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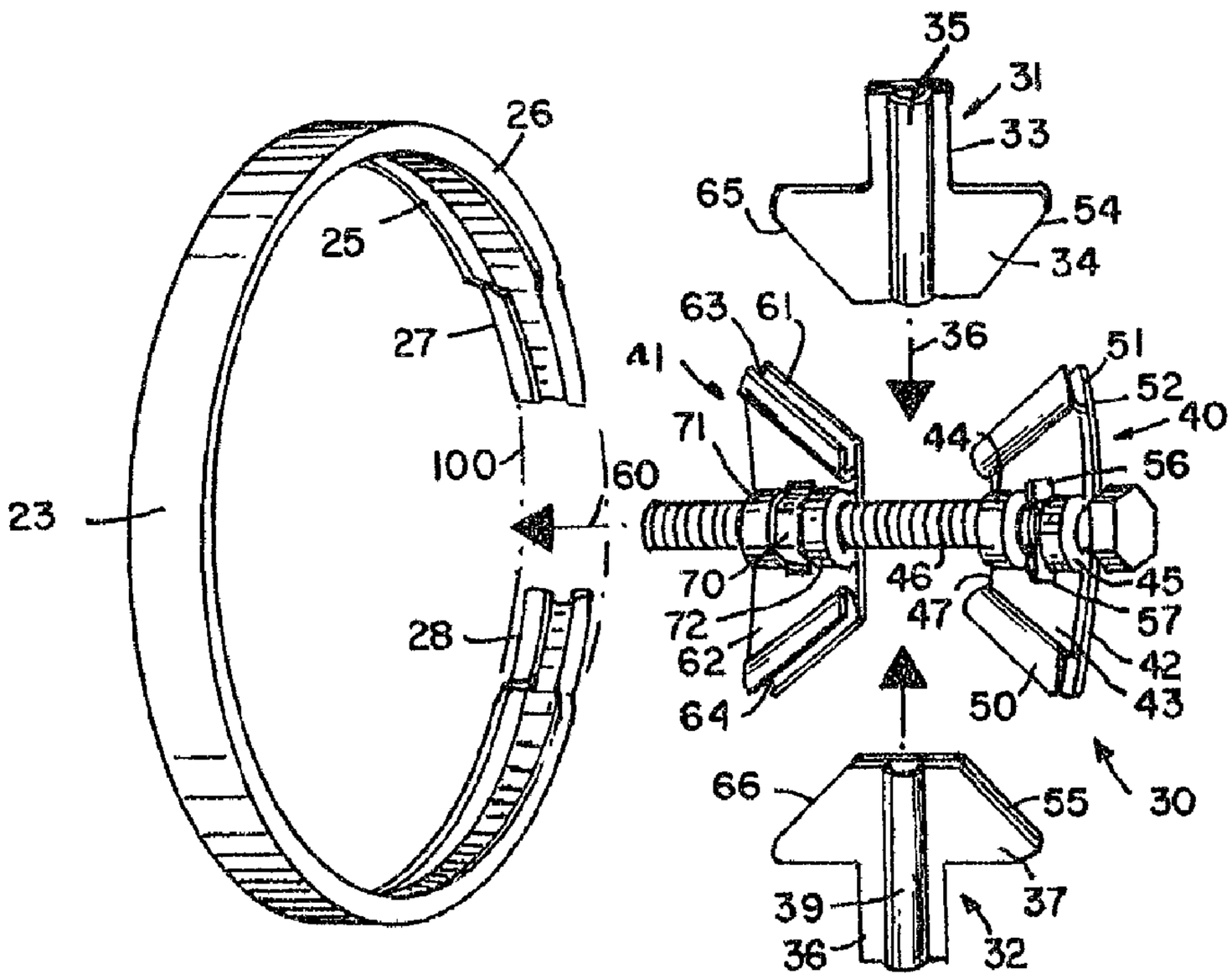
(72) Inventeur/Inventor:
Gundy, William P., US

(73) Propriétaire/Owner:
NPC, Inc., US

(74) Agent: BROUILLETTE KOSIE

(54) Titre : BANDE MUNIE DE CAMES BISEAUTEES A COIN
(54) Title: BAND WITH SLOTTED WEDGE CAMS



(57) Abrégé/Abstract:
A band assembly for effecting a seal particularly adapted for use in establishing a joint between a sewer pipe and a reinforced concrete manhole riser. The seal is affected by a tapered elastomeric tubular connector boot and a clamping band member with an expansion mechanism. Wedge followers are loosely captured in the end sections of the clamping band and lie along a circumferential center line on the band. Driving wedges extend along an axis transverse to the circumferential center line. The wedge followers and wedge drivers both have divergent edge sections that interengage and slide over one another as the driving wedges are pulled together by a clamping mechanism comprising, in a simplest form, a nut and bolt. As the driving wedges move toward the circumferential center line, they displace the wedge followers. The wedge followers engage the end portions of the clamping band and force it and the connector boot into a sealing relationship with the surrounding manhole riser.

Abstract

A band assembly for effecting a seal particularly adapted for use in establishing a joint between a sewer pipe and a reinforced concrete manhole riser. The seal is affected by a tapered elastomeric tubular connector boot and a clamping band member with an expansion mechanism. Wedge followers are loosely captured in the end sections of the clamping band and lie along a circumferential center line on the band. Driving wedges extend along an axis transverse to the circumferential center line. The wedge followers and wedge drivers both have divergent edge sections that interengage and slide over one another as the driving wedges are pulled together by a clamping mechanism comprising, in a simplest form, a nut and bolt. As the driving wedges move toward the circumferential center line, they displace the wedge followers. The wedge followers engage the end portions of the clamping band and force it and the connector boot into a sealing relationship with the surrounding manhole riser.

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Background of the Invention

Field of the Invention

This invention generally relates to sealing arrangements for pipe joints and more specifically to an improved clamping device for effecting a seal between a pipe and a manhole.

Description of Related Art

Various proposals exist for connecting pipes to manholes in sewer systems. For example, United States Letters Patent No. 3,958,313 for a Method, Apparatus and Product for Improved Pipe-to-Manhole Sealing issued May 25, 1976 to the same assignee as the present invention discloses an underground joint between a sewer pipe and a reinforced concrete manhole riser. A flexible boot slips over the free end of the pipe and an external clamp compresses the seal onto the pipe to produce a boot-to-pipe seal. The other end of the boot penetrates an aperture in a manhole through a normally core-drilled opening in a riser wall. The end of the boot fits in the aperture. A clamping assembly with a clamping band and an integral toggle expander fits inside the boot in alignment with the riser wall. When the toggle expander is operated, it expands the band into the boot and compresses the boot against the riser to produce a boot-to-riser seal.

Occasionally it is necessary to remove the connector from the riser because of improper installation of the seal or an incorrectly sized clamping assembly. In these cases both the

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clamping band and toggle, that constitute an integral unit, had to be replaced. As disclosed in my copending U. S. Patent Application Serial No. 07/513,216 dated April 23, 1990 for A Band For Effecting A Seal and assigned to the same assignee as this invention, an integrally formed toggle nests in the end sections of a band and expands the band when a hydraulic jack or other means forces a center vee-shaped portion of the toggle radially outward.

Core drilling through a concrete riser wall produces a porthole of nominal diameter, but occasionally because of core drill outer roundness caused by damage, the actual size will vary from site to site. Optimal sealing must occur over the entire range of variations. It is difficult to achieve optimal sealing with the toggle and clamp of either of the foregoing references if the hole size variations exceed a narrow range.

Another construction of a clamping band for sewer pipe applications utilizes wedge-shaped cam members for acting with followers on a clamping band. As disclosed hereinafter, this approach is more readily accommodates a wider range of hole size variations. Essentially two wedge-shaped members are drawn together by a bolt and nut. The cam members drive follower members, affixed to the band, circumferentially apart. Although this structure has been available for a number of years and provides superior sealing to the toggle structures, it has not been widely accepted, particularly with compression

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bands for smaller diameter pipes, because the costs of such structures are not justified for smaller diameter pipes. In part this cost reflects a need to maintain an inventory of separate clamping structures for each pipe diameter. Thus, two basic clamping band structures continue to be used and for smaller pipes, optimal sealing force are compromised for reduced costs.

Summary

Therefore it is an object of this invention to provide an expansible clamping band with a wide range of clamping adjustments.

It is another object of this invention to provide an expansible clamping band that is less expensive to manufacture.

Yet another object of this invention is to provide an expansible clamping mechanism that is economical to utilize and accommodates a wide range of pipe sizes.

In accordance with this invention, an improved operating mechanism for a clamping band includes first and second follower means that are inserted into the ends of a clamping band and captured thereby. First and second wedge members with divergent edges engage corresponding divergent edges of the follower means and are aligned along an axis transverse to a center line that extends circumferentially along the center of the clamping band. Compression means pull the wedging means

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together along the transverse axis toward the center ligne. The wedging means coact with the follower means to separate the ends of the clamping band thereby to increase the separation between the first and second ends of the clamping band and produce a sealing force.

The present invention in accordance with an aspect thereof provides in a system for clamping a flexible pipe connector to a pipe wall including a clamping member with a nominal radius of curvature and an outer surface for engaging the pipe connector and spaced first and second end sections that align along a circumferential center line, the improvement of expansion means for altering the separation between the first and second end sections thereby to alter the radius of curvature of the clamping member, said expansion means comprising:

A. first follower means and second follower means each having a shank portion for being inserted along the center line into a corresponding end section of the clamping member and a head portion with a base for overlying the end section and with divergent planar edge portions constituting the sides of the head portion,

B. first wedge means and second wedge means adapted for lying in a spaced relationship along an axis that is transverse to the center line to control the separation of said follower means, each of said first and second wedge means having edge means that diverge with respect to the transverse axis, that parallel said follower means edge portions and that terminate with outwardly facing open channel means for receiving said follower means planar edge portions, and

C. compression means for displacing said first and second wedge means with respect to the center line, one of said wedge means having means for receiving said compression means and the other of said wedge means including means for engaging said compression means whereby operation of said compression means changes the separation between

the first and second end sections.

In accordance with the present invention the compression means may comprise bolt and nut means for being threaded together and the receiving means and the engaging means on said wedge means may include integral U-shaped saddle means for guiding said bolt means along the transverse axis to the nut means and the saddle means on one of the wedge means positioning the nut means. In accordance with the present invention each of the U-shaped saddle means may comprise first and second saddles for being spaced along the transverse axis, one of said wedge means having respective first and second saddle means spaced apart to receive a nut means therebetween and having means intermediate said respective first and second saddles means for preventing rotation of the nut means with respect to said one wedge means.

In accordance with the present invention each of the wedge means may be formed of overlying stamped metal components. In accordance with the present invention each of the wedge means may be formed of bonded overlying stamped metal components. In accordance with the present invention each of the follower means may include a central reinforcing structure formed integrally therewith coextensively with the center line.

In accordance with another aspect the present invention provides an apparatus for connecting a pipe to a manhole riser at an opening through a wall thereof, said apparatus comprising:

A. a connector boot with a first circular end portion for insertion in the opening of the manhole riser, a second circular end portion for receiving the pipe, and a central transition portion interconnecting said first and second end sections,

B. a clamping band having a profile with a nominal radius of curvature and extending along a circumferentially extending center line with spaced first and second end sections, and

C. expansion means for altering the separation between the first and second end sections of said clamping band thereby to produce a sealing force that effects a seal between said first circular end and the wall of the opening in the manhole riser, said expansion means being as defined herein.

In accordance with the present invention each of the wedge means may have a trapezoidal shape. In accordance with the present invention each of the follower means may comprise a shank portion for insertion in one of said first and second end sections of said clamping band and a trapezoidal head portion with a base that overlies the end section and with the divergent edges constituting sides of the trapezoid.

An apparatus in accordance with the present invention may have connector boot means having a first pocket means formed at said first circular end portion for receiving said expansion means.

An apparatus in accordance with the present invention may have connector boot means having a second pocket angularly centered on said first pocket means and extending longitudinally into said central transition portion for receiving portions of said compression means.

The present invention in accordance with an additional aspect provides an apparatus for connecting a pipe to a manhole riser at an opening through a wall thereof including a connector boot with a first circular end portion for insertion in the opening of the manhole riser to be coextensive with portions of the wall. a second circular end portion for receiving the pipe and a central transition portion interconnecting said first and second end portions, a clamping band extending along a circumferentially extending center line with spaced first and second end sections and expansion means, having compression means including a portion adapted to extend transversely from said clamping band for producing the expansion and for altering the separation between the first and second end sections thereby to produce a sealing force that effects a seal

between said first circular end portion and the wall of the manhole riser, the improvement comprising pocket means, being formed in an interior surface of the connector boot, for receiving the expansion means including the compression means so the compression means remains spaced from the interior surface of the connector boot.

In accordance with the present invention the compression means may be loosely captured by saddle means for producing the expansion and altering the separation and wherein the pocket means may include first and second pockets, the first pocket for receiving the expansion means proximate the clamping band and the second pocket being angularly centered on the first pocket and extending longitudinally into the boot central transition portion for receiving the portion of the compression means adapted to extend transversely from the clamping band, whereby the compression means remains spaced from the interior surface of the connecting boot when disposed in the second pocket.

Brief Description of the Drawings

This invention is pointed out with particularity in the appended claims. The various objects, advantages and novel features of this invention will be more fully apparent from a reading of the following detailed description in conjuction with the accompanying drawings in which like reference numerals refer to like parts, and in which:

FIG. 1 is a perspective view of a sewer pipe and manhole riser sealably jointed together by means of a connector boot of the type illustrated in FIG. 2 and adapted for utilizing a connector band and expansion mechanism as shown in Figs. 4 through 7;

FIG. 2 is an exploded view showing, in perspective, sealing joint components of one embodiment in the prior art;

FIG. 3 is an exploded view showing another embodiment of an expansion mechanism of the prior art;

FIG. 4 is an exploded view of an expansion mechanism constructed in accordance with this invention;

FIG. 5 is an exploded view of a compression band with an expansion mechanism that is adapted for use with this invention;

FIG. 6 is an enlarged assembled plan view of the expansion mechanism as shown in Fig. 5; and

FIG. 7 is a cross-sectional view of the connector boot adapted for use with the expansion mechanism in Figs. 4 through 6.

Description of Illustrative Embodiments

FIGS. 1 and 2 correspond to FIGS. 16 and 18 in U.S. Letters Patent No. 3,958,313 and also use the same reference numerals. By way of background, FIG. 1, discloses a manhole riser 200 mounted on a base 201 and having formed therein, by core drilling or other similar procedure, a port hole into which the extremity of a pipe 203 is inserted. The outer diameter of the pipe 203 is appreciably smaller than the inner diameter of the port hole.

The pipe 203 and the riser 200 are held in a sealably joined relationship by a clamp pipe connector boot assembly generally denoted by arrow 204. The connector boot assembly 204 and a clamping band of the prior art are shown in more detail removed from the riser and pipe in FIG. 2.

As shown more clearly in FIG. 2, the connector boot 204 comprises an elongated, flexible tubular body having an

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internal clamping end 206 of a cylindrical shape and size suitable for loosely engaging within a porthole. Located around the outer surface of the clamping end 206 are spaced beads or ribs 209 which are deformable under pressure to fill in irregularities in the riser porthole edge in the fully clamped position.

Pressure is exerted against the clamping end 206 by an internal clamping band 212 which includes a toggle expander device consisting of toggle arms 212A and 212B. The band and toggle arms can be forced into a position in which they are essentially aligned such that the band 212 becomes expanded under relatively high pressures and the end 206 of the connector boot 204 is thereby compressed solidly against the porthole edge. When an external device forces the toggle expander arms 212A and 212B into an aligned position, the toggle arms move outwardly and radially of the porthole and provide an over-center travel which positions the arm in a self-locking position so they constantly maintain pressure on the clamping band 212.

At its opposite extremity, the tubular connector body 204 is formed with an external clamping end 208 also of a cylindrical shape, but appreciably smaller than the end 206 so as to loosely engage around the outer periphery of the pipe 203 in FIG. 1. This end 208 is also formed with a series of beads 208A. An external clamping band 211 located in a channel 208B

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is solidly clamped by screwdriver pressure exerted through a tightening screw 213. This pressure deforms the beads 208A and clamps the end 208 in tightly sealed relationship around the pipe.

Extending between the parts 206 and 208 of the connector boot is an intermediate flexible tubular body portion 210 which is of a gradually decreasing size and designed to yieldably join the parts 206 and 208 together so that relative movement of one to the other may take place under varying stress forces.

FIG. 3 discloses an expansion mechanism 210 of the prior art for use in producing a seal. The expansion mechanism 210 interacts with a clamping band 220, a portion of which is shown in FIG. 3 that has end sections 221 and 222 and has circumferentially extending inwardly turned lips 223 and 224 for radial strength. The end sections 221 and 222 receive stamped, metal wedge followers 225 and 226 that are welded to the end sections 221 and 222 respectively. These wedge followers extend generally along a circumferential center line 227 through the band 220.

Referring to the wedge follower 225, a shank 226 fits between the lips 223 and 224. A trapezoidal head 231 has edge structures 232 and 233 that diverge from an apex 234 on the circumferential center line 227. The edge structures 232 and 233 diverge as they extend toward the shank 230. One base of the head 231 abuts the edges of the lips 223 and 224 and a

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portion of the band 220 backs the head portion 231. The edge structures 232 and 233 have a channel-like shape.

The wedge follower 226 has a similar construction with a shank 235, a head 236, and divergent edges 237 and 238 that extend back from an apex 239. Both the wedge followers 225 and 226 are permanently welded to the band 220 during its manufacture.

The wedge expansion system also includes a driving wedge or cam 240 that has a general shape of a trapezoid formed by an outer plate 241 and inner plate 242 that are welded together. The inner plate 242 includes a saddle 243 that forms a cylinder 244 with the outer plate 241. The cylinder 240 is tapped to provide internal threads 245. The wedge 240 additionally has diverging edges 246 and 247 that taper outward from a transverse center line 248, the minor side of the trapezoidal wedge member 240 facing the band and being parallel to the center line 227.

A complementary driving wedge 250 has an outer plate 251 and an inner plate 252 with a central saddle 253. The saddle forms a cylinder 254 that is counterbored. Divergent edges 256 and 257 extend outwardly and transverse to the center line 248. A bolt 260 passes through the clearance hole 254 in the driving wedge 250 and engages the threads 245 in the wedge 240. Divergent edges 246 and 247 engage the channels 233 and 238 respectively of the wedge followers 226 and 235. Similarly the

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divergent edges 256 and 257 of the driving wedge 250 engage the divergent edges 237 and 232 of the wedge followers 226 and 225. As the bolt 260 tightens, the bolt head 261 engages an upper edge 262 of the driving wedge 250 and the driving wedges 240 and 250 are drawn together and toward the center ligne 227. This causes the followers 225 and 226 to be displaced circumferentially apart in a direction parallel to the center line 227.

An elongated tab 263 formed to one end section of the clamping band 220 has a sufficient length to cover any gap that the driving wedges 240 and 250 can produce thereby to provide a continuous sealing band for producing a sealing force that acts radially outward.

As previously stated, this construction provides superior sealing, but is expensive to manufacture. This expense is not justified economically for use with seals of smaller diameter pipes. So toggle arrangements have continued to be used to effect the seals in such applications.

FIG. 4 discloses a clamping band and expansion mechanism that provides the advantages of the structures of FIG. 3 at costs comparable to those of clamping bands with toggle expanders. As shown in FIG. 4, a connector boot 20 having a similar configuration as the connector boot 204 in FIGS. 1 and 2, has a first end 21 adapted to be inserted into a core drill opening in a manhole riser and a second end 22 adapted for

surrounding a pipe and being sealed thereto by a clamping band 23 that is similar to the clamping band 211 shown in FIG. 2.

An annular clamping band 24 in FIG. 4 has radially extending inturned lips 25 and 26 extending about the circumference thereof for strength. An expansion mechanism 30 is positioned between end sections 27 and 28. The structure of the expansion mechanism 30 is shown in more detail in FIG. 5.

More specifically the lip portions 25 and 26 on the band 24 rolled over to be parallel with the band and spaced therefrom over the length of the end sections 27 and 28. The end sections 27 and 28 therefore serve as guides for receiving wedge followers 31 and 32 respectively. As shown in FIG. 5 the wedge follower 31 has a shank portion 33 and a trapezoidal head portion 34. A stiffening rib 35 extends through the shank and the head along a center line 36. The wedge follower 32 has a similar structure with a trapezoidal head 37, a shank 38 and a stiffening rib 39. These wedge followers 31 and 32 are readily stamped from a planar stainless steel or similar metal thereby to be produced in quantity at low cost.

The expansion mechanism 30 additionally comprises driving wedges 40 and 41. In this particular embodiment the driving wedge 40 has an outer plate 42 and an inner plate 43. The inner plate is formed with a pair of spaced saddles 44 and 45 that provide a clearance for a bolt 46. The driving wedge 40 additionally has a generally trapezoidal shape with a leading

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edge 47 and divergent edge sections 50 and 51 that extend to a rear base portion 52. The edge sections 50 and 51 are formed as U-shaped channels to engage divergent edges 54 and 55 formed by the trapezoidal head sections 34 and 37. An aperture extends through the plates 42 and 43 intermediate the saddles 44 and 45 and the inner plate 43; tabs 56 and 57 are formed along edges parallel to an axis 60 about which the bolt 46 turns.

The driving wedge 41 has an identical structure and includes an outer plate 61 and an inner plate 62 formed with U-shaped channels 63 and 64 that define divergent edges. The channels 63 and 64 engage divergent edges 65 and 66 formed on the trapezoidal head portions 34 and 37 of the wedge followers 31 and 32. The driving wedge 41 has a standard hexagonal nut 70 located between spaced saddles 71 and 72. Tabs, described in detail later, on the driving wedge 41, which is identical to the driving wedge 40, engage the edges of the nut 70 thereby to prevent its rotation.

Both the driving wedges 40 and 41 are metal stampings. In this particular embodiment plates 42 and 43 are welded together as are the plates 61 and 62. However, the components of this expansion mechanism 30 are all inexpensive to manufacture. Moreover, a given set of mechanism components provide expansion mechanisms for bands 23 of different diameters. It is merely necessary to place the stamped wedge followers 31 and 32 and

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the driving wedges 40 and 41 in stamping dies to produce a radius of curvature for each of those pieces that corresponds to the radius of curvature of the band so the mechanism conforms to the band's profile and does not protrude therefrom. In the structure shown in FIG. 3, the use of such stamping operations to adapt the driving wedges 240 and 250 for different profiles could either close the clearance hole 254 or deform the cylinder 241 causing the integrity of the threaded connection to be lost. Threaded engagement in accordance with this invention, as shown in FIGS. 4 through 6, is limited solely on the integrity of a standard nut that is inserted after the structure is bent.

FIG. 6 discloses an assembled mechanism 30 intermediate the end sections 27 and 28 of the clamping band 23. As shown the end section 28 captures the wedge follower 31. The lips 25 and 26 are rolled parallel to the band 23 thereby to form channel sections 80 and 81 that engage the shank portion 33. The base of the head portion 34 abuts the ends of the channel sections 80 and 81. Similar channel sections 82 and 83 capture the shank portion 36 of the wedge follower 32 such that the base of the head portion 37 abuts the end of the channels 82 and 83.

In an assembled form, the U-shaped channels at divergent edges 50 and 51 overlie the diverging edges 55 and 54 of the wedge followers 32 and 31. Similarly diverging U-shaped

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channels at edges 63 and 64 engage and capture the diverging edge portions 65 and 66 respectively of the edge followers 31 and 32. The bolt 46 extends through the saddles 43 and 44, traverses the space between the driving wedges 40 and 41 and then passes through the saddles 71 and 72. As the bolt 46 is rotated in a tightening direction, it acts on nut 90 lying in the aperture of the driving wedge 41. Tabs 91 and 92 at the edges of the aperture prevent the nut 90 from rotating. The driving wedges 40 and 41 move toward each other and the center line 36. This applies a force to the wedge followers 31 and 32 that separates the end sections 27 and 28 along the axis 36. Force is applied from the base of the head portions 34 and 37 against the ends of the channel portions 80, 81, 82 and 83 to produce that displacement.

FIGS. 4 and 7 depict a connector boot 20 with an end section 21 and an end section 22 modified to provide improved operation with respect to the operating mechanism 30. More specifically, the boot 20 is modified by forming first and second pockets in the boot. As shown in FIG. 7, a first pocket is coextensive with a circumferential channel 94 that extends about the interior wall of the end section 21. This channel 94 locates the band 24 along an axis 95. The pocket 93 is coextensive with the mechanism and extends from an end surface 96. A second pocket 97 extends toward the end 22 over a circumferential area corresponding to the dimensions of the

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bolts. The pockets 93 and 97 allow the mechanism to be used even with small diameter pipes and with connector boots having large tapers. As the mechanism 30 extends and tightens, the bolts 46 will not penetrate or engage the material of the connector boot 20 thereby maintaining its integrity.

A tab 100, shown in phantom in FIG. 5, may be provided which overlies the exterior of the band 23 at the gap between the end sections 27 and 28. This tab 100 assures an even application of pressure completely around the circumference of the connector boots.

Therefore, in accordance with this invention, there is disclosed an expansion mechanism for bands for effecting seals with sever pipe connectors and the like that is simple and inexpensive to manufacture. It provides the superior sealing of more expensive prior art devices at the manufacturing costs of the less effective toggle expanders. A number of variations are possible; and it is the object of the appended claims to cover all variations and modifications as come within the true spirit and scope of this invention.

I claim:

1. In a system for clamping a flexible pipe connector to a pipe wall including a clamping member with a nominal radius of curvature and an outer surface for engaging the pipe connector and spaced first and second end sections that align along a circumferential center line, the improvement of expansion means for altering the separation between the first and second end sections thereby to alter the radius of curvature of the clamping member, said expansion means comprising:

A. first follower means and second follower means each having a shank portion for being inserted along the center line into a corresponding end section of the clamping member and a head portion with a base for overlying the end section and with divergent planar edge portions constituting the sides of the head portion,

B. first wedge means and second wedge means adapted for lying in a spaced relationship along an axis that is transverse to the center line to control the separation of said follower means, each of said first and second wedge means having edge means that diverge with respect to the transverse axis, that parallel said follower means edge portions and that terminate with outwardly facing open channel means for receiving said follower means planar edge portions, and

C. compression means for displacing said first and second wedge means with respect to the center line, one of said wedge means having means for receiving said compression means and the other of said wedge means including means for engaging said compression means whereby operation of said compression means changes the separation between the first and second end sections.

2. An expansion means as defined in claim 1 wherein said compression means comprises bolt and nut means for being threaded together and the receiving means and the engaging means

on said wedge means includes integral U-shaped saddle means for guiding said bolt means along the transverse axis to the nut means and the saddle means on one of the wedge means positioning the nut means.

3. An expansion means as defined in claim 2 wherein each of the U-shaped saddle means comprises first and second saddles for being spaced along the transverse axis, one of said wedge means having respective first and second saddle means spaced apart to receive a nut means therebetween and having means intermediate said respective first and second saddles means for preventing rotation of the nut means with respect to said one wedge means.

4. An expansion means as defined in claim 2 wherein each of the wedge means may be formed of overlying stamped metal components.

5. An expansion means as defined in claim 2 wherein each of the wedge means may be formed of bonded overlying stamped metal components.

6. An expansion means as defined in claim 2 wherein each of the follower means may include a central reinforcing structure formed integrally therewith coextensively with the center line.

7. Apparatus for connecting a pipe to a manhole riser at an opening through a wall thereof, said apparatus comprising:

A. a connector boot with a first circular end portion for insertion in the opening of the manhole riser, a second circular end portion for receiving the pipe, and a central transition portion interconnecting said first and second end sections,

B. a clamping band having a profile with a nominal radius of curvature and extending along a circumferentially extending center line with spaced first and second end sections, and

C. expansion means for altering the separation between the first and second end sections of said clamping band thereby to produce a sealing force that effects a seal between said first circular end and the wall of the opening in the manhole riser, said expansion means being as defined in claim 1.

8. An expansion means as defined in claim 7 wherein said compression means comprises bolt and nut means for being threaded together and the receiving means and the engaging means on said wedge means includes integral U-shaped saddle means for guiding said bolt means along the transverse axis to the nut means and the saddle means on one of the wedge means positioning the nut means.

9. An expansion means as defined in claim 8 wherein each of the U-shaped saddle means comprises first and second saddles for being spaced along the transverse axis, one of said wedge means having respective first and second saddle means spaced apart to receive a nut means therebetween and having means intermediate said respective first and second saddles means for preventing rotation of the nut means with respect to said one wedge means.

10. An expansion means as defined in claim 8 wherein each of the wedge means may be formed of overlying stamped metal components.

11. An expansion means as defined in claim 8 wherein each of the wedge means may be formed of bonded overlying stamped metal components.

12. An expansion means as defined in claim 8 wherein each of the follower means may include a central reinforcing structure formed integrally therewith coextensively with the center line.

13. Apparatus for connecting a pipe to a manhole riser as recited in claim 7 wherein each of said wedge means has a trapezoidal shape.

14. Apparatus for connecting a pipe to a manhole riser as recited in claim 7 wherein each of said follower means comprises a shank portion for insertion in one of said first and second end sections of said clamping band and a trapezoidal head portion with a base that overlies the end section and with the divergent edges constituting sides of the trapezoid.

15. Apparatus for connecting a pipe to a manhole riser as recited in claim 7 wherein said connector boot means has a first pocket means formed at said first circular end portion for receiving said expansion means.

16. Apparatus for connecting a pipe to a manhole riser as recited in claim 15 wherein said connector boot means has a second pocket angularly centered on said first pocket means and extending longitudinally into said central transition portion for receiving portions of said compression means.

17. An apparatus for connecting a pipe to a manhole riser at an opening through a wall thereof including a connector boot with a first circular end portion for insertion in the opening of the manhole riser to be coextensive with portions of the wall. a second circular end portion for receiving the pipe and a central transition portion interconnecting said first and second end portions, a clamping band extending along a circumferentially extending center line with spaced first and second end sections and expansion means, having compression means including a portion adapted to extend transversely from said clamping band for producing the expansion and for altering the separation between the first and second end sections thereby to produce a sealing force that effects a seal between said first circular end portion

and the wall of the manhole riser, the improvement comprising pocket means, being formed in an interior surface of the connector boot, for receiving the expansion means including the compression means so the compression means remains spaced from the interior surface of the connector boot.

18. An apparatus for connecting a pipe to a manhole riser as defined in claim 17 wherein the compression means may be loosely captured by saddle means for producing the expansion and altering the separation and wherein the pocket means may include first and second pockets, the first pocket for receiving the expansion means proximate the clamping band and the second pocket being angularly centered on the first pocket and extending longitudinally into the boot central transition portion for receiving the portion of the compression means adapted to extend transversely from the clamping band, whereby the compression means remains spaced from the interior surface of the connecting boot when disposed in the second pocket.

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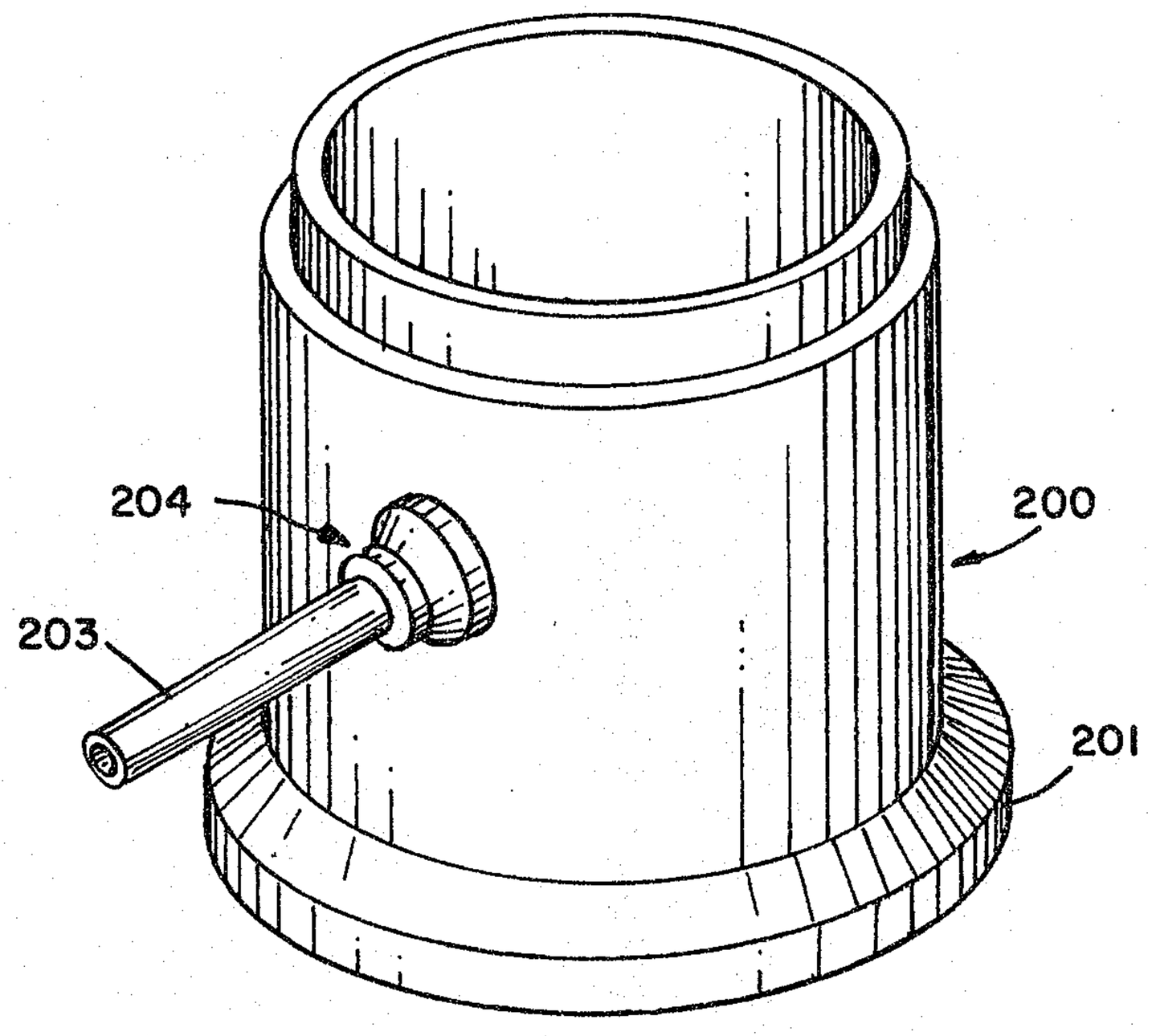

FIG. 1

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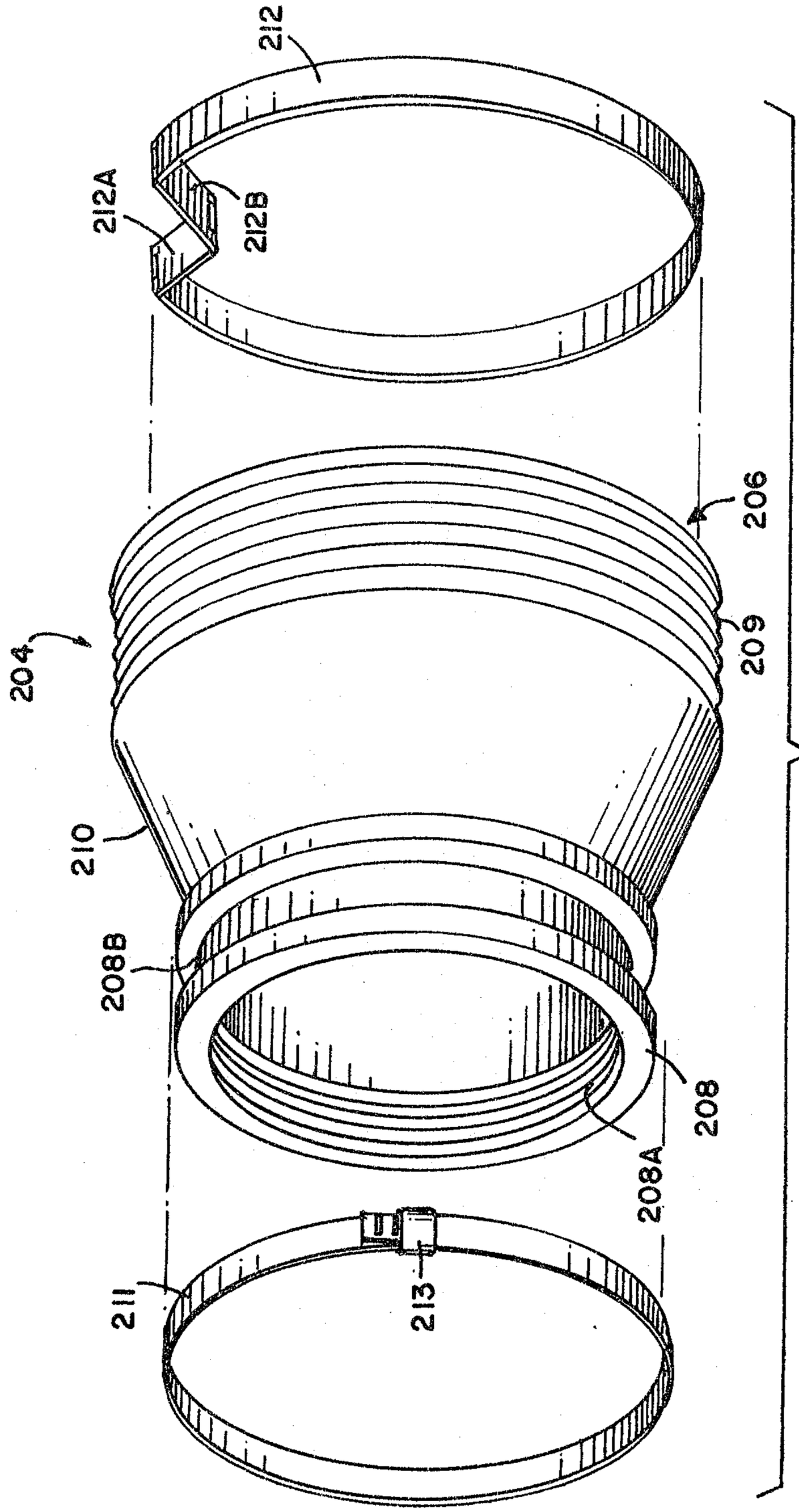

FIG. 2
(PRIOR ART)

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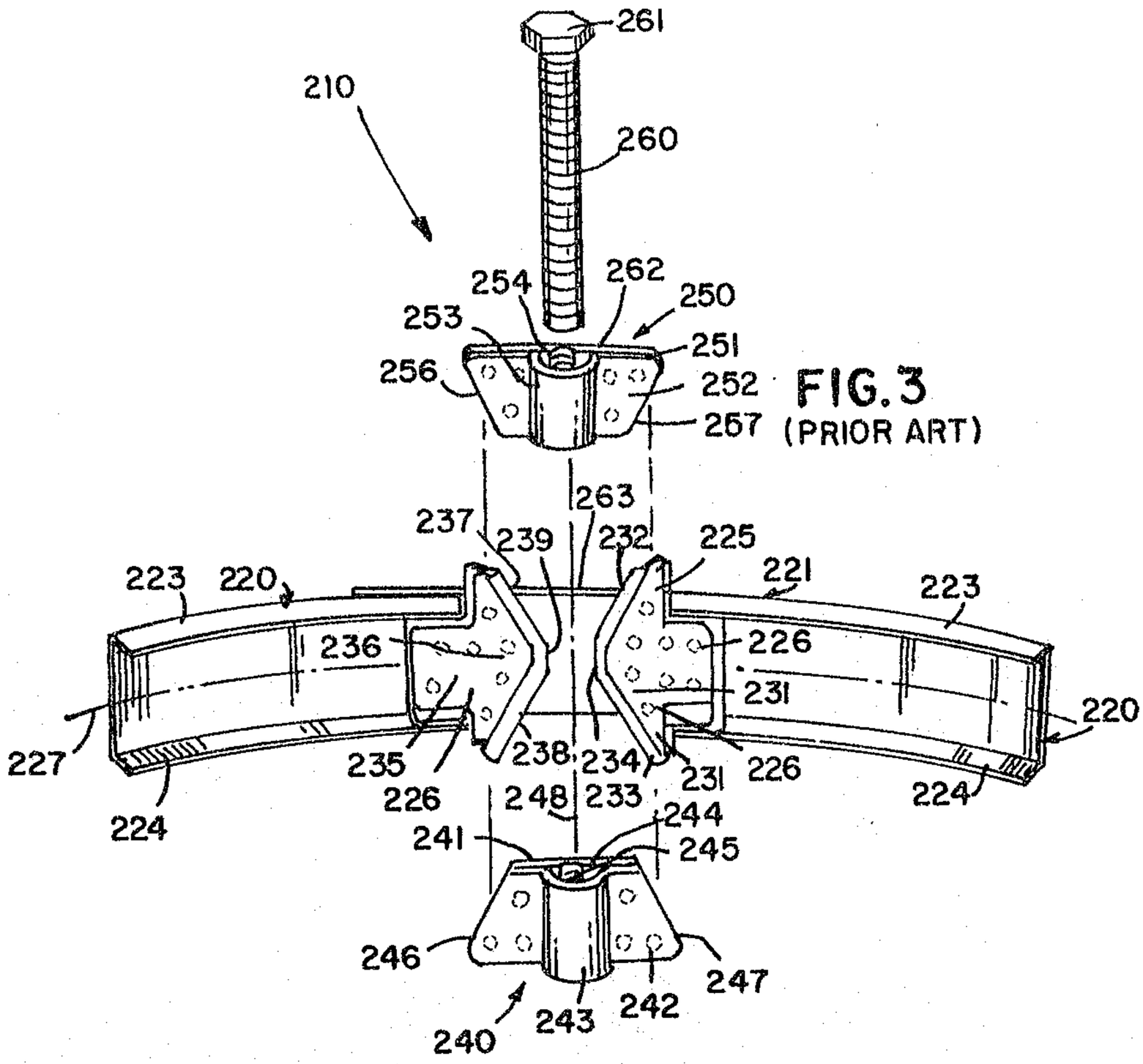

FIG. 3
(PRIOR ART)

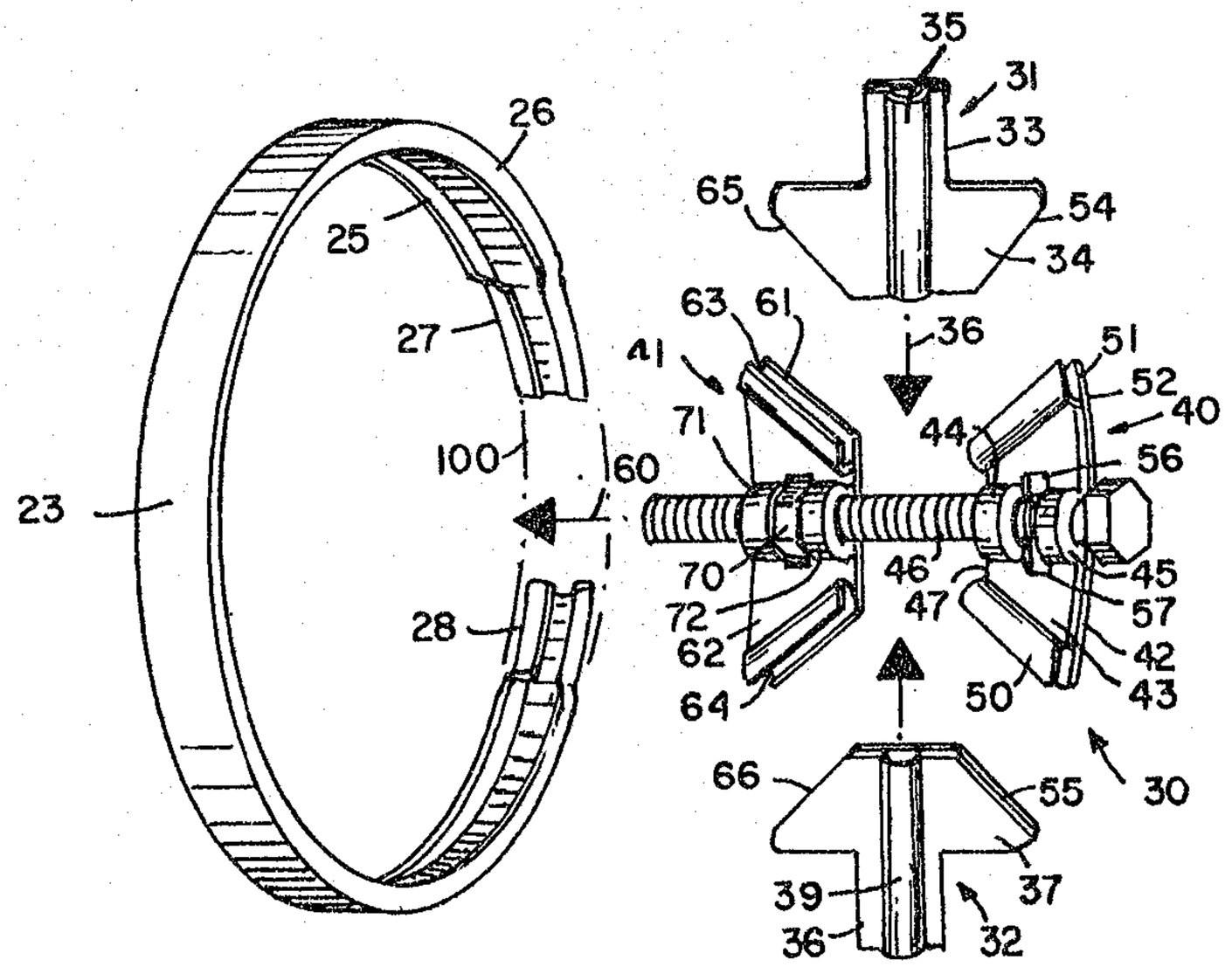

FIG. 5

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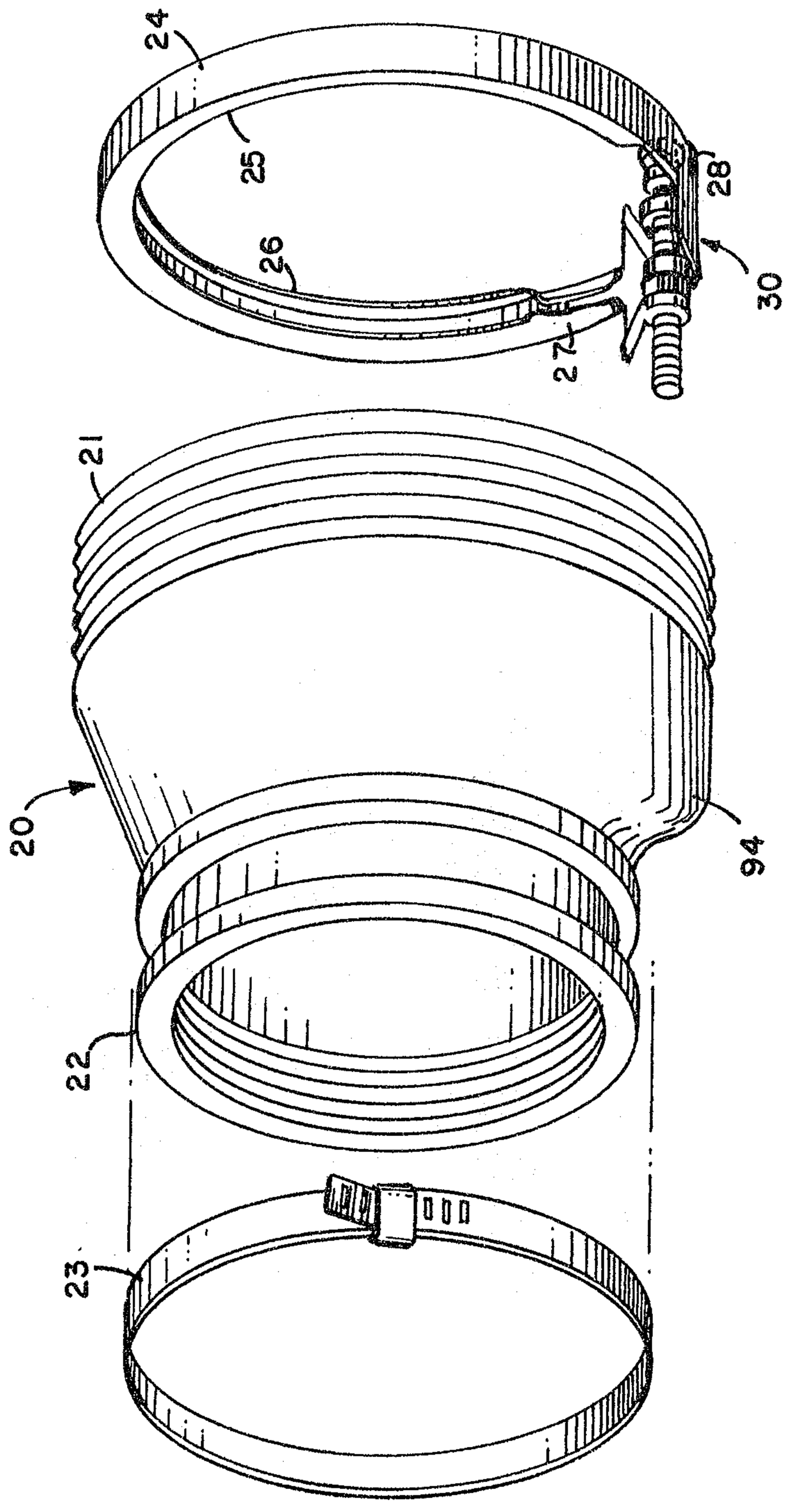

FIG. 4

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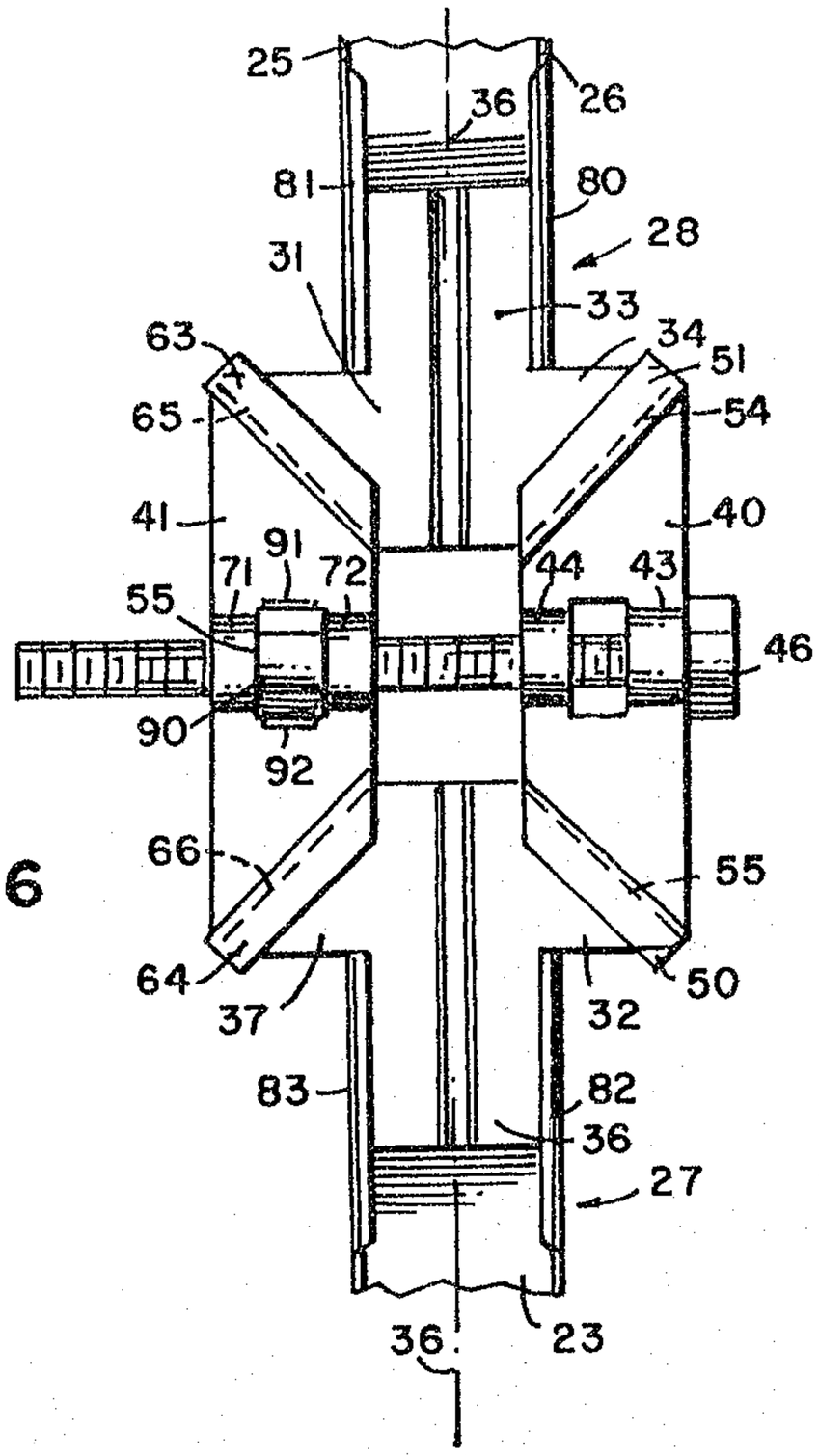

FIG.6

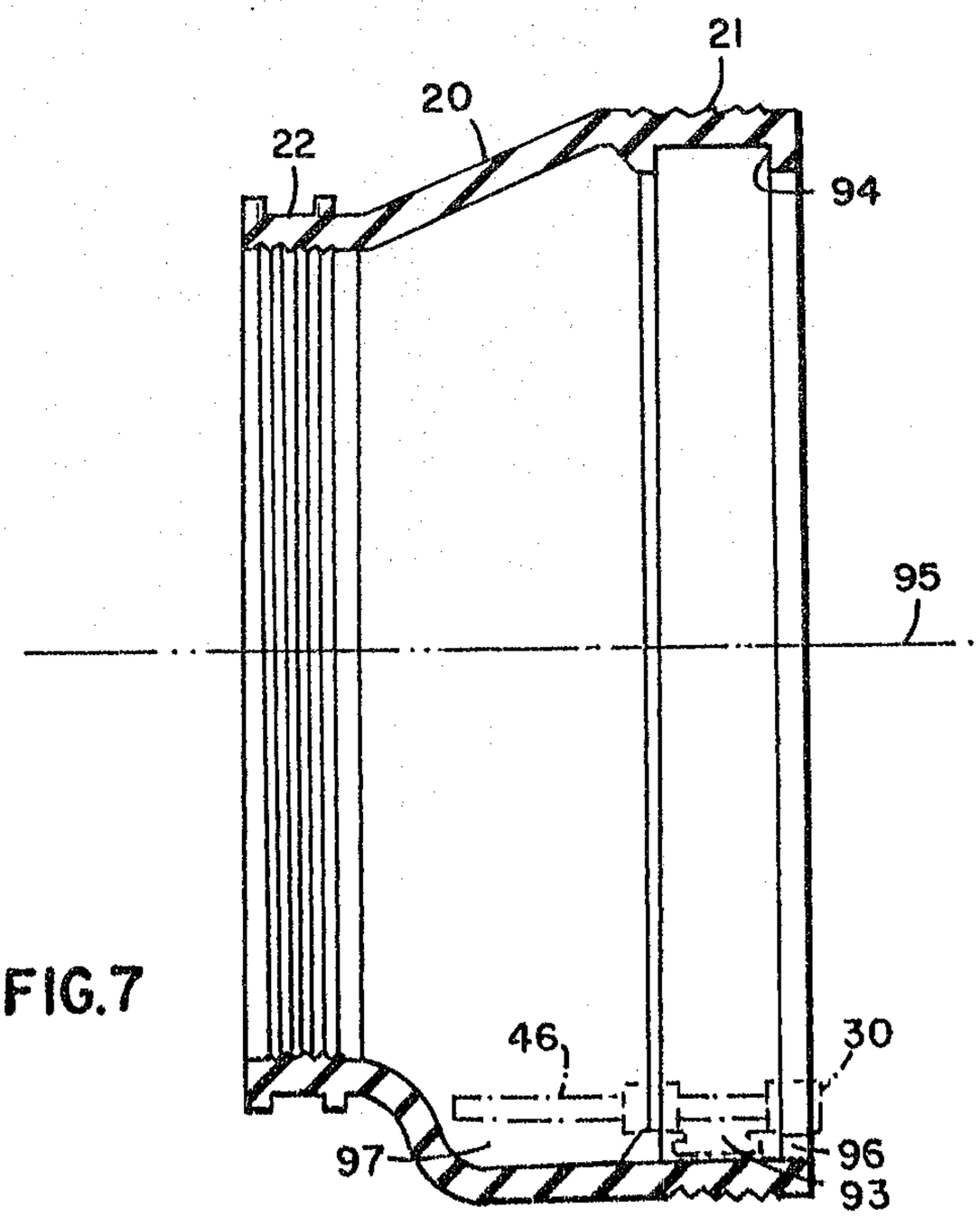

FIG.7

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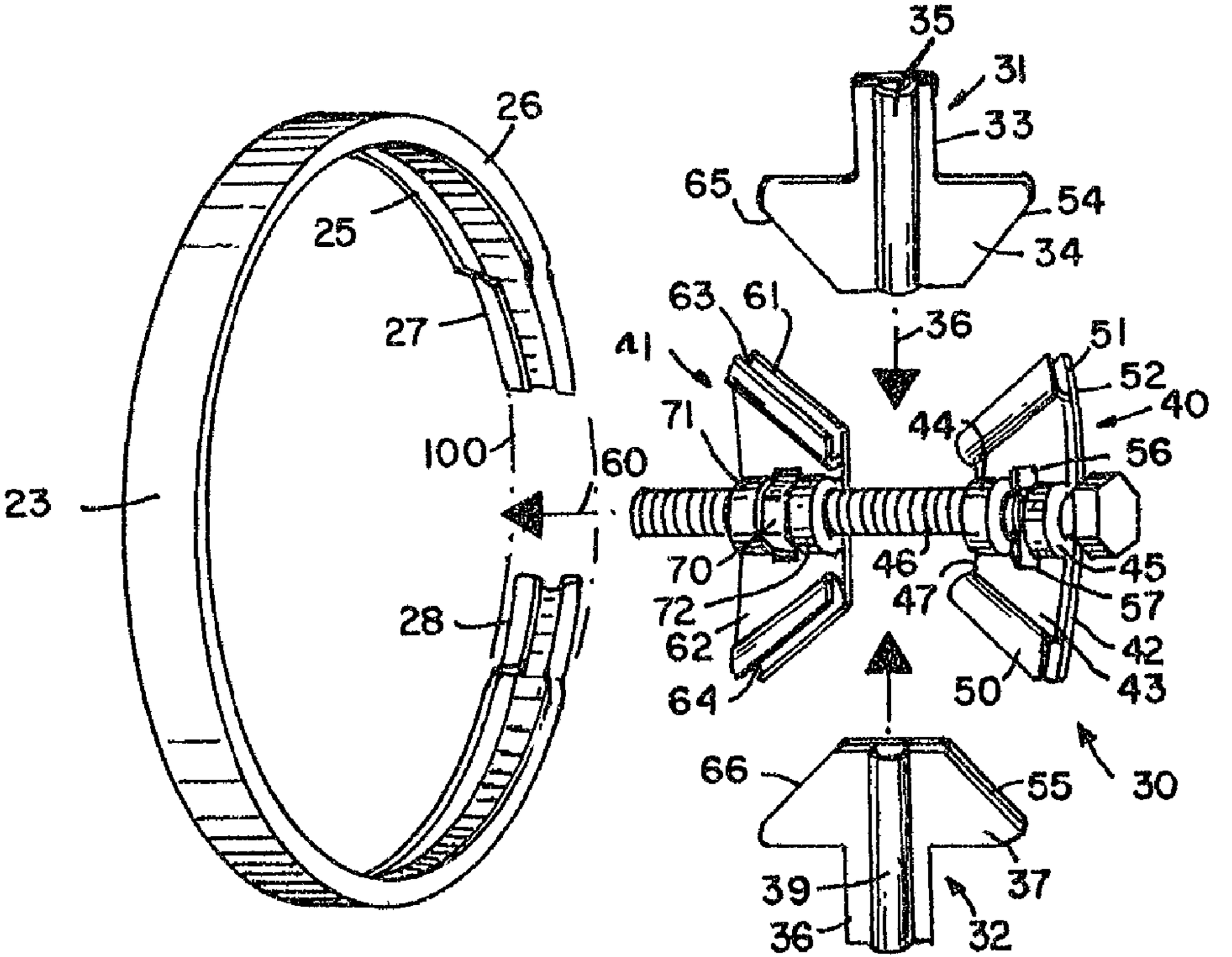
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