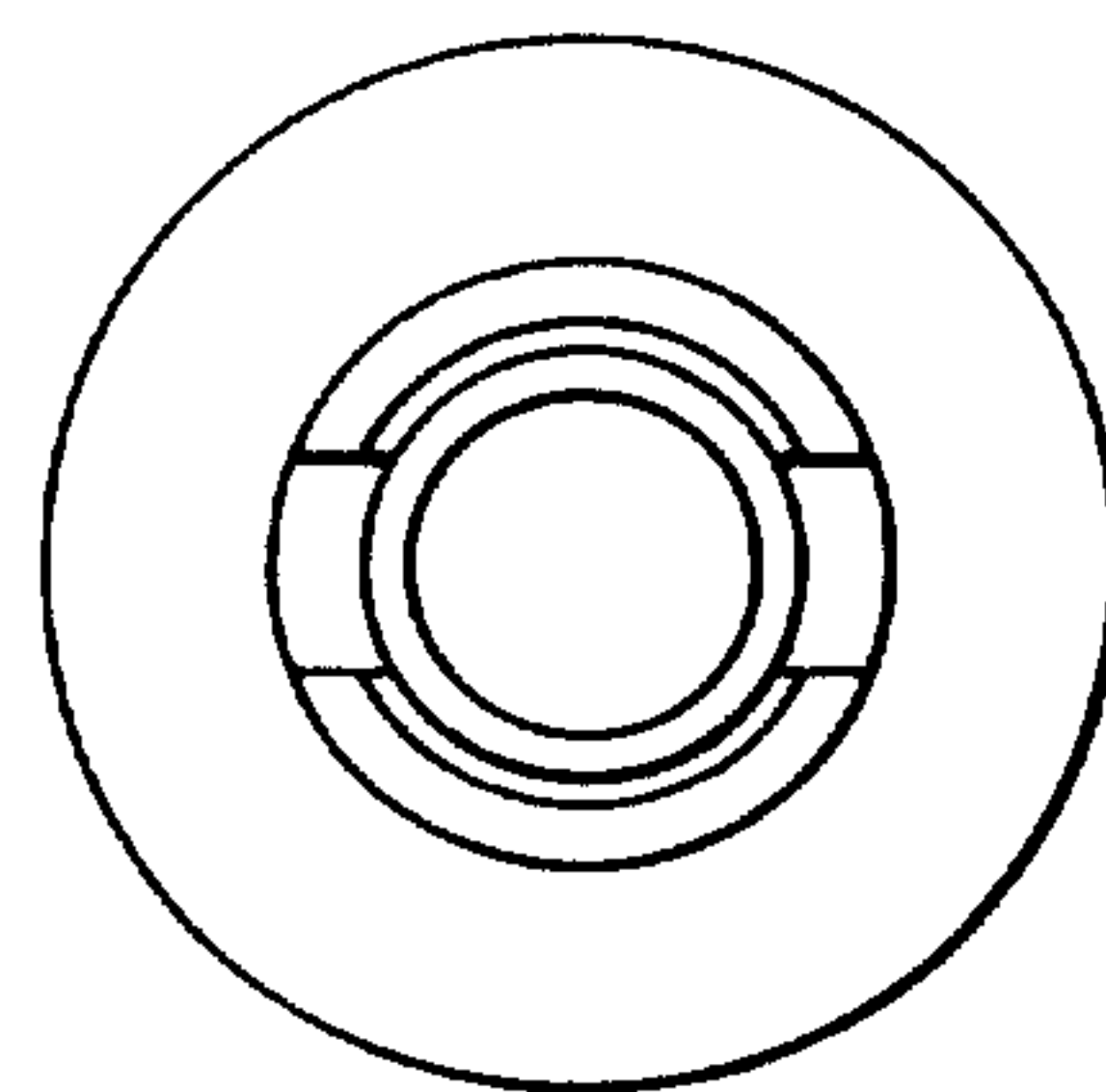


Fig. 16

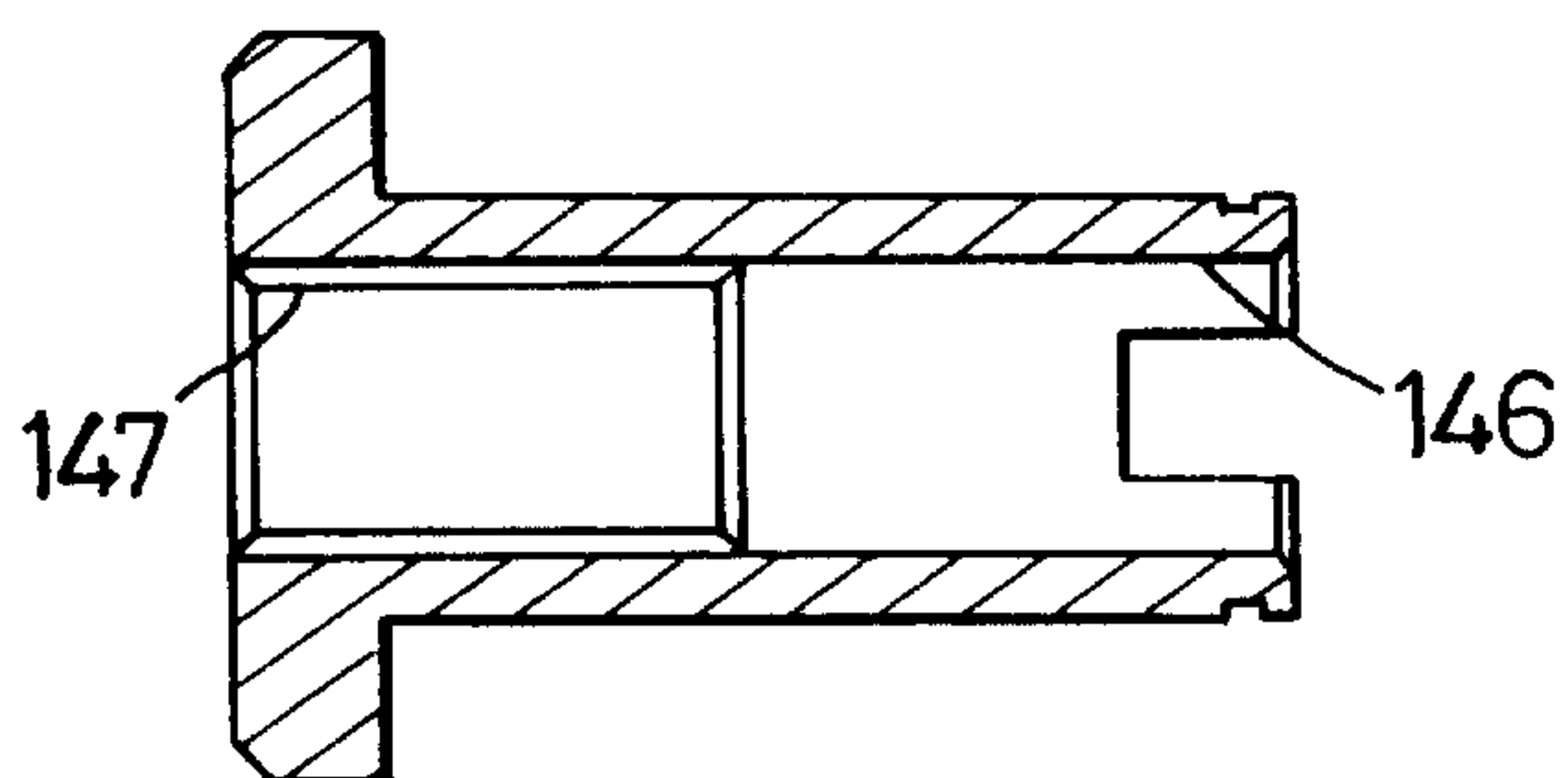


Fig. 15

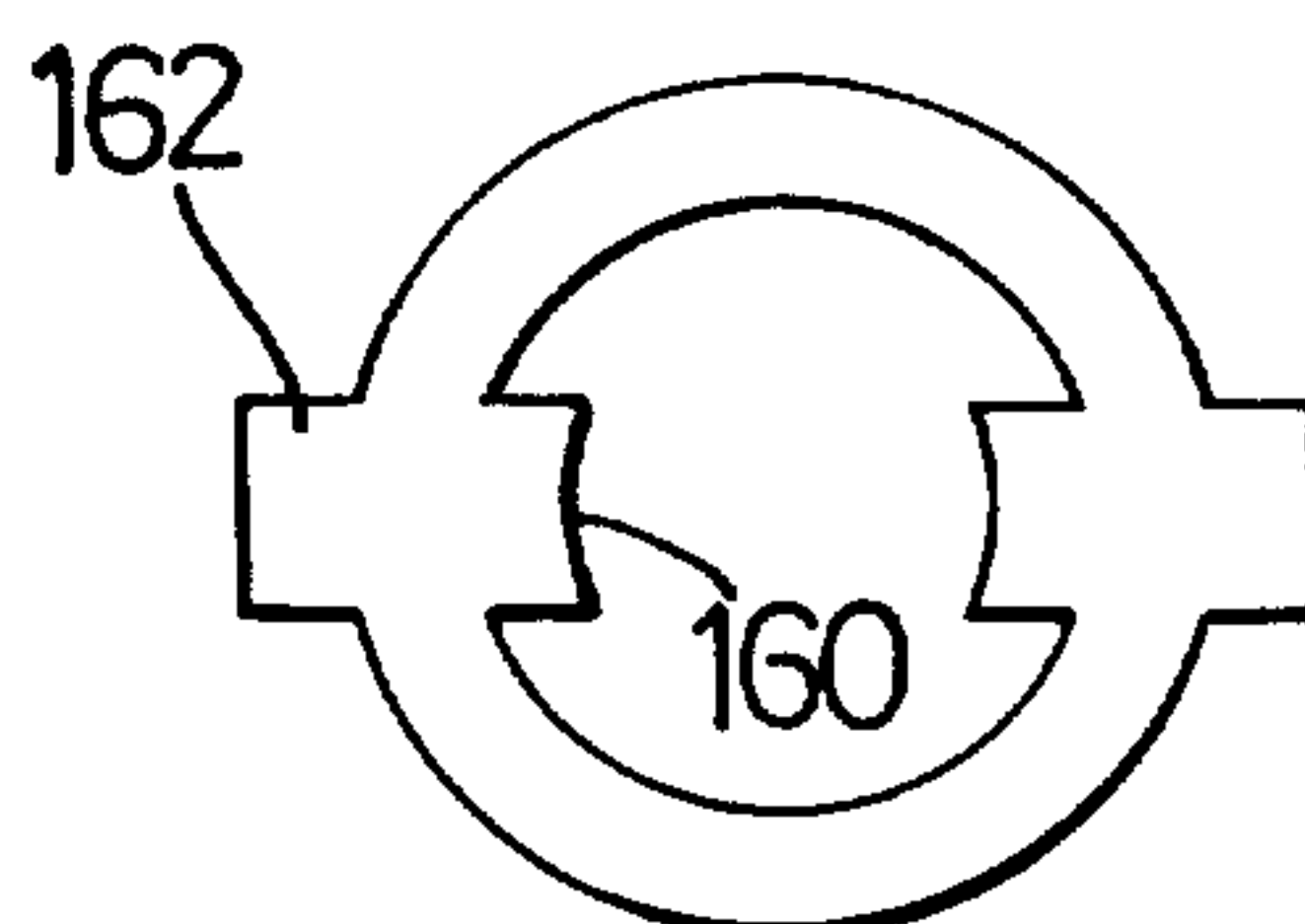


Fig. 17

