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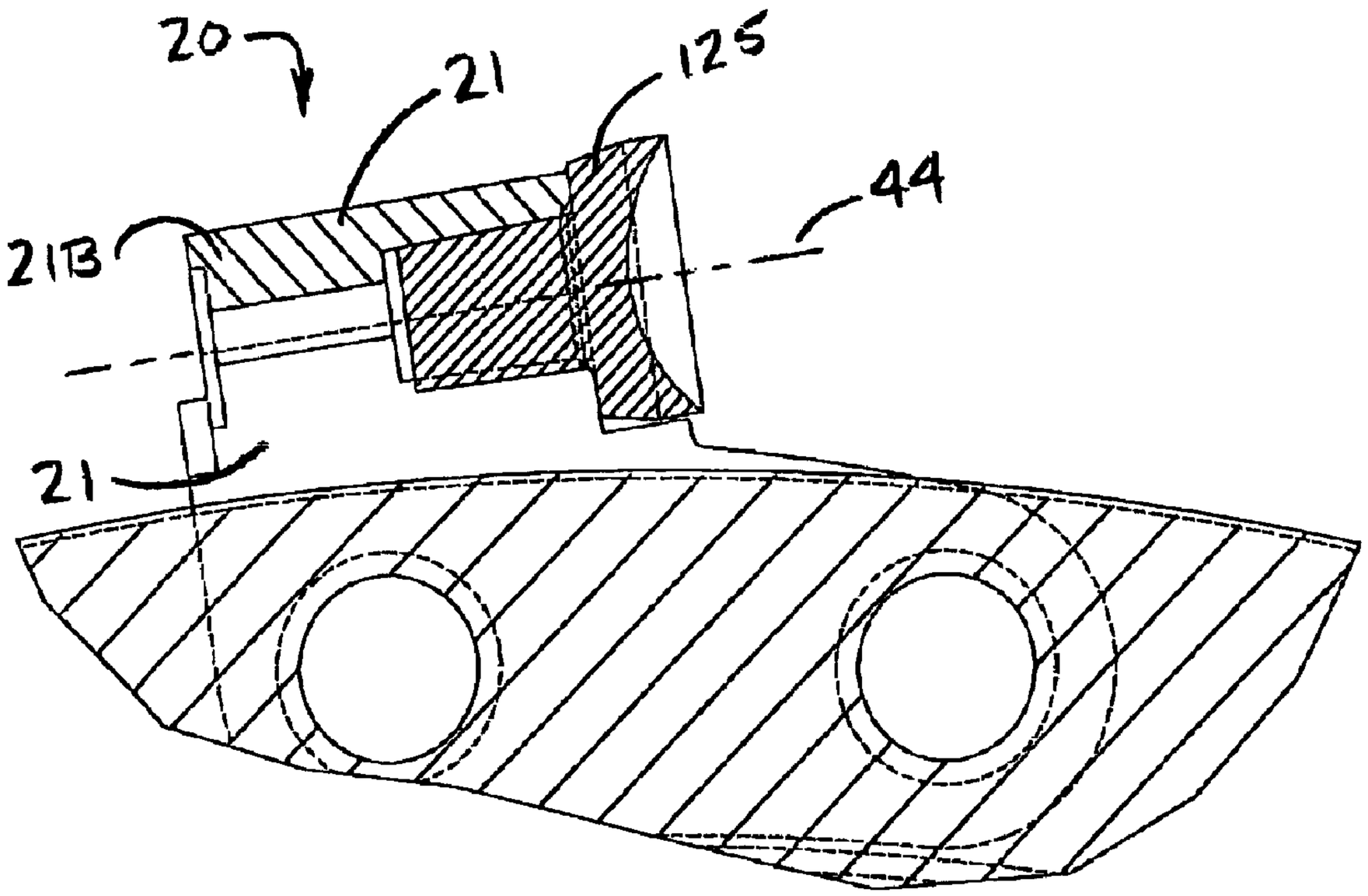
(54) Titre : SYSTEME DE MONTAGE DE DENTS DE SCIE ET DENTS DE SCIE
(54) Title: SAW TOOTH MOUNTING SYSTEM AND SAW TOOTH



(57) Abrégé/Abstract:
A saw blade has a rotatable body with a plurality of cutting elements mounted around its periphery. The cutting elements have self holding tapered shanks which are received in sockets in holders on the saw blade. The sockets have corresponding tapers. The holders are U-shaped members which straddle the peripheral edge of the body. The shanks are dimensioned so that the holders are slightly deformed when the cutting elements are fully inserted into the holders. This helps to grip the cutting elements tightly in the holders. The holders have bearing surfaces adjacent the sockets. The bearing surfaces bear against faces on the cutting elements when the cutting elements are fully engaged in the holders so that impact forces are primarily borne by the bearing surfaces and not by the sockets.

Abstract of the Disclosure

A saw blade has a rotatable body with a plurality of cutting elements mounted around its periphery. The cutting elements have self-holding tapered shanks which are received in sockets in holders on the saw blade. The sockets have corresponding tapers. The holders are U-shaped members which straddle the peripheral edge of the body. The shanks are dimensioned so that the holders are slightly deformed when the cutting elements are fully inserted into the holders. This helps to grip the cutting elements tightly in the holders. The holders have bearing surfaces adjacent the sockets. The bearing surfaces bear against faces on the cutting elements when the cutting elements are fully engaged in the holders so that impact forces are primarily borne by the bearing surfaces and not by the sockets.

SAW TOOTH MOUNTING SYSTEM AND SAW TOOTH

Technical Field

This invention relates to a system for mounting teeth in a circular saw. The system has particular application in circular saws of the type used for severing trees in feller bunchers and other tree-felling machines. Another aspect of the invention relates to a saw tooth for use in a circular saw equipped with a mounting system according to the invention.

Background

Some automated tree felling machines, such as the TK series feller bunchers manufactured by Risley Manufacturing Ltd. of Grande Prairie, Alberta, Canada incorporate a circular saw for severing trees. The circular saws in such machines comprise a disc-like blade and a drive mechanism which can cause the blade to turn rapidly about its axis. The blade is mounted on a carrier which may be advanced in the plane of the blade to move the blade into a log. The blade has cutting teeth around its periphery.

The cutting teeth on such saws experience harsh treatment and require periodic replacement. In most modern blades of this type, the cutting teeth are on cutting elements which are removably attached to holders located around the periphery of the blade. The cutting elements may be removed and replaced if they become damaged or worn. Generally, the cutting elements are rotatable in the holders so that a fresh cutting surface may be exposed by simply rotating the cutting elements in the holders. The **ROTOTOOTH™** teeth available from Risley Manufacturing Ltd. of Grande Prairie, Alberta, Canada are an example

Ltd. of Grande Prairie, Alberta, Canada are an example of replaceable cutting elements for saws of this general type.

In general, in saws of the nature described above, the cutting elements are attached to the holders with bolts. While it is much more convenient to replace the cutting elements of a saw blade, as described above, than it is to replace permanently mounted cutting elements, it is still time consuming to change, or even to rotate, the cutting elements on a saw blade. A saw blade typically has 16 or more cutting elements. Rotating or removing each cutting element requires a bolt to be loosened and subsequently re-tightened. Thus, the machine on which the saw blade is mounted is typically out of service for one hour, or more, each time it becomes necessary to rotate or replace the cutting elements on the saw blade. This machinery down time can be expensive.

Some prior cutting elements for use in circular saws include a shaft extending rearwardly. The shaft is received in a sleeve which is axially welded on the periphery of the saw blade. An example of a saw blade having a cutting element of this configuration is shown in United States Patent No. 4,932,447 to Morin. The Morin design provides locking pins which must be removed each time a cutting element is to be rotated or replaced.

Plante, United States patent No. 5,363,891 discloses a saw blade having tubular saw teeth which are friction fitted into tubular mounts. A special tool is required to remove or rotate the hollow teeth. The Plante tooth provides an axial gap between the tooth and the mount so that all impact forces on the tooth are transmitted through the friction fitting between the tooth and the mount. This can be disadvantageous.

Summary of the Invention

One aspect of this invention provides a rotatable saw blade for a tree felling apparatus. The saw blade comprises: a body adapted to be drivingly rotated in a direction of rotation; a plurality of holders affixed at uniformly spaced apart locations around a peripheral edge of the body and a cutting element received in each of the holders. Each of the holders comprises a socket facing in the direction of rotation of the body and a bearing surface adjacent the socket on at least two opposed sides of the socket. The socket has an inner surface providing a self-holding taper. An aperture extends through the holder from a rear portion of the socket. The aperture may be used to drive a cutting element out of the socket or to receive a fastener for drawing the cutting element into the socket. The cutting elements each comprise a shank received in the socket and having the same self-holding taper as the socket. A front portion is attached to the shank. The front portion has a cutting edge facing in the direction of rotation and a rear face in bearing contact with the bearing surface on the holder.

In one embodiment of the invention a threaded fastener extends through the aperture and holds the shank tightly in the socket. The holder preferably comprises an elastically deformable U-shaped member straddling a peripheral edge of the body. The U-shaped member preferably comprises first and second plates respectively on first and second sides of the body and two or more fasteners extending between the side plates through apertures in the body. The socket is dimensioned to tightly engage the shank. When a cutting element is not present in the socket, the socket preferably has a maximum diameter slightly smaller than a maximum diameter of the shank, wherein the side plates of the U-shaped member are spread slightly when the cutting element is fully engaged in the socket. The stiff resilient springy nature of the side plates helps to hold the shank firmly in the socket despite the impacts and vibrations to which the cutting element must typically endure. The self-holding taper is preferably in the range of 0.45 inches per foot to 0.80 inches per foot.

Another aspect of the invention provides a cutting tooth assembly for use in a saw. The assembly comprises a holder and a cutting element which is receivable in the holder. The holder comprises a member defining a socket, a bearing surface adjacent the socket and an aperture extending through the holder from a rear portion of the socket. The bearing surface extends on at least two opposed sides of the socket. The socket has an inner surface providing a self-holding taper. The cutting element comprises a shank portion dimensioned to be received in the socket and having the same self-holding taper as the socket. A front portion is attached to the shank portion. The front portion has a cutting

edge facing forwardly and a rear face. The rear face is in bearing contact with the bearing surface on the holder when the cutting element is received in the holder. Preferably the holder comprises an elastically deformable U-shaped member comprising first and second side plates connected by a bight portion. Preferably, when the cutting element is not present in the socket, the socket has a maximum diameter slightly smaller than a maximum diameter of the shank so that the side plates of the U-shaped member are spread slightly when the shank is fully engaged in the socket. This helps to retain the shank in the socket.

Yet another aspect of the invention provides a cutting element for removable attachment to a saw, the cutting element comprises: a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a taper in the range of 0.45 inches per foot to 0.8 inches per foot; and, a front portion attached to the shank, the front portion having a cutting edge on its side away from the shank and a flat rear face surrounding the shank.

Still another aspect of the invention provides a method for affixing a cutting element to a rotatable saw in a tree felling apparatus. The method begins by providing a cutting element comprising: a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a taper in the range of 0.45 inches per foot to 0.8 inches per foot; and, a front portion attached to the shank, the front portion having a cutting edge on its side away from the shank and a flat rear face surrounding the shank. The method continues with the steps of inserting the shank into a socket having the same taper as the shank until the shank

is snug in the socket and the flat rear face is spaced apart from a bearing surface adjacent the socket; and, resiliently deforming the socket slightly outwardly by driving the shank farther into the socket until the flat rear face is bearing against the bearing surface.

Brief Description of Drawings

In drawings which illustrate preferred embodiments of the invention but which should not be construed so as to limit the scope of the invention:

Figure 1 is a top plan view of a saw blade having a plurality of cutting elements mounted according to the invention;

Figure 2A is an expanded fragmentary top plan view of a portion of the saw of Figure 1 with a single holder and cutting element;

Figure 2B is a section through the holder and cutting element of Figure 2 in the plane of the saw blade;

Figure 2C is a section through a holder and cutting element according to an alternative embodiment of the invention in the plane of a saw blade;

Figure 3 is a sectional view through the holder and cutting element of Figure 2A in a plane perpendicular to the saw blade;

Figure 4A is a perspective view of a cutting element having a tapered shank according the embodiment of the invention of Figures 1, 2A and 2B;

Figure 4B is a perspective view of a cutting element having a tapered shank according the embodiment of the invention of Figure 2C;

Figures 5A, 5B and 5C are respectively front elevational, side elevational and isometric views of a U-shaped holder for a cutting element according to the invention; and,

Figure 6 is a section through a cutting element according to the invention.

Description

Figure 1 shows a saw blade **10** according to the invention. Saw blade **10** comprises a discoid body **12** having a central hub **14** configured for connection to a drive means (not shown) for rotating blade **10** about its axis **16**. Blade **10** has a plurality of holders or "mounts" **20** around its periphery. Each holder **20** carries a cutting element **25**. Each cutting element **25** has a hardened sharpened cutting edge **26**. Holders **20** may be permanently affixed to body **12**. For example, holders **20** may be welded to body **12**. Fourteen of the sixteen holders **20** of blade **10** are not shown in Figure 1.

Most preferably, each holder **20** comprises a U-shaped member **21** which straddles the edge of body **12**. Member **21** has side plates **21A** on either side of body **12**. Side plates **21A** are connected by a bight portion **21B**. Suitable fasteners such as bolts **22** equipped with suitable washers fasten member **21** to body **12**. Bolts **22** are recessed so that they do not project outwardly from side plates **21A**. In typical embodiments U-shaped members **21** are fabricated from 5/8 inch thick steel plate. The thickness and material of U-shaped members can, of course, be varied to suit the needs of each specific application according to standard engineering principles.

As shown in Figure 2A, each cutting element **25** comprises a front portion **29** which includes cutting edge **26** and a tapered shank **30** which extends rearwardly from front portion **29**. The forward-facing face of front portion **29** inside cutting edge **26** is typically concave, as is known to those skilled in the art of designing saws for tree felling machines.

Shank **30** is received in a correspondingly tapered socket **32** in its holder **20**. Shanks **30** are tapered with a self-holding or "self-locking" taper such as a Morse taper or a Brown & Sharpe taper. Such tapers are described, for example in pages 1727 through 1729 of the Machinery's Handbook, 21st edition. Because shanks **30** have self-locking tapers, there is considerable frictional resistance to any force tending to turn or rotate shanks **30** when they are engaged in sockets **32**.

Shanks **30** have tapers of between about 0.45 inches per foot (approximately 2 degrees) and 0.8 inches per foot (approximately 4 degrees). Most preferably shanks **30** have tapers in the range of approximately 2 degrees to approximately 4 degrees. Socket **32** has an inner surface **33** which has the same taper as the shank **30** which it receives. The tapered portions of Sockets **32** are deeper than shanks **30** so that shanks **30** cannot "bottom out" in sockets **32**. Preferably sockets **32** are dimensioned so that, when shanks **30** are fully engaged in sockets **32** there remains a gap **36** between the rear face of each shank **30** and the bottom of each socket **32**.

The rear face **40** of front portion **29** of each cutting element **25** provides a bearing surface which contacts the front face **42** of holder **20**. Preferably, the rear face **40** of front portion **29** and the front face **42** of holder **20** are generally planar and extend perpendicularly to the longitudinal axis **44** of cutting element **25**. It is an important feature of the invention that impact forces on cutting edge **26** are borne primarily by front face **42** of holder **20** and not by socket **32**. This does not preclude a non-preferred embodiment of the invention where a cutting element **29** with a sufficiently strong shank **30** could locate such that rear face **40** does not contact front face **42** of holder **20**.

Front face **42** of holder **20** provides a bearing surface that extends on at least opposing sides of socket **32**. It is strongly preferable that front face **42** provides a bearing surface extending around at least 3 sides of socket **32** as shown in Figure 5A, 5B and 5C. Longitudinal axis **44** is generally tangential to body **12**.

Socket **32** is preferably dimensioned so that when shank **30** is snugly, but not tightly, engaged in socket **32** there is a slight gap between rear face **40** and front face **42**. That is, the maximum diameter of socket **32** is slightly less than the maximum diameter of shank **30**. As shank **30** is forced tightly into socket **32**, the material of holder **20** yields sufficiently to allow rear face **40** to bear against front face **42**.

When holder **20** comprises a U-shaped member **21** the act of forcing shank **30** tightly into socket **32** tends to spread side plates **21A** apart slightly. This is advantageous because member **21** acts as a very

stiff spring which elastically presses against shank **30**. This holds shank **30** more tightly in socket **32** than would otherwise be the case. The inventors believe that the springlike deformation of U-shaped members **21,** when combined with the self-locking taper of shank **30** and socket **32**, adds considerably to the ability of holders **20** to hold cutting elements **25** firmly even when cutting elements **25** are exposed to great impacts and vibration.

In one embodiment of the invention cutting elements **25** are equipped with threaded fasteners. The threaded fasteners may be used to draw shanks **30** into tight engagement in sockets **32**. The threaded fasteners may be left in place during use of saw blade **10** to help to hold cutting elements **25** in place. In the embodiment of Figure 2B, the threaded fastener comprises a threaded bolt **28**. A cutting element **25** according to this embodiment may be fixed in a holder **20** by cleaning socket **32**, pushing cutting element **25** into socket **32**, threading a bolt **28** and a washer **28A** into a threaded axially extending hole in the cutting element **25** and then tightening bolt **28** until rear face **40** of front portion **29** contacts front face **42** of holder **20**. Cutting element **25** may be removed by loosening bolt **28** and hitting the projecting end of bolt **28** with a hammer.

In another embodiment of the invention cutting elements **125** (Figures 2C and 4B) have no threaded fasteners. A cutting element **125** may be engaged in a socket **32** by cleaning socket **32**, pushing cutting element **125** snugly into socket **32** and then hammering on the front face of cutting element **125** until rear face **40** of front portion **29** contacts front

face **42** of holder **20**. Impacts on cutting edges **26**, as will occur when saw **10** is used, will tend to tighten cutting elements **125** in holders **20**.

Cutting element **25** may be easily and quickly removed by hitting the rear face of shank **30** with a drift. The embodiment of Figures 2B and 4B is advantageous because it allows cutting elements **125** to be rotated to use a new portion of cutting edge **26** or replaced much more quickly than is possible with cutting elements **25** which are attached with threaded fasteners. This can be accomplished with only a hammer and a drift, both of which would be found in almost any mechanic's tool box. No specialized tools are required to rotate or replace cutting elements **125**.

Cutting elements **25** (or **125**) should be hardened and tempered as is understood to those skilled in the art. Preferably cutting elements **25** (or **125**) have a hardness in the range of about 50-55 on the Rockwell C scale.

The mounting system of the invention may be used with various configurations of cutting edges **26**. Cutting edges **26** may be circular as described, for example, in Isley, United States Patent No. 4,738,291 or may be square, as described for example, in Morin, U.S. patent No. 4,932,447 or may have some other shape. The mounting system of the invention is particularly advantageous for use with round cutting elements because the self-holding interfit of shank **30** in socket **32** prevents rotation of cutting elements **25** (or **125**). The symmetrical nature of round cutting elements means that they cannot be held against rotation

by providing an abutment in the holder as is often done, for example, with square cutting elements. An advantage of the invention is that a single holder can be made to accommodate variously shaped cutting elements.

A feature of the invention is that holders **20** are capable without modification of allowing cutting elements **25** (or **125**) to be rotated about axis **44** through any desired angle. The same holder **20** will allow a cutting element **25** having a square cutting edge **26** to be rotated about axis **44** in increments of ninety degrees to expose fresh cutting edges and will also allow a cutting element **25** having a round cutting edge **26** to be rotated about axis **44** in smaller increments, if desired.

It can be appreciated that a mounting system according to the invention can make it possible to quickly replace or rotate cutting elements in a saw with common hand tools. At the same time the use of a self-holding taper to receive cutting elements holds the cutting elements against rotation during use.

As will be apparent to those skilled in the art in the light of the foregoing disclosure, many alterations and modifications are possible in the practice of this invention without departing from the spirit or scope thereof. By way of example only, the cutting elements **25** or **125** and holders **20** are not limited to use only on a blade **10** comprising a flat circular discoid body **12**. Holders **20** may be attached to blades having other configurations. It is convenient to make faces **40** and **42** flat. However, while faces **40** and **42** should have complementary configura-

tions so that the area of contact between faces **40** and **42** is reasonably large, faces **40** and **42** are not necessarily flat. While the threaded fastener used to draw cutting elements **25** into engagement in sockets **32** has been described as a bolt **28**, bolt **28** could be replaced with a stud projecting outward from shank **30** or a bolt passing through a central bore in cutting element **25** and fastened with a nut, or the like without departing from the invention.

Accordingly, the scope of the invention is to be construed in accordance with the substance defined by the following claims.

WHAT IS CLAIMED IS:

1. A rotatable saw blade for a tree felling apparatus, the saw blade comprising:

(a) a body adapted to be drivingly rotated in a direction of rotation;

(b) a plurality of holders affixed at uniformly spaced apart locations around a peripheral edge of the body, each of the holders comprising a socket facing in the direction of rotation of the body and a bearing surface adjacent the socket on at least two opposed sides of the socket, the socket having an inner surface providing a self-holding taper, an aperture extending through the holder from a rear portion of the socket; and,

(c) a cutting element in each of the holders, the cutting elements each comprising a shank received in the socket and having the same self-holding taper as the socket, and a front portion attached to the shank, the front portion having a cutting edge facing in the direction of rotation and a rear face in bearing contact with the bearing surface on the holder.

2. The rotatable saw blade of claim 1 comprising a threaded fastener extending through the aperture and holding the shank tightly in the socket.

3. The rotatable saw blade of claim 1 wherein the holder comprises an elastically deformable U-shaped member straddling a peripheral edge of the body.

4. The rotatable saw blade of claim 3 wherein the U-shaped member comprises first and second plates respectively on first and second sides of the body and two or more fasteners extending between the side plates through apertures in the body.

5. The rotatable saw blade of claim 3 wherein, when the socket is free of a cutting element, the socket has a maximum inner diameter slightly smaller than a maximum outer diameter of the shank, wherein the side plates of the U-shaped member are spread slightly when the cutting element is fully engaged in the socket.

6. The rotatable saw blade of claim 5 wherein the self-holding taper is in the range of 0.45 inches per foot to 0.80 inches per foot.

7. The rotatable saw blade of claim 6 wherein the bearing surface and the rear face of the front portion of the cutting element are both flat.

8. A cutting tooth assembly for use in a saw, the assembly comprising:

(a) a holder comprising a member defining a socket and a bearing surface adjacent the socket and an aperture extending through the holder from a rear portion of the socket, the bearing surface extending on at least two opposed sides of the socket,

the socket having an inner surface providing a self-holding taper; and,

(b) a cutting element receivable in the holder, the cutting element comprising a shank dimensioned to be received in the socket and having the same self-holding taper as the socket, and a front portion attached to the shank, the front portion having a cutting edge facing in the direction of rotation and a rear face, the rear face in bearing contact with the bearing surface on the holder when the cutting element is received in the holder.

9. The cutting tooth assembly of claim 8 comprising a threaded fastener extending through the aperture and holding the shank tightly in the socket.

10. The cutting tooth assembly of claim 8 wherein the holder comprises an elastically deformable U-shaped member.

11. The cutting tooth assembly of claim 10 wherein the U-shaped member comprises first and second side plates connected by a bight portion.

12. The cutting tooth assembly of claim 10 wherein, when the socket is free of a cutting element, the socket has a maximum inner diameter slightly smaller than a maximum outer diameter of the shank so that

the side plates of the U-shaped member are spread slightly when the shank is fully engaged in the socket.

13. The cutting tooth assembly of claim 12 wherein the self-holding taper is in the range of 0.45 inches per foot to 0.80 inches per foot.

14. The cutting tooth assembly of claim 13 wherein the bearing surface and the rear face of the front portion of the cutting element are both flat.

15. A cutting element for removable attachment to a saw, the cutting element comprising:

(a) a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a taper in the range of 0.45 inches per foot to 0.8 inches per foot; and,

(b) a front portion attached to the shank, the front portion having a cutting edge on its side away from the shank and a flat rear face surrounding the shank.

16. A method for affixing a cutting element to a rotatable saw in a tree felling apparatus, the method comprising the steps of:

(a) providing a cutting element comprising:

(1) a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a taper in the range of 0.45 inches per foot to 0.8 inches per foot; and,

(2) a front portion attached to the shank, the front portion having a cutting edge on its side away from the shank and a flat rear face surrounding the shank;

(b) inserting the shank into a socket having the same taper as the shank until the shank is snug in the socket and the flat rear face is spaced apart from a bearing surface adjacent the socket; and,

(c) resiliently deforming the socket slightly outwardly by driving the shank farther into the socket until the flat rear face is bearing against the bearing surface.

17. A cutting element for removable attachment to a saw, the cutting element comprising:

(a) a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a self-holding taper.

18. A method for affixing a cutting element to a rotatable saw in a tree felling apparatus, the method comprising the steps of:

(a) providing a cutting element comprising:

(1) a solid shank having an outer circularly symmetrical surface, the outer surface tapered with a self-holding taper; and,

(2) a front portion attached to the shank, the front portion having a cutting edge on its side away from the shank and a flat rear face surrounding the shank;

(b) inserting the shank into a socket having the same taper as the shank until the shank is snug in the socket and the flat rear face is spaced apart from a bearing surface adjacent the socket; and,

(c) resiliently deforming the socket slightly outwardly by driving the shank farther into the socket until the flat rear face is bearing against the bearing surface.

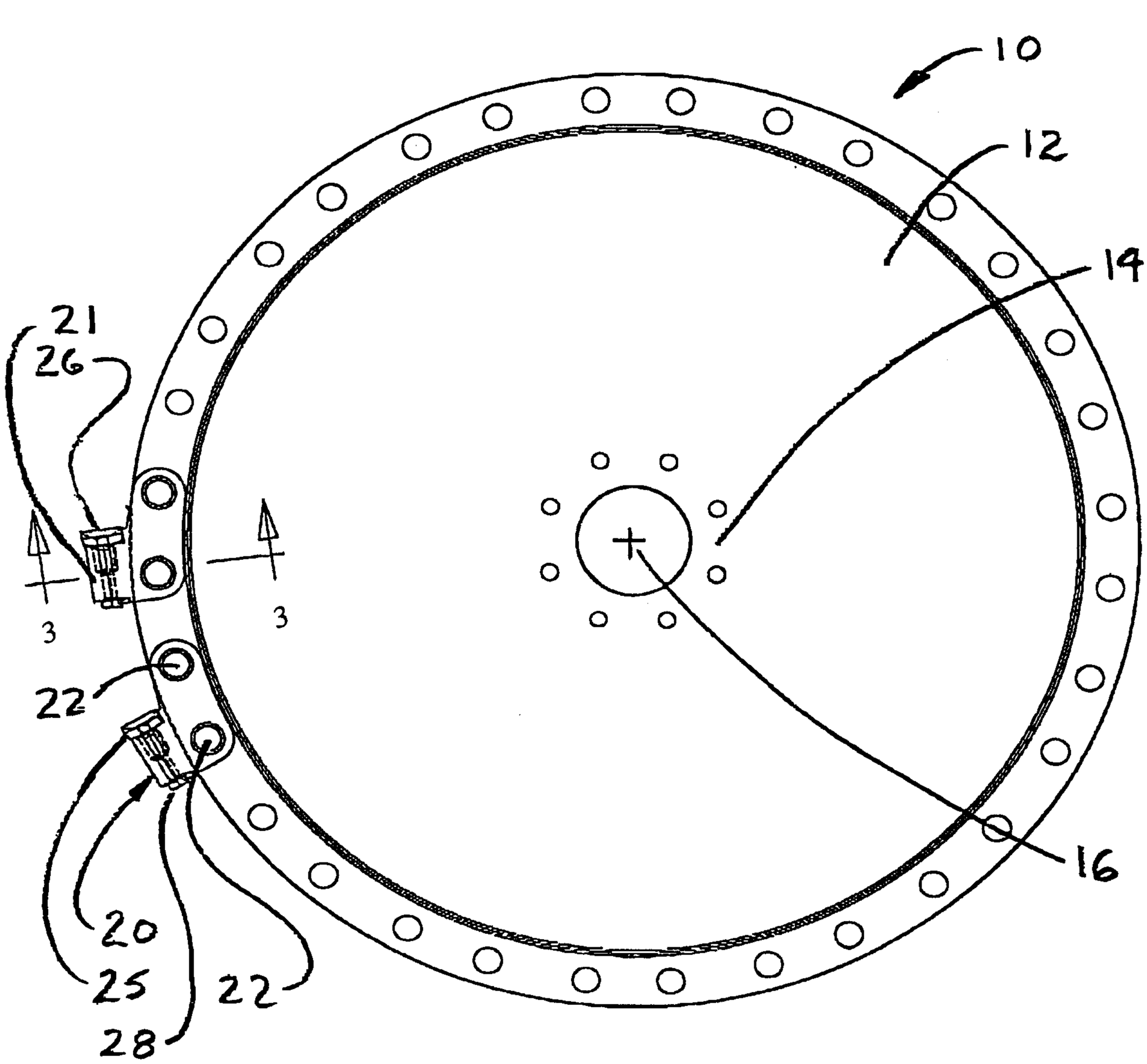


FIG 1

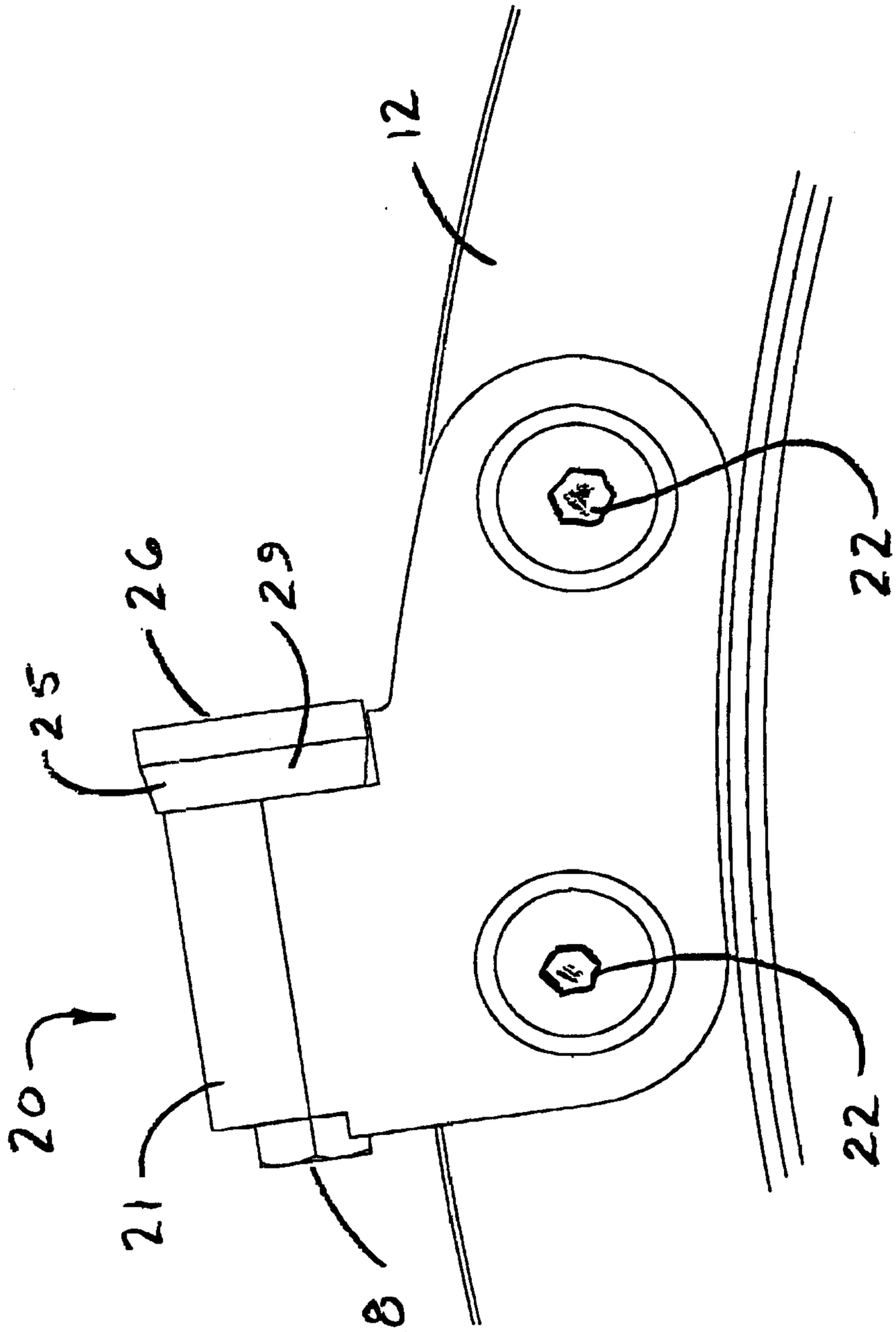


FIG 2A

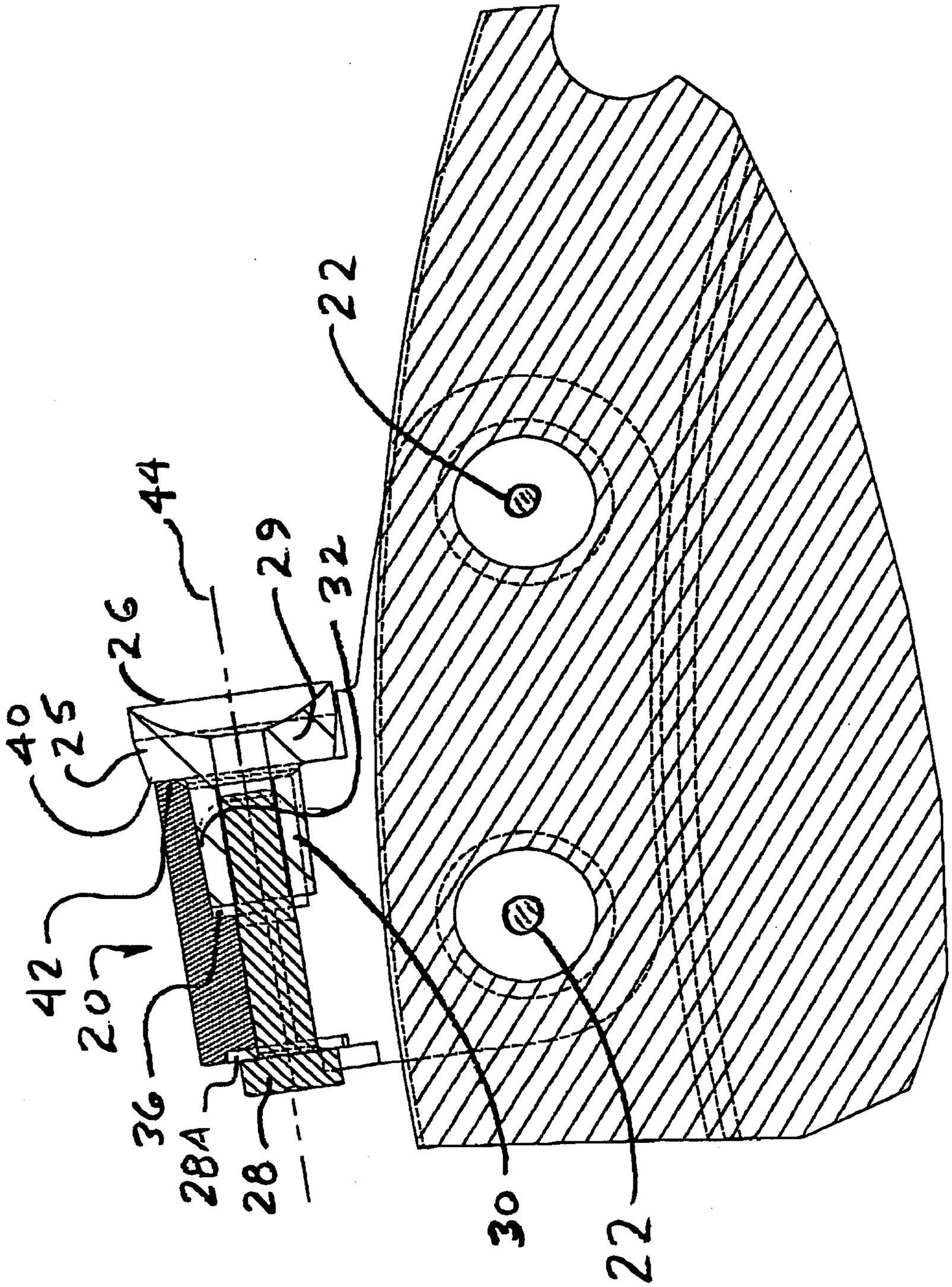


FIG 2B

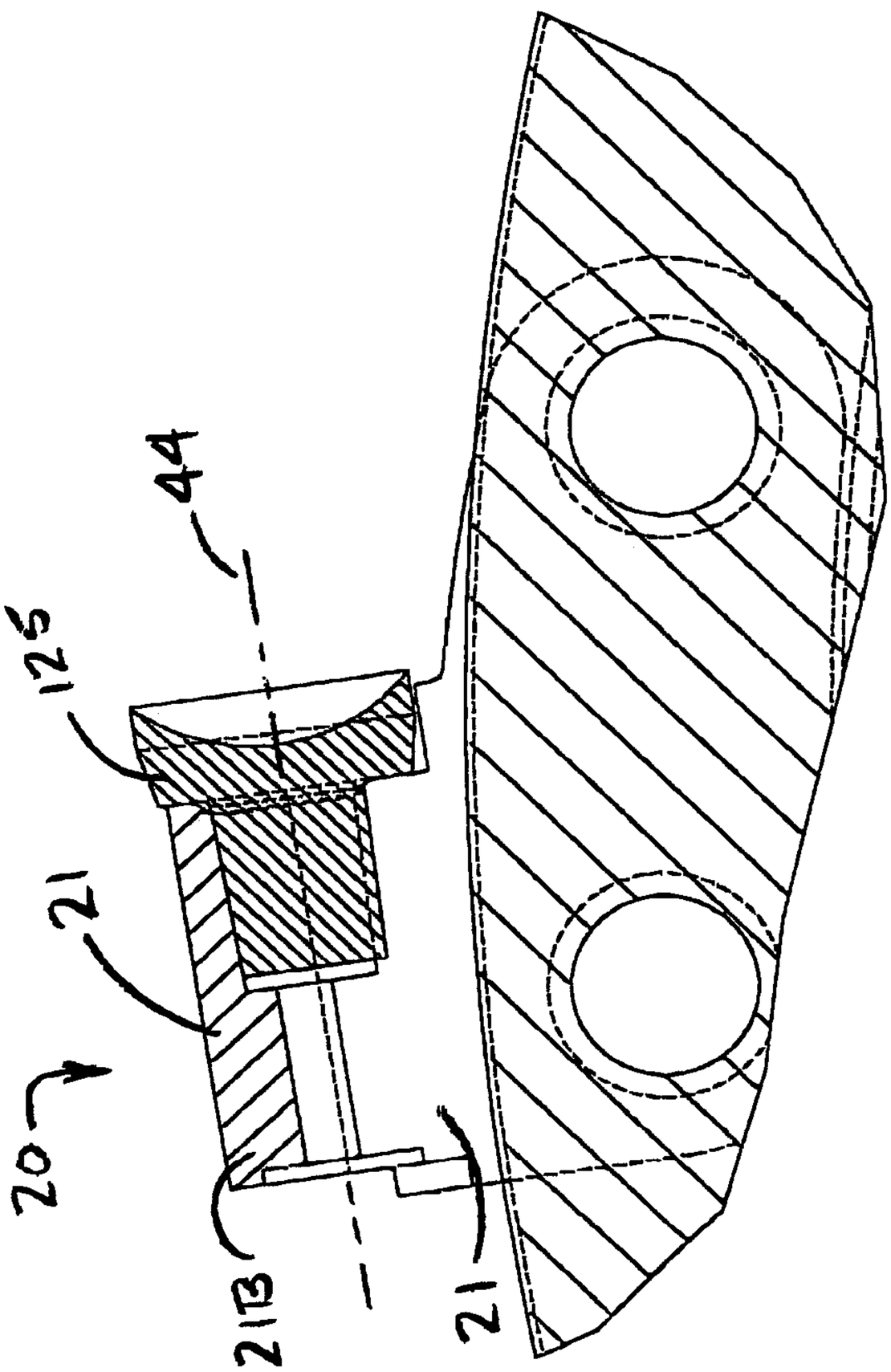


FIG 2C

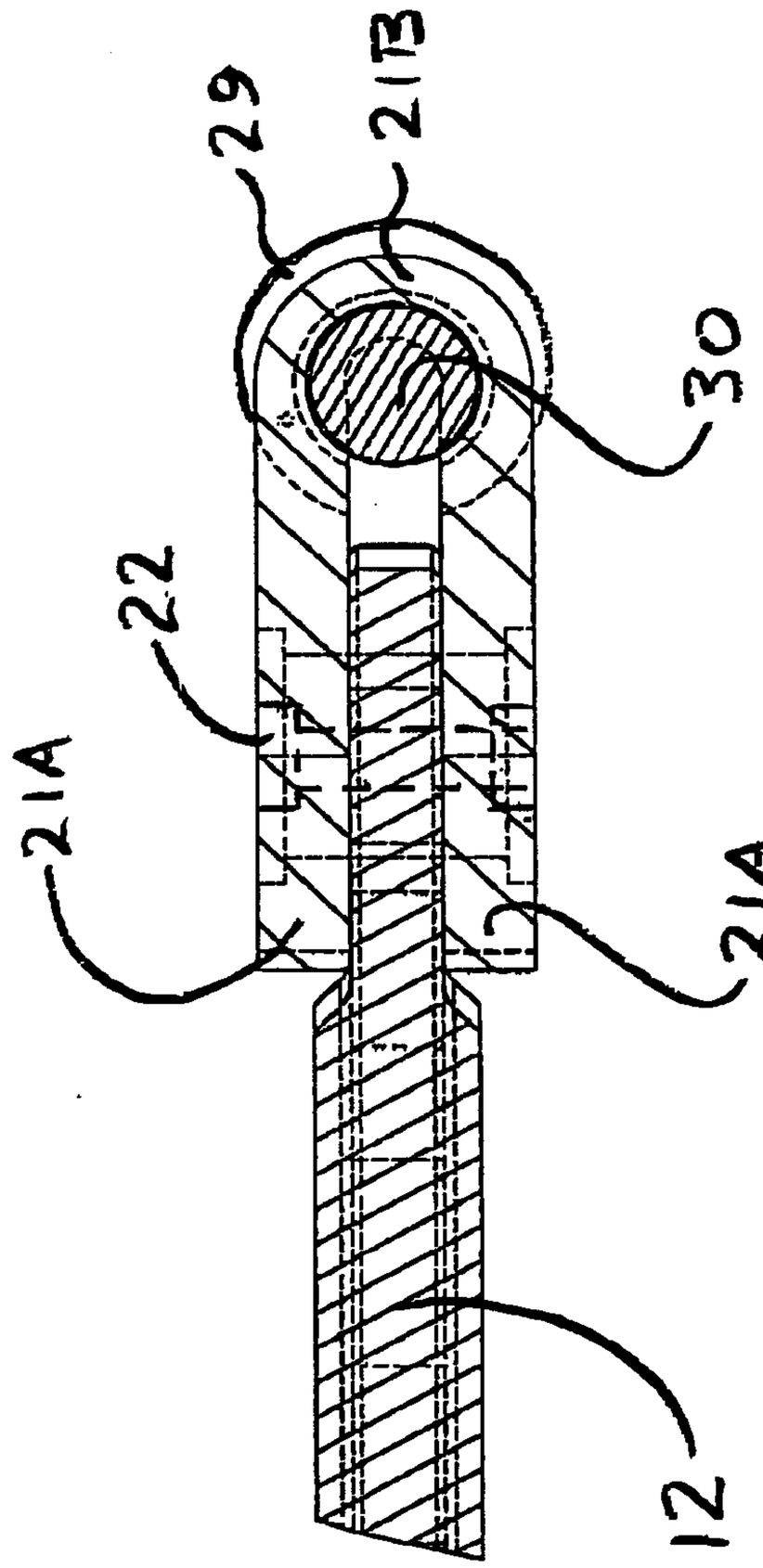


FIG 3

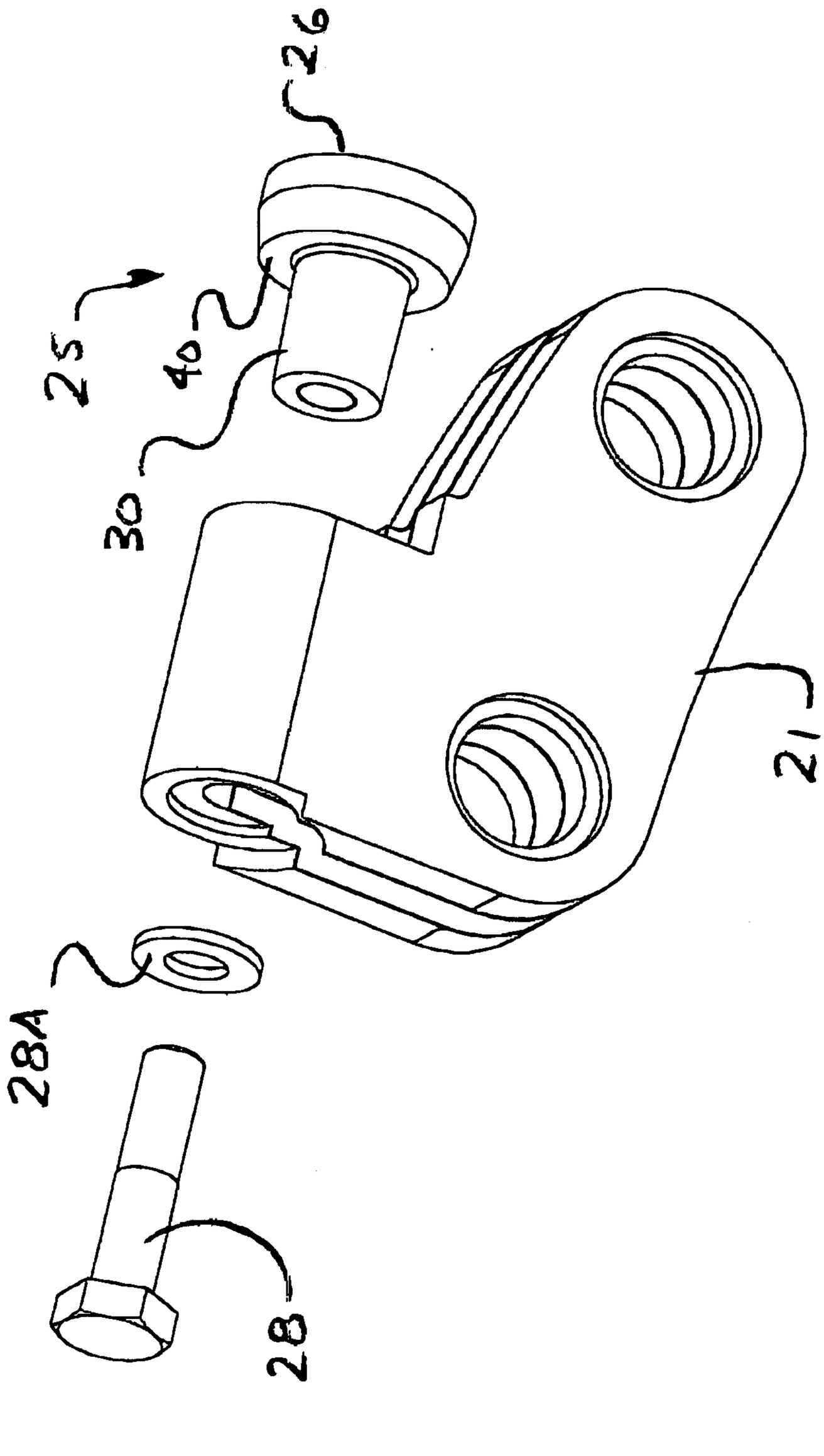


FIG 4A

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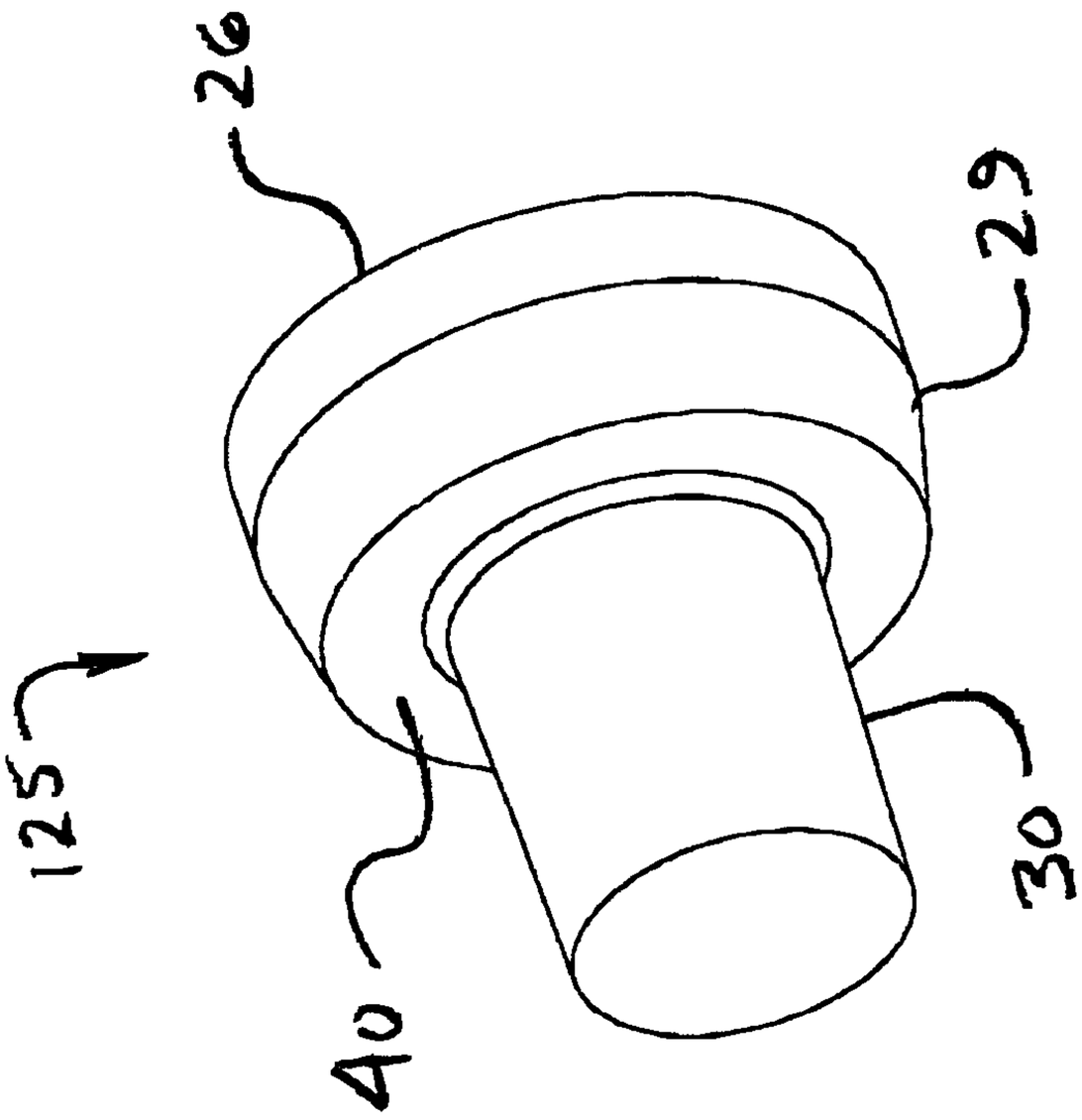

FIG 4B

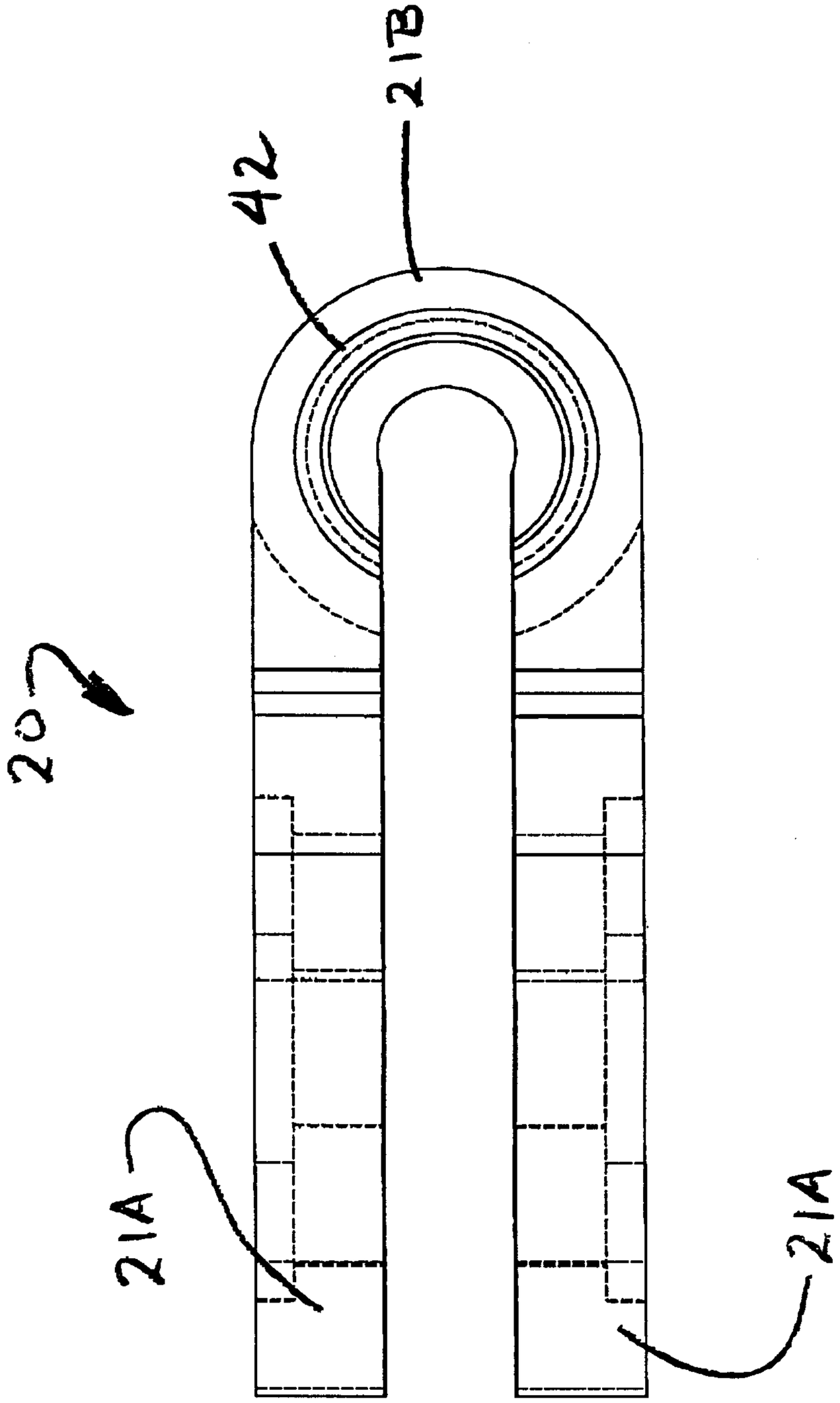

FIG 5A

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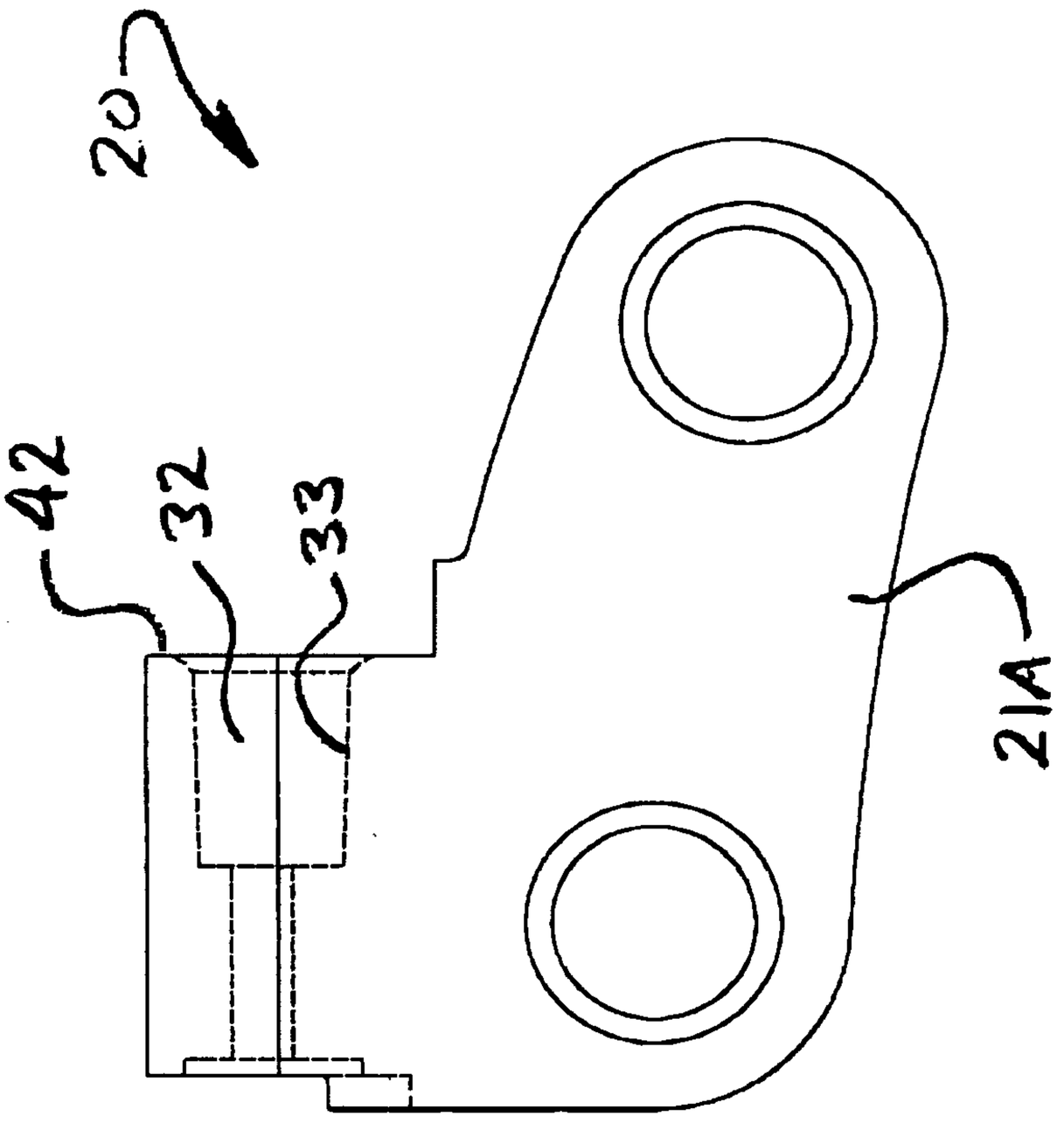


FIG 5B

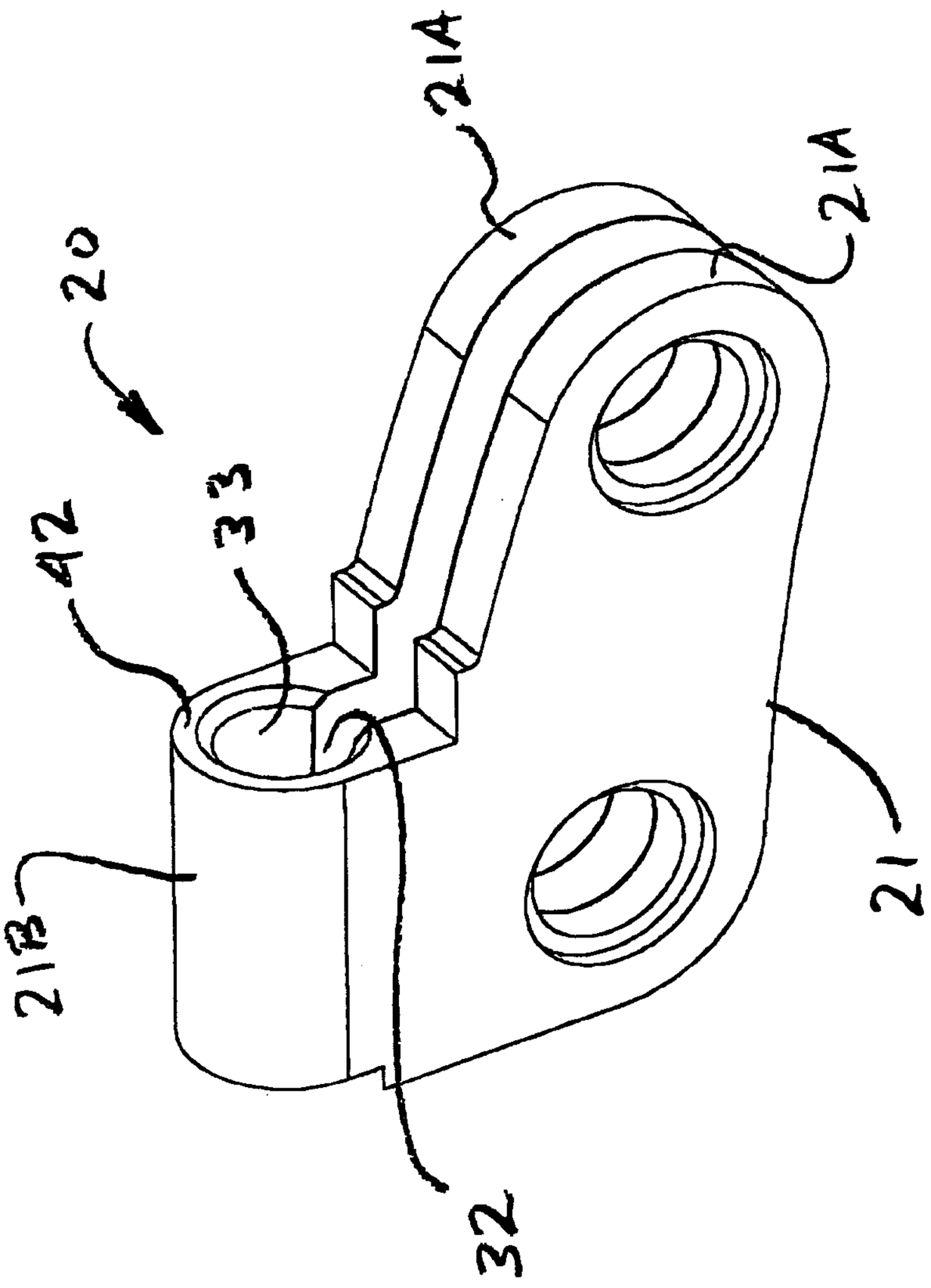


FIG 5C

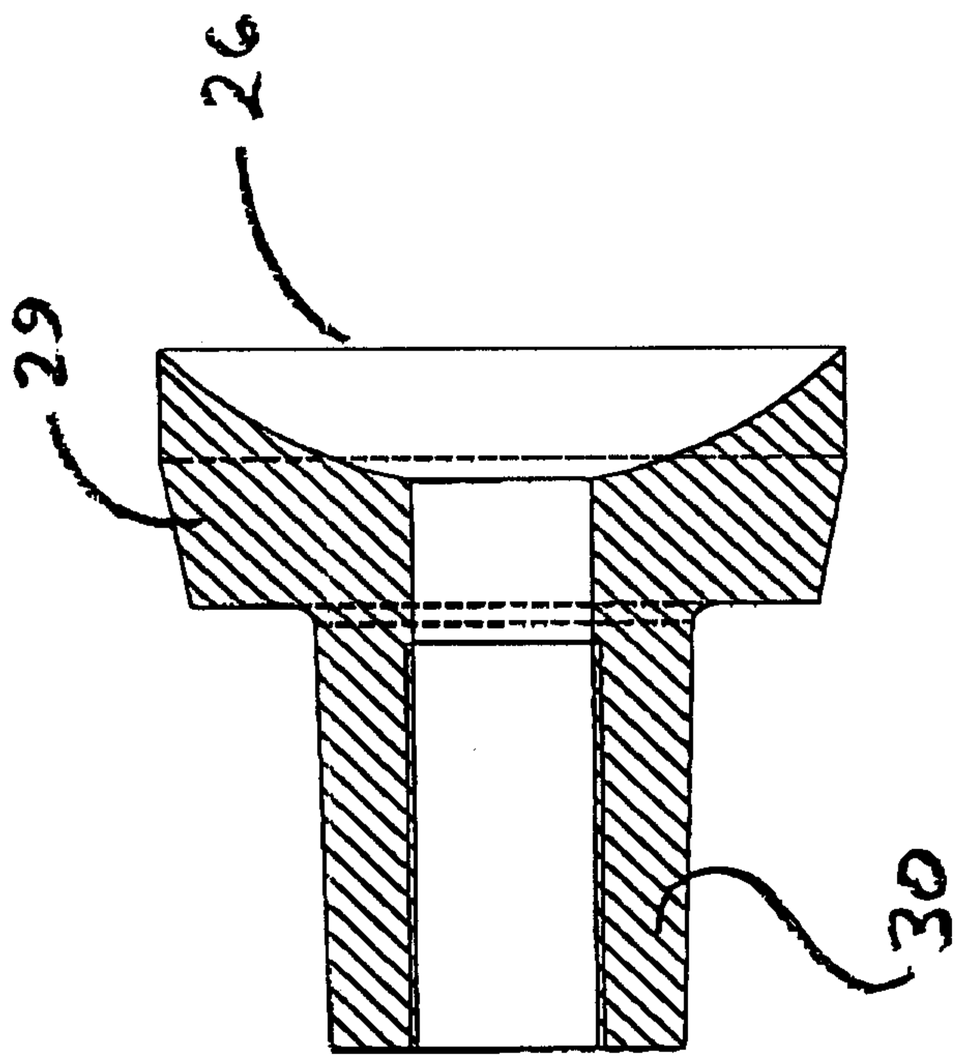
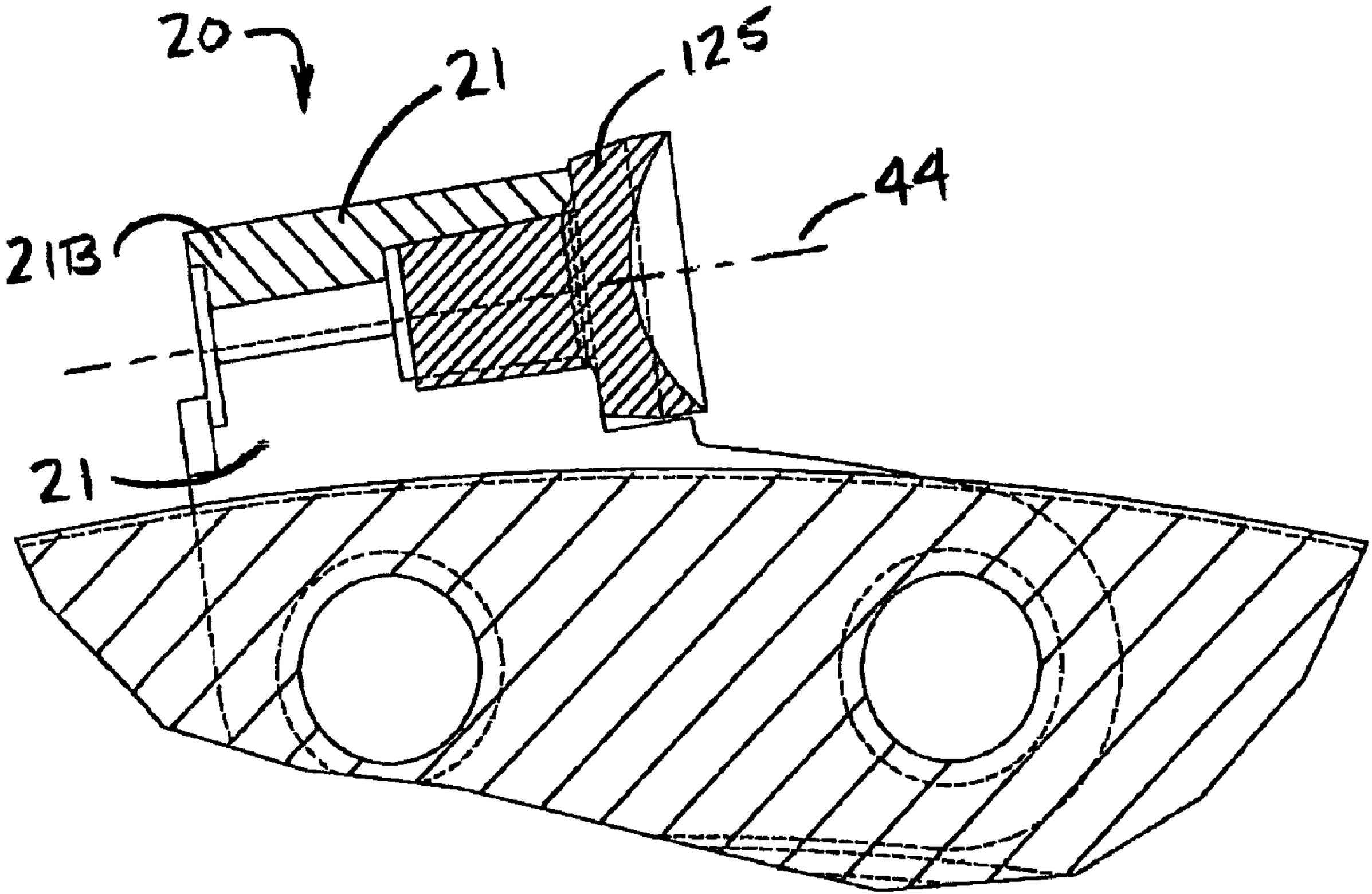


FIG 6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