



(86) **Date de dépôt PCT/PCT Filing Date:** 2005/10/19  
 (87) **Date publication PCT/PCT Publication Date:** 2006/04/27  
 (45) **Date de délivrance/Issue Date:** 2015/05/19  
 (85) **Entrée phase nationale/National Entry:** 2007/04/12  
 (86) **N° demande PCT/PCT Application No.:** US 2005/037547  
 (87) **N° publication PCT/PCT Publication No.:** 2006/044943  
 (30) **Priorités/Priorities:** 2004/10/19 (US60/620,051);  
 2004/11/09 (US60/626,247)

(51) **Cl.Int./Int.Cl. F16F 7/10** (2006.01)

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(54) **Title: SPARE TIRE MASS DAMPER**

(57) **Abrégé/Abstract:**

The present disclosure relates to a damper assembly for use in a vehicle structure that includes a spare tire mounted thereto is provided. The damper assembly includes a support member extending from the structure and a damper secured to the support member. The damper is operatively interposed between and interconnects the structure and the spare tire for modulating relative motion of the spare tire with respect to the structure for damping vibrations of the structure.



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## (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
27 April 2006 (27.04.2006)

PCT

(10) International Publication Number  
**WO 2006/044943 A2**

(51) International Patent Classification:  
A47H 1/10 (2006.01)

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(21) International Application Number:  
PCT/US2005/037547

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(22) International Filing Date: 19 October 2005 (19.10.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/620,051 19 October 2004 (19.10.2004) US  
60/626,247 9 November 2004 (09.11.2004) US

(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

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(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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**Published:**

— *without international search report and to be republished upon receipt of that report*

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

(54) Title: SPARE TIRE MASS DAMPER

(57) Abstract: The present disclosure relates to a damper assembly for use in a vehicle structure that includes a spare tire mounted thereto is provided. The damper assembly includes a support member extending from the structure and a damper secured to the support member. The damper is operatively interposed between and interconnects the structure and the spare tire for modulating relative motion of the spare tire with respect to the structure for damping vibrations of the structure.

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## SPARE TIRE MASS DAMPER

### **Background of the Invention**

**[0002]** The present disclosure generally relates to a damper assembly and, more particularly, is concerned with a damper assembly for damping vibrations of a vehicle by modulating relative motion of a mass, particularly a spare tire, with respect to the vehicle.

**[0003]** Damper assemblies are commonly used in vehicles to reduce vibrations excited in vehicles and noise levels. Such vibrations can induce booming, droning, spattering, and/or squeaking sounds that can be transmitted to a steering wheel, rear view mirror, interior trim, or other portions of the vehicle's interior or to the surroundings. Reduction of such unwanted vibrations and associated noise improves the handling and comfort of a vehicle.

**[0004]** As it relates to conventional damper assemblies, there are known (a) a mass damper wherein a mass member is fixed to a vibrating member, (b) a dynamic damper wherein a mass member is supported by and connected to the vibrating member via a spring member and (c) a damping material such as an elastic member secured to the vibrating member. However, these conventional devices suffer from various potential problems. For instance, the mass damper and the dynamic damper both require a relatively large mass of the mass member, and exhibit desired vibration damping effect only to significantly narrow frequency ranges, or are limited to certain directions of the excitation force. The damping material suffers from difficulty in exhibiting a desired damping effect, since the damping effect of the damping material is prone to vary depending upon the ambient temperature.

**[0005]** Mass dampers have long been used to control vibratory disturbances in a vehicle. A downside of a mass damper is that to damp a vibration of a large vibrating mass (e.g., a frame), a large mass must be used in the construction of the damper. This adds weight to a vehicle, and negatively impacts fuel economy.

**[0006]** In light of the foregoing, it becomes evident that there is a need for a damper assembly that would provide a solution to one or more of the deficiencies from which the prior art and/or conventional damper assemblies have suffered. Accordingly, it would be desirable to develop a damper assembly having a support member and a damper for damping vibrations of a vehicle by modulating the relative motion of a spare tire with respect to the vehicle.

### **Brief Description of the Invention**

**[0007]** In accordance with one aspect of the present invention, a damper assembly for use in an associated vehicle structure that includes an existing mass mounted thereto is provided. The damper assembly includes a support member extending from the vehicle structure and a damper secured to the support member. The damper operatively interconnects the vehicle structure and the existing mass for modulating relative motion of the existing mass with respect to the vehicle structure for damping vibrations of the vehicle structure.

**[0008]** In accordance with another aspect, a damper assembly for a vehicle frame including first and second spaced apart frame rails supporting a spare tire is provided. The damper assembly includes a support member in spaced relation to the spare tire and a damper secured to the support member. The damper is operatively connected to one of the frame and the spare tire.

**[0009]** In accordance with yet another aspect, a method of damping vibrations of a vehicle frame includes the steps of mounting an existing mass, such as a spare tire, to the vehicle frame and modulating the relative motion of the existing mass with respect to the vehicle frame.

**[0010]** In accordance with still yet another aspect, a damper assembly for use in a vehicle frame that includes a spare tire operatively secured to a winch mechanism is provided. The damper assembly includes a support member extending from the vehicle frame. The winch mechanism is mounted to a portion of the support member. A damper is secured to the support member. The damper operatively interconnects the vehicle frame and the spare tire for modulating relative motion of the spare tire and winch assembly with respect to the vehicle frame for damping vibrations of the vehicle frame.

**[0011]** A winch mechanism travels with the spare tire in the preferred embodiment, rather than being rigidly secured to the frame.

[0012] The vertical bounce mode is significantly different than all other modes, e.g., the modes are all very stiff except for the vertical bounce mode.

[0013] A primary benefit of the invention resides in the ability to provide an improved damper assembly for a vehicle by using an existing mass of the vehicle, such as a spare tire.

[0014] Another benefit resides in damping vibrations in a plurality of vibration input directions.

[0015] Still another benefit of the invention resides in the ability to provide an improved damper assembly for a vehicle having a configuration which has no impact to the design and function of a conventional winch mechanism.

[0016] Still another benefit of the invention resides in the ability to provide an improved damper assembly for vehicles without attaching an independent mass member to the vehicle.

[0017] Yet another benefit resides in the ability to provide an improved damper assembly for vehicles capable of exhibiting a desired damping effect with high stability.

[0018] Still other non-limiting benefits and aspects of the invention will become apparent from a reading and understanding of the description of the preferred embodiments below.

### **Brief Description of the Drawings**

[0019] The present invention may take physical form in certain parts and arrangements of parts, preferred embodiments of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part of the invention.

[0020] FIGURES 1 and 2 are perspective views of a first embodiment of a damper assembly according to the present invention.

[0021] FIGURE 3 shows a side perspective view of the damper assembly of FIGURE 1 with a spare tire removed for ease of illustration.

[0022] FIGURE 4 shows a bottom perspective view of the damper assembly of FIGURE 1 secured to a frame of a vehicle.

[0023] FIGURE 5 is a cross-sectional view of the damper assembly of FIGURE 3.

[0024] FIGURE 6 is a cross-sectional view of a torsional damping assembly of the damper assembly of FIGURE 1.

[0025] FIGURE 7 is an elevational view representing potential travel limits of the spare tire relative to the frame.

[0026] FIGURE 8 is a perspective view of a second embodiment of a damper assembly according to the present invention.

[0027] FIGURE 9 is front perspective view, partially broken away, of the damper assembly of FIGURE 8 secured to a frame and spare tire of a vehicle.

[0028] FIGURE 10 is a schematic representation of a third embodiment of a damper assembly according to the present invention..

[0029] FIGURE 11 is a perspective view of a fourth embodiment of a damper assembly according to the present invention with a spare tire removed for ease of illustration.

[0030] FIGURE 12 is a partially enlarged perspective view of the damper assembly of FIGURE 11.

[0031] FIGURE 13 is a perspective view of the damper assembly of FIGURE 11 including a winch mechanism secured thereto.

[0032] FIGURE 14 is a perspective view of the damper assembly of FIGURE 13 including a spare tire secured thereto.

[0033] FIGURE 15 is a perspective view of a fifth embodiment of a damper assembly according to the present invention.

[0034] FIGURE 16 is a top plan view of the damper assembly of FIGURE 15.

[0035] FIGURE 17 is a partial perspective view of the damper assembly of FIGURE 15 secured to a vehicle frame.

[0036] FIGURE 18 is a perspective view of a sixth embodiment of a damper assembly according to the present invention.

### **Detailed Description of the Invention**

[0037] The description and drawings herein are merely illustrative and various modifications and changes can be made to the components and arrangement(s) of components without departing from the spirit of the invention. Like numerals refer to like parts throughout the several views.

[0038] The illustrated embodiments of the present invention generally show a damper assembly extending from a vehicle frame and operatively engaged to a spare tire for damping road hop, axle tramp and other excitations associated with the operation of the vehicle. It should be appreciated by one skilled in the art that the

damper assembly is not limited to frame vehicles and could also be applied to uni-body vehicles without departing from the scope and intent of the invention. It should also be appreciated that the spare tire is one example of an existing vehicle mass that can be operatively engaged to the damper assembly and that other existing vehicle masses can be used without departing from some aspects of the scope and intent of the present invention.

**[0039]** A first embodiment of the present invention is shown in FIGURES 1-7. With reference to FIGURES 1-4, damper assembly **D** extends from a frame **F** of a vehicle (not shown). Typically, the frame **F** includes first and second spaced apart frame rails **10** and **12** shown here in generally parallel relation, and at least one cross member **14** interconnecting the first and second frame rails. A spare tire **T** is located between the frame rails.

**[0040]** The damper assembly **D** includes a support member **20**. Typically, the support member is a metal structure, although as will be appreciated in accordance with the present invention, alternative materials including non-metallic materials such as nylon can be used to form the support member. The support member **20** is configured for operative engagement between the first and second frame rails **10**, **12** and the spare tire. In the illustrated embodiment, the support member extends in a longitudinal direction that is generally parallel to the frame rails, although it will be appreciated that the particular geometry or orientation of the support member relative to the frame may be altered without departing from the scope and intent of the invention.

**[0041]** As shown in FIGURES 1-4, the support member includes a base section **22** that spans generally across a diameter of the tire. The base section includes first and second end sections **24** and **26** extending from opposing ends thereof. At least one of the first and second end sections **24**, **26** preferably has a contour conforming to an outer radial contour or conformation of the spare tire. In the present embodiment, the first and second end sections have an arcuate contour, however, as will be appreciated, other variations or contours may be used without departing from the scope and intent of the present invention. The conforming contour of at least one of the first and second sections **24**, **26** ensures that the base section **22** operatively supports, abuts, or engages the spare tire. Thus, the base section is oriented to use the mass of the spare tire for controlling vibratory disturbances of the vehicle frame **F**.

**[0042]** To raise and lower the spare tire **T** relative to the vehicle frame, conventionally a winch mechanism is fixedly secured, generally bolted, to the vehicle

frame. However, in the present invention, the winch mechanism **28** is operatively fastened to the damper assembly **D**. In particular, and as shown in FIGURE 3, the winch assembly **28** is mounted to the base section **22** of the support member **20** for selectively raising and lowering the spare tire **T** relative to the vehicle frame **F**, and in this instance relative to the support member **20**. Because the winch mechanism is mounted to the damper assembly **D**, the winch mechanism travels and moves in unison with the spare tire. Thus, the damper assembly **D** operatively interconnects the vehicle frame **F** and the spare tire **T** for modulating relative motion of the spare tire and the winch assembly **28** with respect to the vehicle frame for damping vibrations of the vehicle frame. A flexible member, such as a winch cable (not shown), is fed to and from the winch mechanism to lower the tire to the ground, or raise the spare tire into the stowed position shown in the Figures where the spare tire is supported between the frame rails.

**[0043]** The support member **20** further includes a pivotal support assembly **30** fixedly secured to the second arcuate end section **26** for mounting the spare tire to the vehicle frame. The pivotal support includes a base section **32** and first and second arm sections **34** and **36** extending therefrom. The arm sections serve to interconnect the support member to the frame, particularly each arm section being pivotally secured to a respective frame rail. For example, a conventional bushing or bearing assembly could be used to interconnect the support member with the frame. In the preferred arrangement, however, each arm section **34** and **36** of the pivotal support assembly **30** includes a torsional damping assembly **40**. The torsional damping assembly includes a housing **42**. Typically, the housing is a metal structure, although as will be appreciated in accordance with the present invention, alternative materials including non-metallic materials can be used to form the housing. Secured to an inner surface **44** of the housing is a torsional damper **46** for damping pivoting and rotational movement of the support member **20** relative to the vehicle frame **F**. The torsional damper is often an elastomer or rubber construction because of the ability of the rubber or elastomeric material to isolate and reduce noise and vibration from being transmitted therethrough because of the elastic nature of the material. The torsional damper **46** is preferably mold bonded to the inner surface **44**, although it will be appreciated that other bonding arrangements, such as an adhesive bond, can be used without departing from the scope and intent of the present invention.

**[0044]** An inner diameter portion **48** of the torsional damper **46** is secured to a bushing member **60** that is mounted to the frame. Each bushing member **60** includes a fastener (not shown) and a sleeve **62**. The fastener of each bushing member **60** secures the bushing to the vehicle frame **F**.

**[0045]** As illustrated in FIGURES 5 and 6, the torsional damper **46** may incorporate one or more arcuate or circumferentially extending openings. Thus, the torsional damper in the preferred arrangement is radially continuous between the housing **42** and the bushing member **60** in one diametrical dimension (e.g., in the horizontal direction as shown) and is discontinuous in another diametrical direction (e.g., in the vertical direction as shown) through the inclusion of openings **68**, **70**. Here, the openings are generally symmetrical, but need not necessarily be symmetrical or similarly shaped.

**[0046]** With continued reference to FIGURE 5, a damper **80** is secured to the support member **20**. The damper is operatively interposed between the vehicle frame **F** and the spare tire for modulating relative motion of the spare tire with respect to the frame and thereby damping vibrations of the frame. The damper **80** is also spaced from the bushing members **60** in the longitudinal direction. The damper is oriented to use a mass of the spare tire for controlling vibratory disturbances of the vehicle frame **F**. The damper **80** includes an elastomeric member **82** for damping relative movement between the spare tire and the frame such as in the vertical direction. The elastomeric member **82** also isolates and reduces noise and vibration from being transmitted therethrough because of the elastic nature of the material.

**[0047]** The elastomeric member **82** is fixedly secured to the support member **20**. Particularly, the base section **22** includes a through bore, and first and second flanges **84** and **86** associated with opposite faces of the base section for mounting the damper **80** thereto. The elastomeric member **82** is preferably mold bonded to the inner surface of the bore, however other bonding arrangements, such as an adhesive bond, can be used without departing from the scope and intent of the present invention.

**[0048]** With continued reference to FIGURE 5, the damper **80** further includes at least one travel restrictor **92** disposed in spaced relation to the support member **20**. The travel restrictor preferably comprises first and second plate members **94** and **96**, respectively, interconnected in axially spaced relation by a travel rod **98**. The travel rod extends through an aperture (not shown) located in the elastomeric member **82**. A conventional fastener assembly **100** secures the plate members to opposite ends of the travel rod. As shown in FIGURE 4, the travel restrictor **92** is operatively engaged at one

end to the vehicle frame **F**. In operation, the travel restrictor **92** limits vertical displacement of the spare tire relative to the frame as best represented in FIGURE 7. In particular, as the spare tire **T** moves vertically relative to the frame **F**, the support member **20** will pivot about the pivotal supports **30**. The base section **22** of the support member will move vertically on the travel restrictor **92**. The vertical movement of the base section however is restricted by the plate members **94** and **96** of the travel restrictor abutting respective ends of the elastomeric member **82**. This limited vertical movement, in turn, modulates relative motion of the spare tire **T** with respect to the frame **F** thereby damping vibrations of the frame.

**[0049]** Similar to the aforementioned embodiment, a second embodiment of the damper assembly is shown in FIGURES 8 and 9. Since most of the structure and function is substantially identical, reference numerals with a single primed suffix (') refer to like components (e.g., vehicle frame is referred to by reference numeral **F'**), and new numerals identify new components in the additional embodiment.

**[0050]** As shown, the damper assembly **D'** includes a support member **120** configured for operative engagement with a cross member extending between the first and second frame rails **10'**, **12'** and a spare tire **T**. The spare tire includes a rim **R** having a plurality of conventional mounting apertures dimensioned to receive the threaded studs of a wheel hub.

**[0051]** The support member **120** includes a first or base section **122** secured to the cross member **14'** of the vehicle frame **F**. Preferably, the base section conforms to the contour of the cross member. In this embodiment, the base section has a generally planar upper surface **124** which is contiguous with a lower surface of the cross member **14'**. A second section **130** of the support member **120** extends generally normal from a lower surface of the first section **122**. The second section has a general circular cross-section, although, it can be appreciated that other cross-sections can be used without departing from the scope and intent of the present invention.

**[0052]** As shown in FIGURE 9, the support member **120** further includes a housing **134** fixedly secured to one end of the second section **130** of the support member. The housing comprises at least one bore **140** for securing at least one damper **80'**. In the present embodiment, the housing **134** includes five circumferentially spaced bores for securing five dampers, one damper dimensioned for respective receipt through one of the mounting apertures of the rim **R**.

[0053] The damper **80'** includes an elastomeric member **82'** for damping relative movement between the spare tire **T** and the frame **F'**. The elastomeric member **82'** is fixedly secured in the housing **132**. Preferably, an outer surface of the elastomeric member is bonded to an inner surface of the bore **140**. The damper **80'** further includes at least one travel restrictor **92'**. The travel restrictor comprises first and second plate members **94'** and **96'** interconnected by a generally axially extending travel rod **98'**. The travel rod extends through an aperture of the elastomeric member **82'**, and the first plate member **94'** is secured to a first end of the travel rod **98'** while a second end of the travel rod extends through the mounting aperture of the rim and is secured to the second plate **96'** beneath the rim. The travel restrictor **92'** thus operatively limits displacement of the spare tire relative to the frame **F'**. As to a further discussion of the manner of usage and operation of the second embodiment, the same should be apparent from the above description relative to the first embodiment. Accordingly, no further discussion relating to the manner of usage and operation will be provided.

[0054] FIGURE 10 schematically represents that one or more dampers may be located at various positions relative to the spare tire. Thus, although the embodiment of FIGURES 8 and 9 locate the dampers within the area of the spare tire, it will be appreciated that one or more dampers can be mounted outside the periphery of the spare tire and still effectively use the mass of the spare tire to dampen the vibrations of the vehicle frame. Again, this third embodiment schematically illustrates what one of ordinary skill in the art would recognize, namely that alternative arrangements may be used to achieve the same result.

[0055] Similar to the aforementioned embodiment, a fourth embodiment of the damper assembly is shown in FIGURES 11-14. Since some of the structure and function is substantially identical, reference numerals with a triple primed suffix ("") refer to like components (e.g., damper assembly is referred to by reference numeral **D'''**), and new numerals identify new components in the additional embodiment.

[0056] The damper assembly **D'''** includes a support member **180** configured for operative engagement between first and second frame rails (not shown) and the spare tire **T'''** (FIGURE 14). Similar to the first embodiment, the support member extends in a longitudinal direction that is generally parallel to the frame rails, although it will be appreciated that the particular geometry or orientation of the support member relative to the frame may be altered without departing from the scope and intent of the invention.

[0057] As shown in FIGURES 11-14, the support member includes a base section **182** secured to a pair of arms **184** and **186** which span generally across a diameter of the spare tire. Each arm preferably has an end section with a contour conforming to an outer radial contour or conformation of the spare tire. In the present embodiment, the end sections have an arcuate contour, however, as will be appreciated, other variations or contours may be used without departing from the scope and intent of the present invention. The conforming contour of the end sections of the arms **184** and **186** ensures that the support member **180** operatively supports, abuts, or engages the spare tire. Thus, the support member is oriented to use the mass of the spare tire for controlling vibratory disturbances of the vehicle frame.

[0058] The base section has a generally planar top surface **188** including at least a slotted opening **190** for receiving and operatively securing a portion of a conventional winch mechanism **192**. The conventional winch mechanism **192** selectively raises and lowers the spare tire relative to the vehicle frame (not shown), and in this instance relative to the support member. Similar to the first embodiment, because the winch mechanism **192** is mounted to the damper assembly **D'''**, the winch mechanism travels and moves in unison with the spare tire **T'''** (FIGURE 14). A flexible member such as a winch cable **194** is fed to and from the winch mechanism to lower the spare tire to the ground, or raise the spare tire into the stowed position shown in FIGURE 14 where the spare tire is supported between the frame rails.

[0059] The support member **180** further includes a pivotal support assembly **200** fixedly secured to the arcuate end sections of the arms **184** and **186** for mounting the support member to the vehicle frame. The pivotal support includes first and second arm sections **202** and **204** which serve to interconnect the support member **180** to the frame, particularly each arm section being pivotally secured to a respective frame rail. Each arm section **202** and **204** of the pivotal support assembly **200** includes a torsional damping assembly **210**.

[0060] With reference to FIGURE 12, each torsional damping assembly **210** includes a housing **212**. Typically, the housing is a metal structure, although as will be appreciated in accordance with the present invention, alternative materials including non-metallic materials can be used to form the housing. Secured to an inner surface of the housing is a torsional damper **214** for damping pivoting and rotational movement of the support member **180** relative to the vehicle frame. Similar to the first embodiment, the torsional damper is often an elastomer or rubber construction because of the ability

of the rubber or elastomeric material to isolate and reduce noise and vibration from being transmitted therethrough because of the elastic nature of the material.

[0061] An inner diameter portion of the torsional damper **214** can be secured to a bushing member which is fixedly secured to respective first ends **220** and **222** of the first and second arm sections **202** and **204**. In the illustrated embodiment, each first end includes a projection **224** which is secured to the inner diameter portion of the torsional damper **214**. The torsional damper is preferably mold bonded to the projection **224**, although it will be appreciated that other bonding arrangements, such as an adhesive bond, can be used.

[0062] Extending from each housing **212** of the torsional damping assemblies **210** is a flange **230**. The flange includes a generally planar surface **232** having at least one mounting aperture **234** adapted to receive a conventional fastener (not shown). The fastener secures the flange, and in turn, the torsional damping assemblies **210** to the vehicle frame.

[0063] With continued reference to FIGURES 11 and 12, a damper **238** is secured to respective second ends **240** and **242** of the first and second arm sections **202** and **204**. Similar to the previous embodiments, the dampers **238** operatively interconnect the vehicle frame and the spare tire **T** for modulating relative motion of the spare tire with respect to the frame and thereby damping vibrations of the frame. The dampers **238** are also spaced from the torsional damping assemblies **210** in the longitudinal direction. Each damper includes a housing **244**. The housing can be oblong in cross-section and includes an elastomeric member **246** secured to an inner surface of the housing for damping relative movement between the spare tire and the frame such as in the vertical direction. The elastomeric member **246** also isolates and reduces noise and vibration from being transmitted therethrough because of the elastic nature of the material.

[0064] Each damper **238** further includes at least one travel restrictor **92** for limiting vertical displacement of the spare tire relative to the frame. Similar to the first embodiment, the travel restrictor preferably comprises a first plate member (not shown) and a second plate member **96** interconnected in axially spaced relation by a travel rod (not shown). The travel rod extends through an aperture **248** located in the elastomeric member **246**. A conventional fastener (not shown) can secure the plate members to opposite ends of the travel rod. The travel restrictor **92** is operatively engaged at one end to the vehicle frame by the second plate member **96**.

**[0065]** In operation, as the spare tire **T'''** moves vertically relative to the frame, the support member **180** will pivot about the pivotal supports **200**. This, in turn, will cause each travel restrictor **92'''** to move vertically within the elastomeric member **246**. The vertical movement of the support member is restricted by the plate members abutting respective ends of the elastomeric members. This limited vertical movement, in turn, modulates relative motion of the spare tire **T'''** with respect to the frame thereby damping vibrations of the frame.

**[0066]** Similar to the fourth embodiment described above, FIGURES 15-17 illustrate a fifth embodiment of a damper assembly **D''''** of the present invention, more particularly, an alternative arrangement of the pivotal support assembly **280**. Each pivotal support assembly is fixedly secured to end sections of a pair of arms **282** and **284** of a support member **286** which is similar in structure to support member **180**. The pivotal support includes first and second arm sections **290** and **292** which serve to interconnect the support member to the frame **F''''**. Each arm section includes a damping assembly, such as conical damping assembly **296**, secured at one end and a damper **238'** secured at the other end.

**[0067]** Each damping assembly **296** includes a housing **298** preferably having a conical cross-section. Secured to an inner surface of the housing is a damper **300** for damping vertical movement of the support member relative to the vehicle frame. Similar to the previous embodiments, the conical damper **300** is often an elastomer or rubber construction because of the ability of the rubber or elastomeric material to isolate and reduce noise and vibration from being transmitted therethrough because of the elastic nature of the material. As shown in FIGURE 17, an inner diameter portion of the damper **300** is secured to a bushing member **302** that is mounted to the frame **F''''**. The bushing member can include a fastener and a sleeve, the fastener securing the bushing to the vehicle frame.

**[0068]** As to a further discussion of the manner of usage and operation of the fifth embodiment, the same should be apparent from the above description relative to the previous embodiments. Accordingly, no further discussion relating to the manner of usage and operation will be provided. Again, this fifth embodiment schematically illustrates what one of ordinary skill in the art would recognize, namely that alternative arrangements may be used to achieve the same result of modulating relative motion of the spare tire with respect to the frame thereby damping vibrations of the frame.

**[0069]** A sixth embodiment of a damper assembly of the present invention is illustrated in FIGURE 18. The damper assembly **D''''** includes a support member **350** configured for operative engagement between first and second frame rails (not shown) and the spare tire **T''''**.

**[0070]** The support member includes first and second arms **352** and **354**, respectively, interconnected by first and second cross supports **358** and **360**, respectively. The first and second arms connect the support member to the frame, particularly each arm being mounted to a respective frame rail by a first damper **370** secured to respective first ends **372** and **374** of the first and second arms. The first dampers **370** are similar in structure to dampers **80**. Spaced from the first dampers **370** in the longitudinal direction is a second damper **380** similar in structure to damper **238**. The second damper is fixedly secured between respective second end portions **382** and **384** of the first and second arms **352** and **354** adjacent the second cross support **360**. A portion of the second damper is secured to the spare tire. In operation, the first and second dampers limit vertical displacement of the spare tire relative to the frame thereby damping vibrations of the frame.

**[0071]** A conventional winch mechanism **400** is mounted between the respective second end portions **382** and **384** of the first and second arms **352** and **354**. Again, the winch mechanism selectively raises and lowers the spare tire relative to the vehicle frame, and in this instance relative to the support member **350**. Similar to the first embodiment, because the winch mechanism **400** is mounted to the damper assembly **D''''**, the winch mechanism moves with the spare tire **T''''**.

**[0072]** From the foregoing, it should be apparent that the present invention provides a damper assembly for damping vibrations of a vehicle frame by modulating the relative motion of a spare tire with respect to the vehicle frame. The damping assembly generally comprises a support member secured to the vehicle frame and a damper secured to the support member. The pivoting support frame allows and encompasses the positioning of the damper at or near the centre of percussion which reduces unwanted energy input into the vehicle frame or body. The damper includes an elastomeric member which dampens vibrations between the vehicle frame and the spare tire by tuning the elastomeric member to the frequency of the vibrations of the vehicle frame. The support member can also be torsionally dampened which restricts the rotational movement of the support member relative to the vehicle frame.

**[0073]** As is well known, vertical vibrations or vertical bounce mode is generally higher than all other frequency modes when compared to road bounce. The damper assembly of the present invention, which can be stiff in all modes except the vertical bounce mode thereby allowing the mounts to move together, dampens at least the vertical vibrations of the spare tire and at least one frequency mode of the vehicle frame. The damper assembly preferably also dampens at least one of the side to side vibrations and the fore and aft vibrations of the vehicle frame. The present invention provides a vertical vibration mode tunable to the vehicle frame beaming frequency while all other vibration modes are significantly higher than road input frequencies. This prevents secondary modes from being excited by frame beaming and other road inputs. Thus, this vibration damper assembly facilitates the bouncing displacement of the spare tire relative to the vehicle frame, thereby exhibiting an improved vibration damping effect without attaching an independent mass member to the vehicle frame.

**[0074]** The figures illustrate various embodiments of a damper assembly according to the present invention. The damper assembly is primarily directed toward automotive applications for reducing unwanted noise and vibrations transmitted to the vehicle interior or its surroundings. It should be noted, however, as will become apparent to those skilled in the art from the following description and claims, the principles of the present invention are equally applicable to other devices where mass vibrations are to be reduced or substantially eliminated.

**[0075]** The present invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. For example, it will be appreciated that the use of additional cushions, such as rebound cushions, do not detract from the scope of the present invention. Likewise, various other manufacturing steps may be employed or in a different sequence and different materials may be used or alternative processes without departing from the present invention. It is intended that the present invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

**WHAT IS CLAIMED IS:**

1. A damper assembly for use in an associated vehicle structure that includes an associated existing mass mounted thereto, the damper assembly comprising:  
a support member extending from the associated vehicle structure; and  
first and second dampers secured to the support member, the dampers operatively interconnecting the associated vehicle structure and the associated existing mass for modulating relative motion of the associated existing mass with respect to the associated vehicle structure, the first damper modulating the vertical relative motion and the second damper modulating non-vertical relative motion.
2. The damper assembly of claim 1 wherein the first damper is operatively interposed between the associated vehicle structure and the associated existing mass.
3. The damper assembly of claim 1 wherein the associated existing mass includes a spare tire mounted to the associated vehicle structure.
4. The damper assembly of claim 3 wherein the support member is configured for operative engagement between the associated vehicle structure and the spare tire.
5. The damper assembly of claim 3 wherein the support member includes a base section in spaced relation to the spare tire.
6. The damper assembly of claim 5 wherein a portion of the base section conforms to at least one of the associated vehicle structure and the spare tire.
7. The damper assembly of claim 5 wherein the portion of the base section operatively abuts the associated spare tire.
8. The damper assembly of claim 3, further comprising a winch mechanism being mounted to a portion of the support member, wherein the spare tire is operatively secured to the winch mechanism.
9. The damper assembly of claim 1 wherein a portion of the support member conforms to at least one of the associated vehicle structure and the associated existing mass.

10. The damper assembly of claim 1 wherein the support member includes a pivotal support assembly for mounting the associated existing mass to the associated vehicle structure.

11. The damper assembly of claim 10 wherein the pivotal support assembly includes the second damper for torsional damping.

12. The damper assembly of claim 11 wherein the second damper includes a torsional damper for damping pivoting and rotational movement of the support member relative to the associated vehicle structure.

13. The damper assembly of claim 10 wherein the pivotal support assembly includes a conical damping assembly.

14. The damper assembly of claim 13 wherein the conical damping assembly includes the first damper for damping vertical movement of the support member relative to the associated vehicle structure.

15. The damper assembly of claim 10 wherein the pivotal support assembly includes at least one bushing member fastened to the associated vehicle structure.

16. The damper assembly of claim 15 wherein the support member includes an arm extending therefrom and operatively secured to the bushing member.

17. The damper assembly of claim 10 wherein the pivotal support assembly includes first and second bushings disposed adjacent opposite ends of an elongated support portion of the support member that extends between associated first and second rails of the associated vehicle structure.

18. The damper assembly of claim 17 wherein the first damper is spaced from the first and second bushings extending in a longitudinal direction parallel to the associated first and second rails of the associated vehicle structure.

19. The damper assembly of claim 1 wherein the first damper is oriented to use a mass of the associated existing mass for controlling vertical vibratory disturbances of the associated vehicle structure.

20. The damper assembly of claim 1 wherein the first damper includes an elastomeric member that dampens relative movement between the associated existing mass and the associated vehicle structure.

21. The damper assembly of claim 1 wherein the first damper includes a travel restrictor disposed in spaced relation to the support member.

22. The damper assembly of claim 20 wherein the travel restrictor is operatively engaged to at least one of the associated frame and the associated spare tire.

23. The damper assembly of claim 1 wherein the second damper is molded to at least one of the support member and the arm.

24. The damper assembly of claim 1, wherein the first damper provides lower frequency damping and the second damper provides higher frequency damping.

25. A method of damping vibrations of a vehicle structure by modulating the relative motion of a spare tire with respect to the vehicle structure, the method comprising the steps of:

- securing a support member to the vehicle structure;
- securing a first damper to the support member for damping vertical vibrations between the vehicle structure and the spare tire; and
- securing a second damper to the support member for damping at least one non-vertical vibration between the vehicle and the spare tire.

26. The method of claim 25 wherein the second damper torsionally damps the support member for restricting rotational movement of the support member relative to the vehicle structure.

27. The method of claim 25 wherein the second damper torsionally damps at a location spaced from the spare tire and the first damper damps at least the vertical vibrations of the spare tire.

28. The method of claim 25 wherein the damping includes damping at least one frequency mode of the vehicle structure.

29. The method of claim 25 wherein the second damper damps at least one of the side to side vibrations and the fore and aft vibrations of the vehicle structure.

30. A damper assembly for an associated vehicle frame including first and second spaced apart associated frame rails, the associated vehicle frame supporting an associated spare tire, the damper assembly comprising:

a support member in spaced relation to the associated spare tire;

a first damper secured to the support member, the damper being operatively connected to one of the associated frame and the associated spare tire for damping vertical vibrations; and

a second damper for damping at least one of side to side vibrations and fore/aft vibrations.

31. The damper assembly of claim 30 wherein the second damper includes a bushing member.

32. The damper assembly of claim 31 wherein the bushing member further includes a torsional elastomer for restricting rotational movement of the support member.

33. The damper assembly of claim 31 wherein the support member includes an arm extending therefrom and operatively secured to the bushing member.

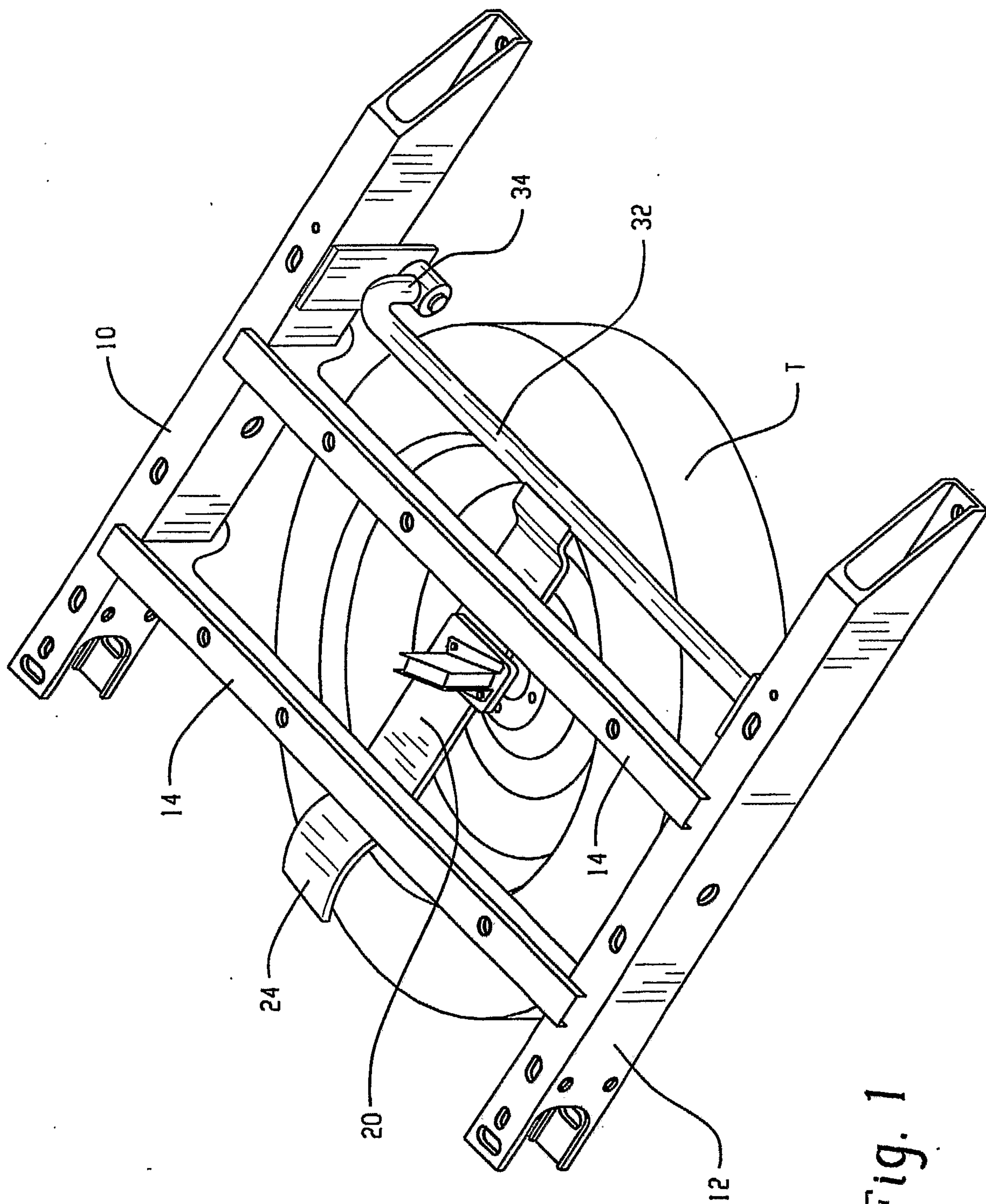


Fig. 1

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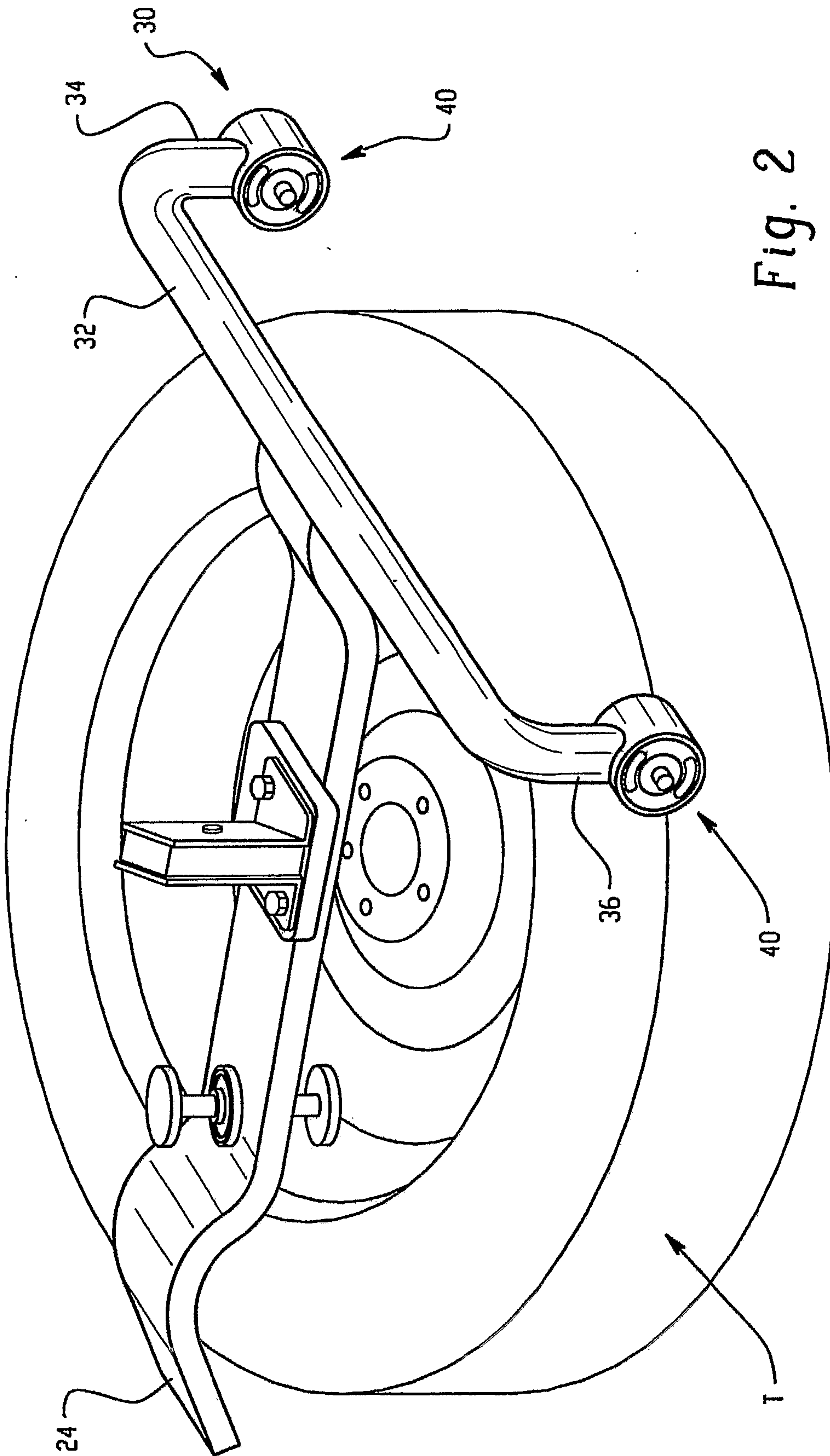


Fig. 2

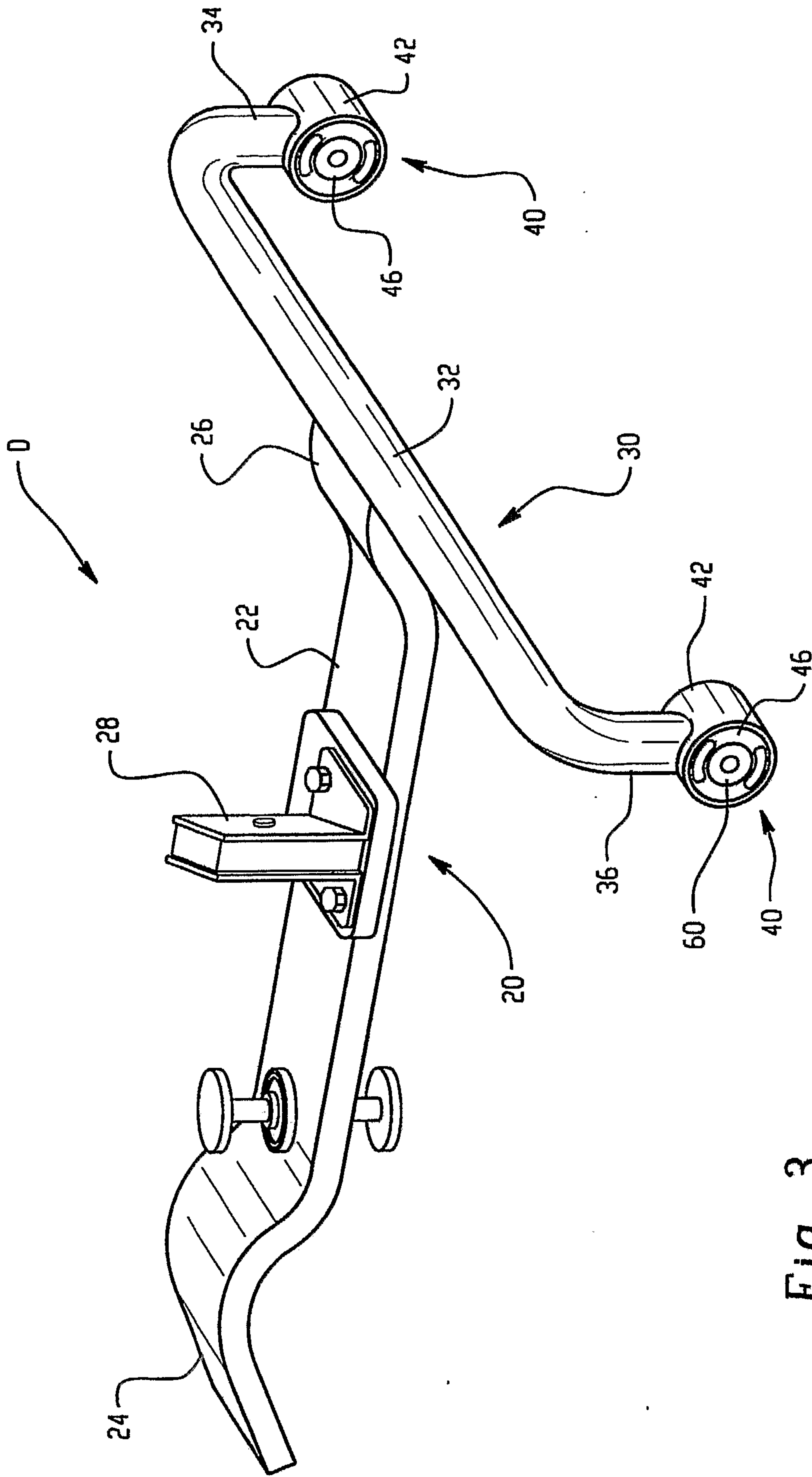


Fig. 3

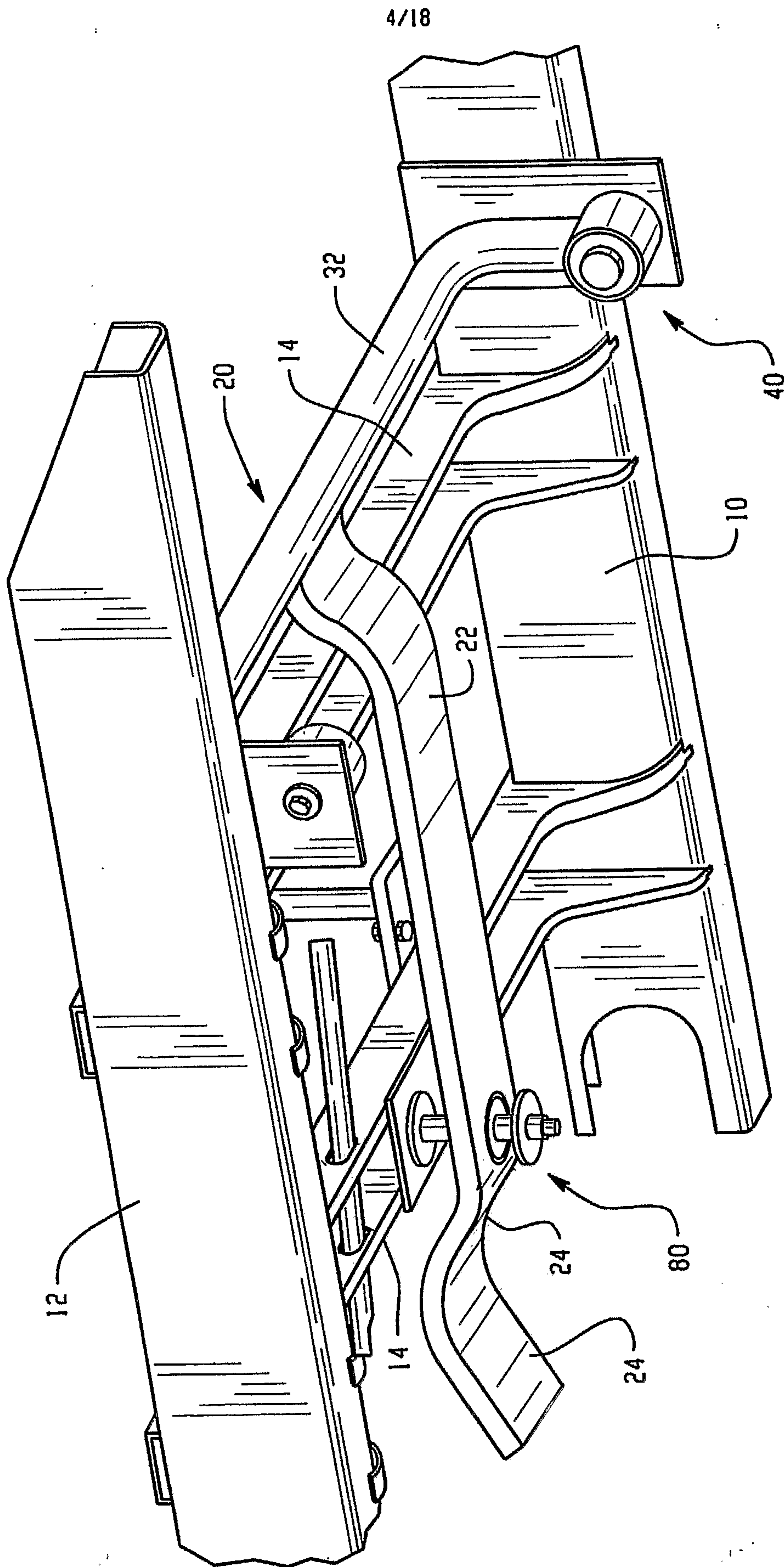


Fig. 4

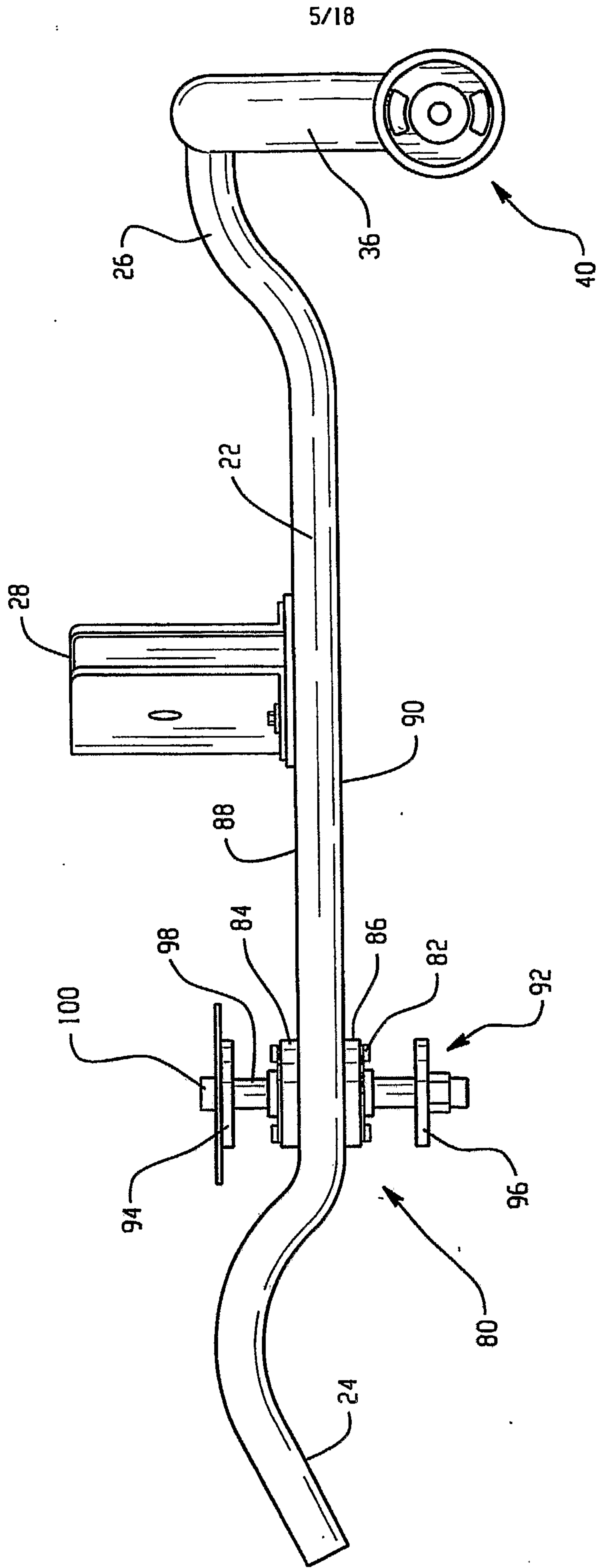


Fig. 5

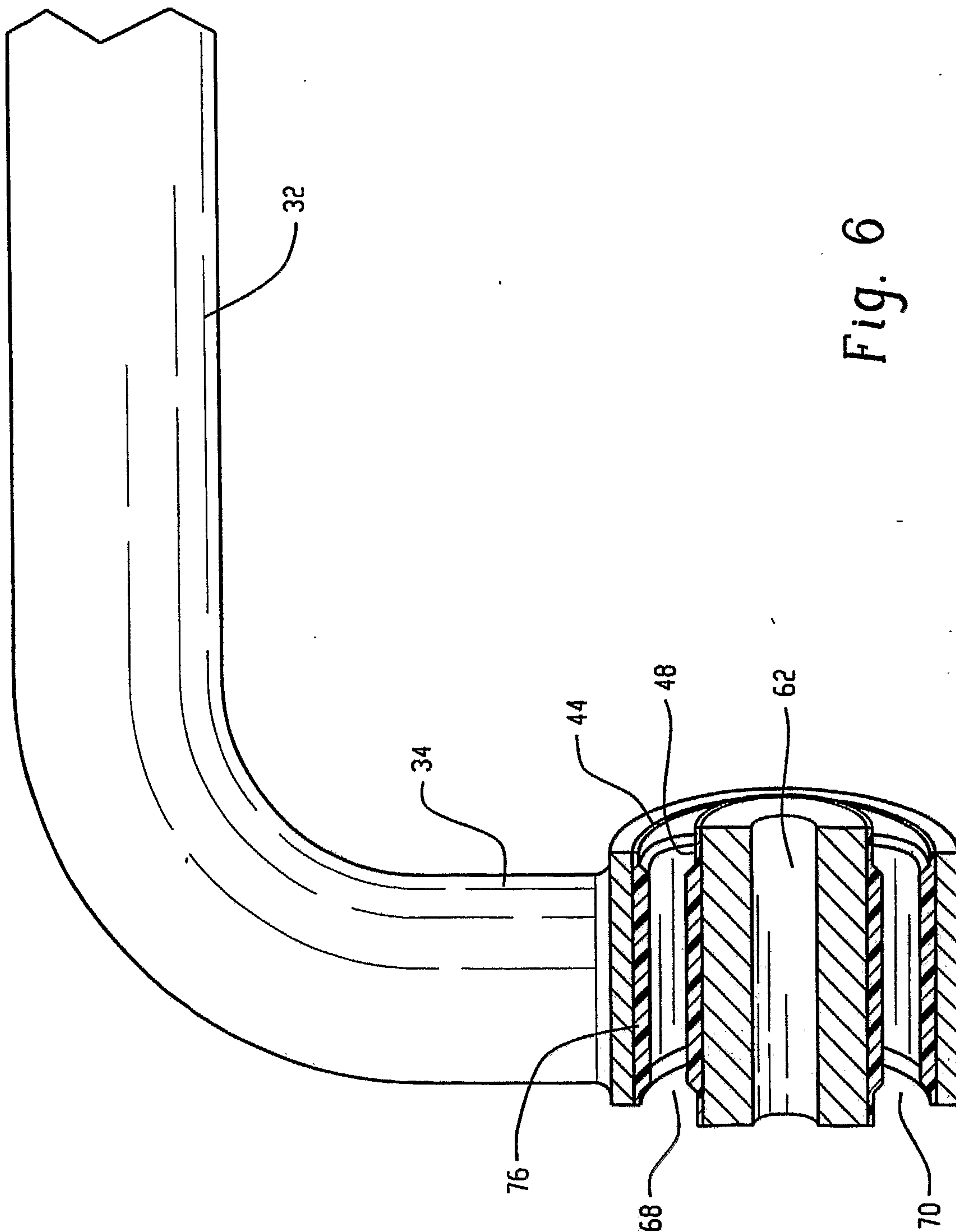


Fig. 6

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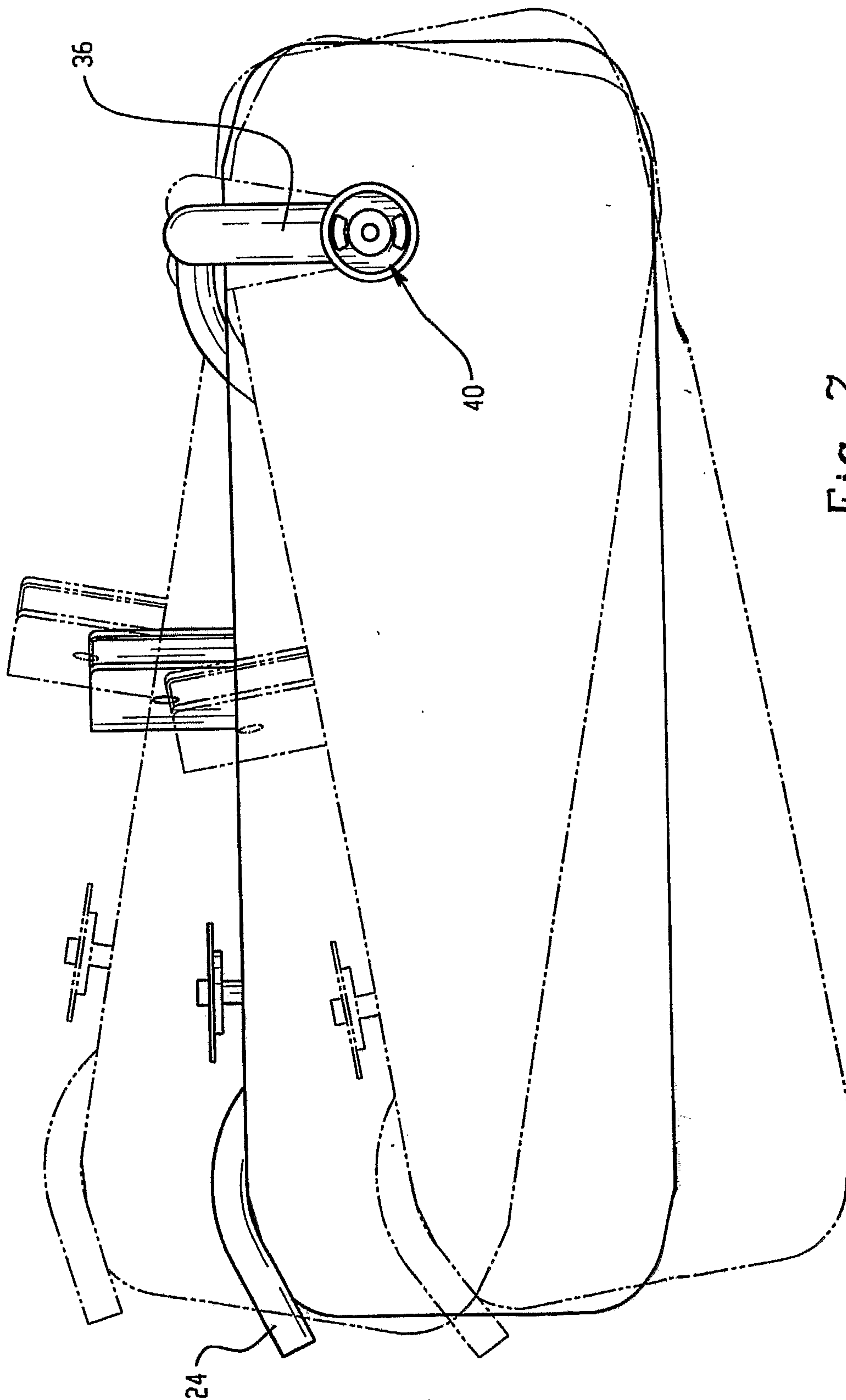


Fig. 7

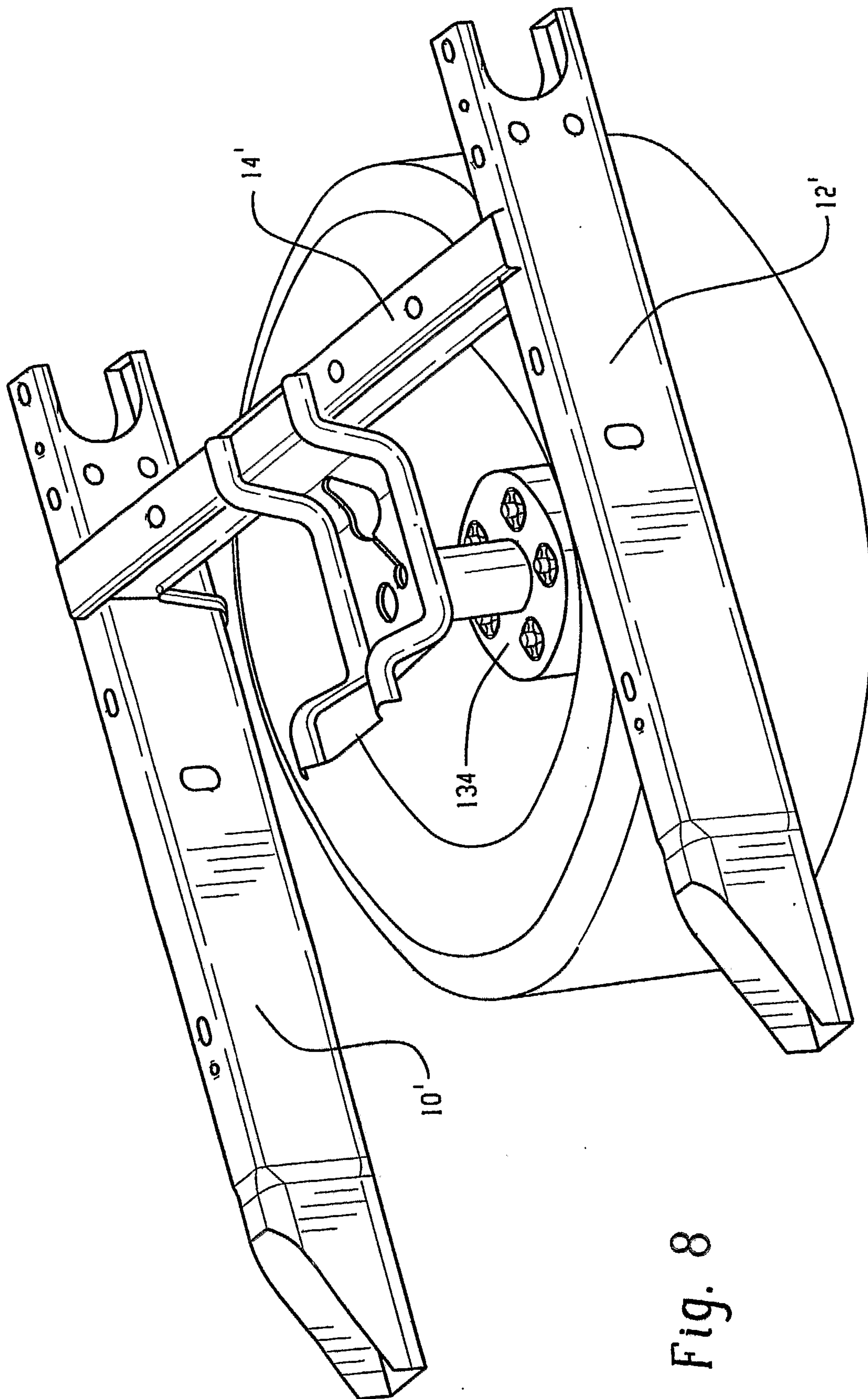


Fig. 8



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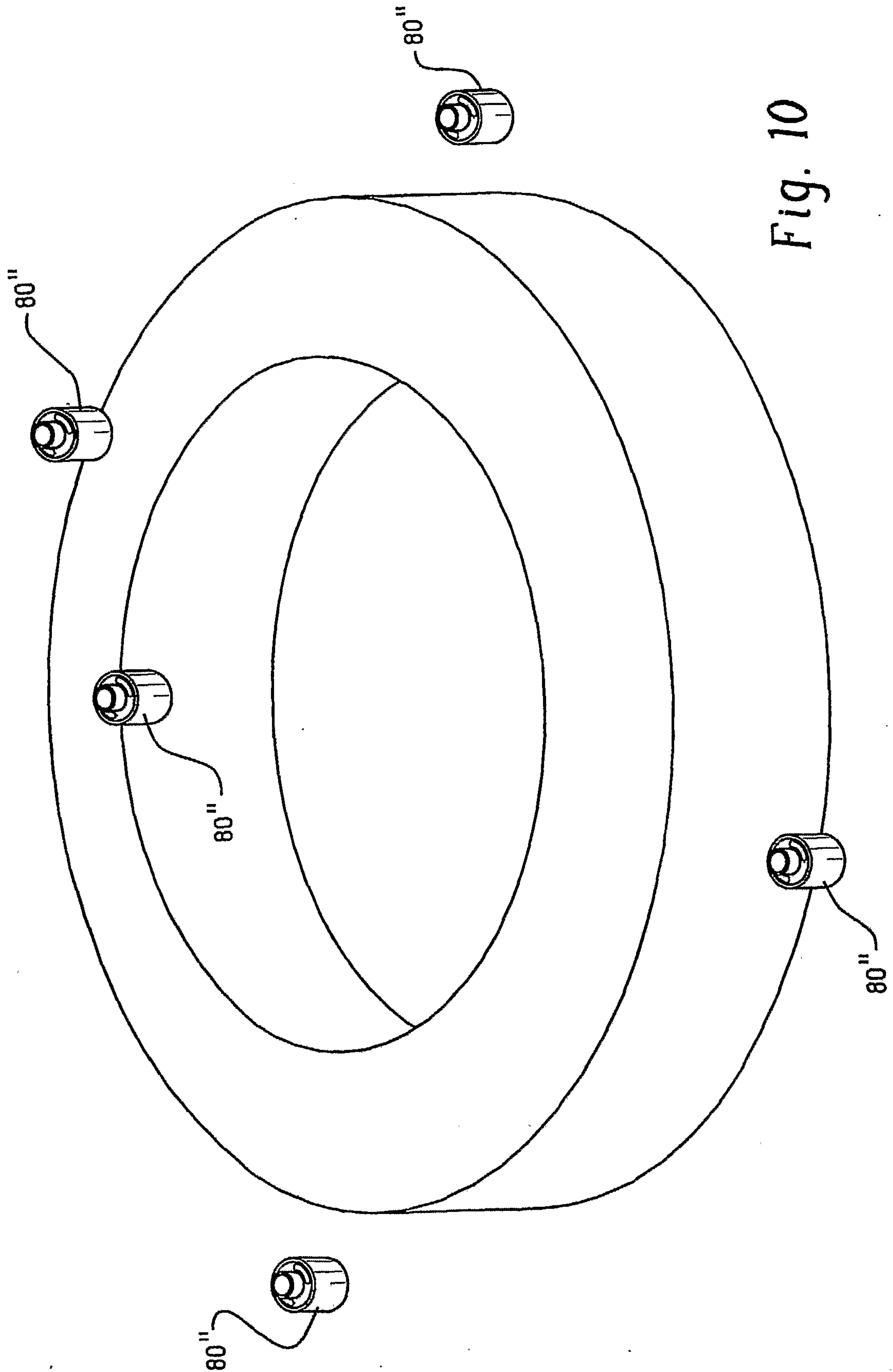


Fig. 10

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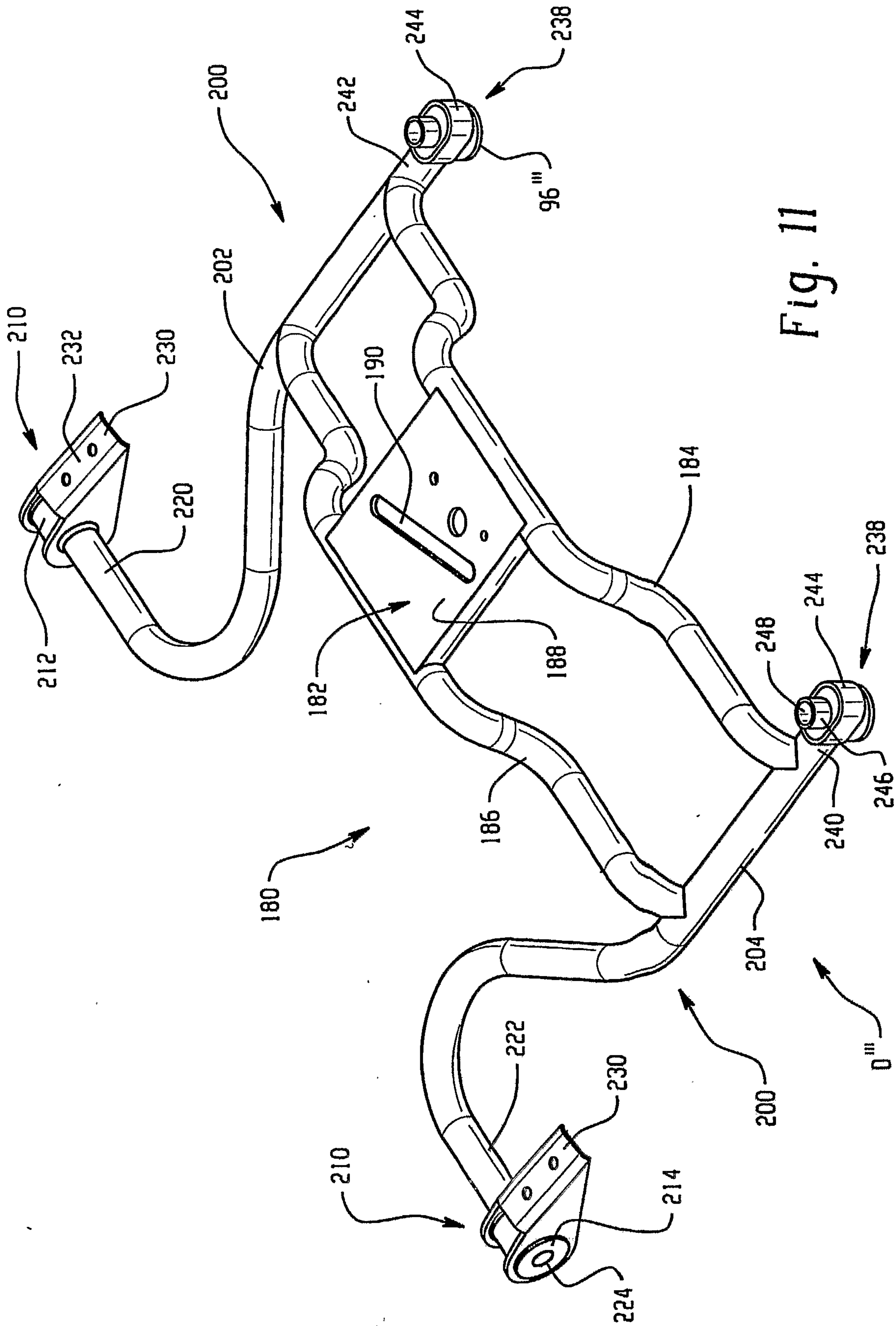


Fig. 11

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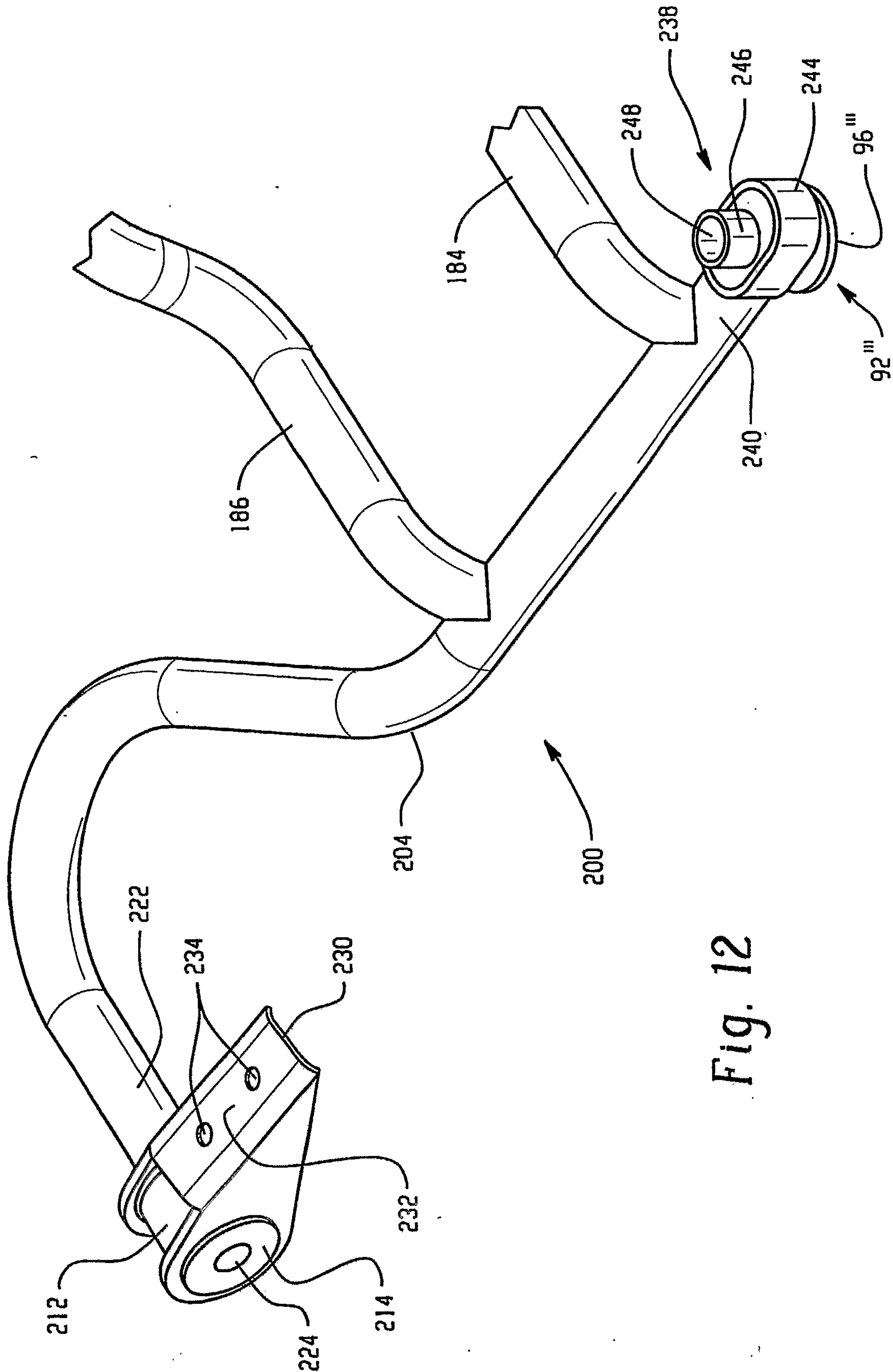


Fig. 12

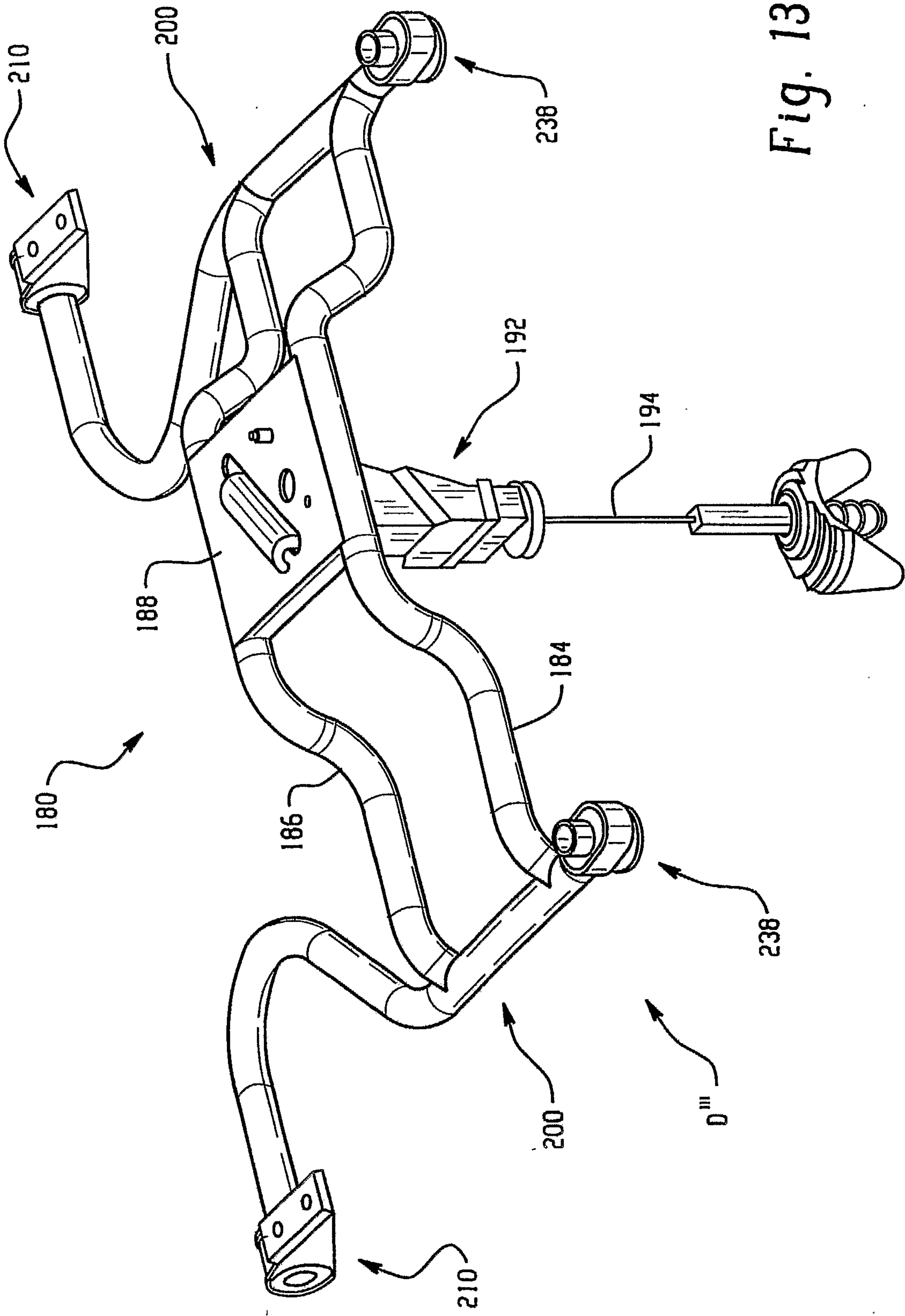


Fig. 13

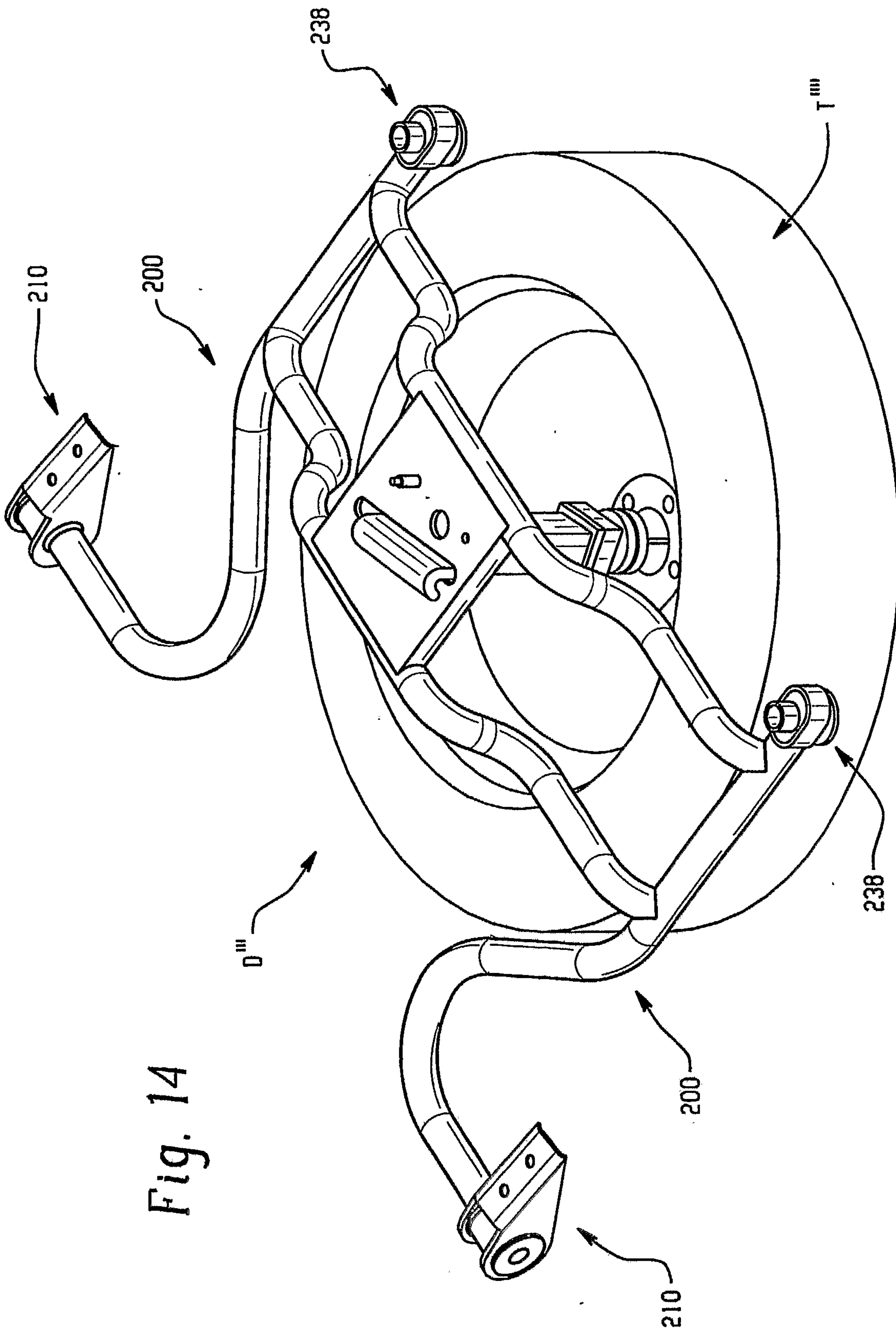


Fig. 14

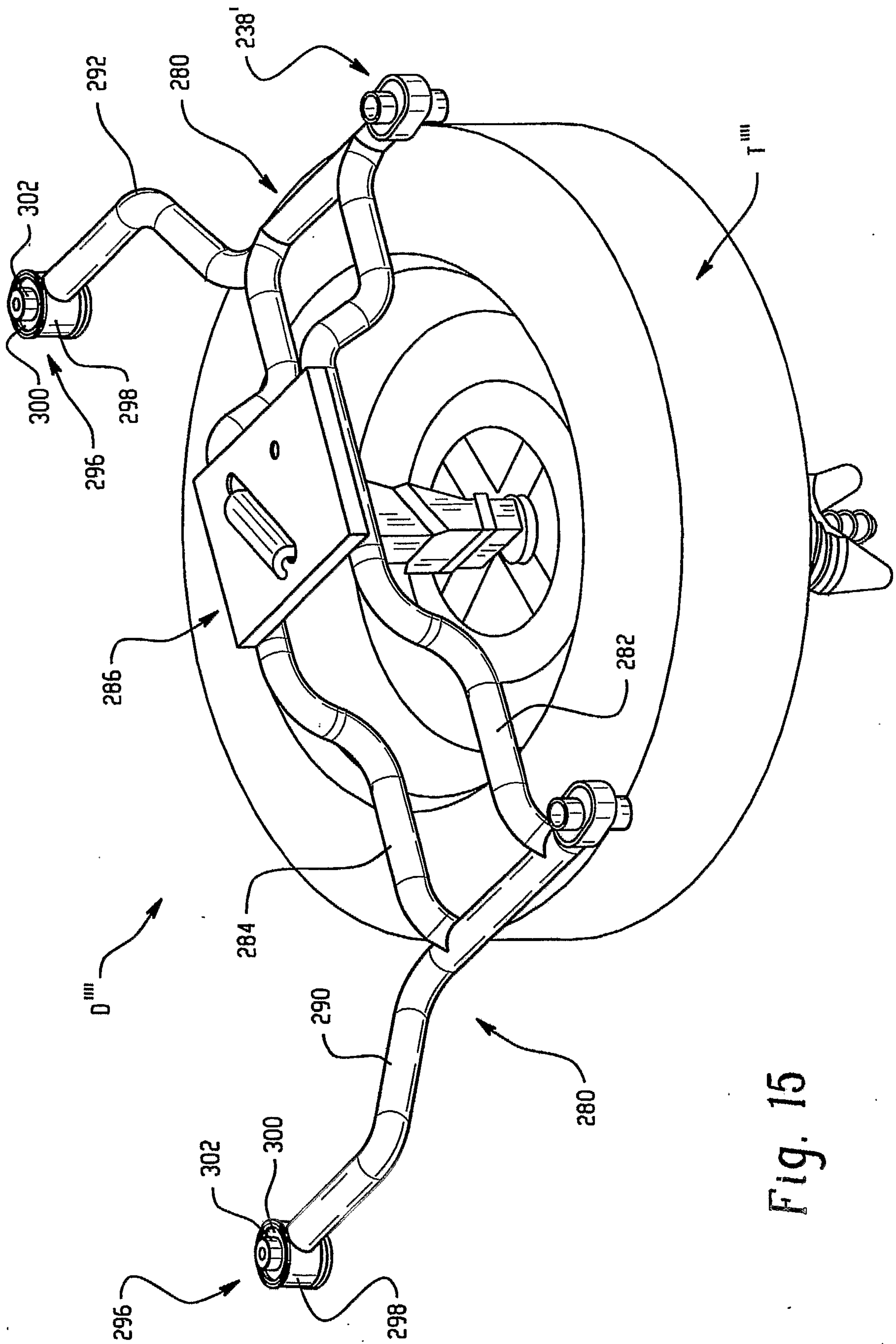


Fig. 15

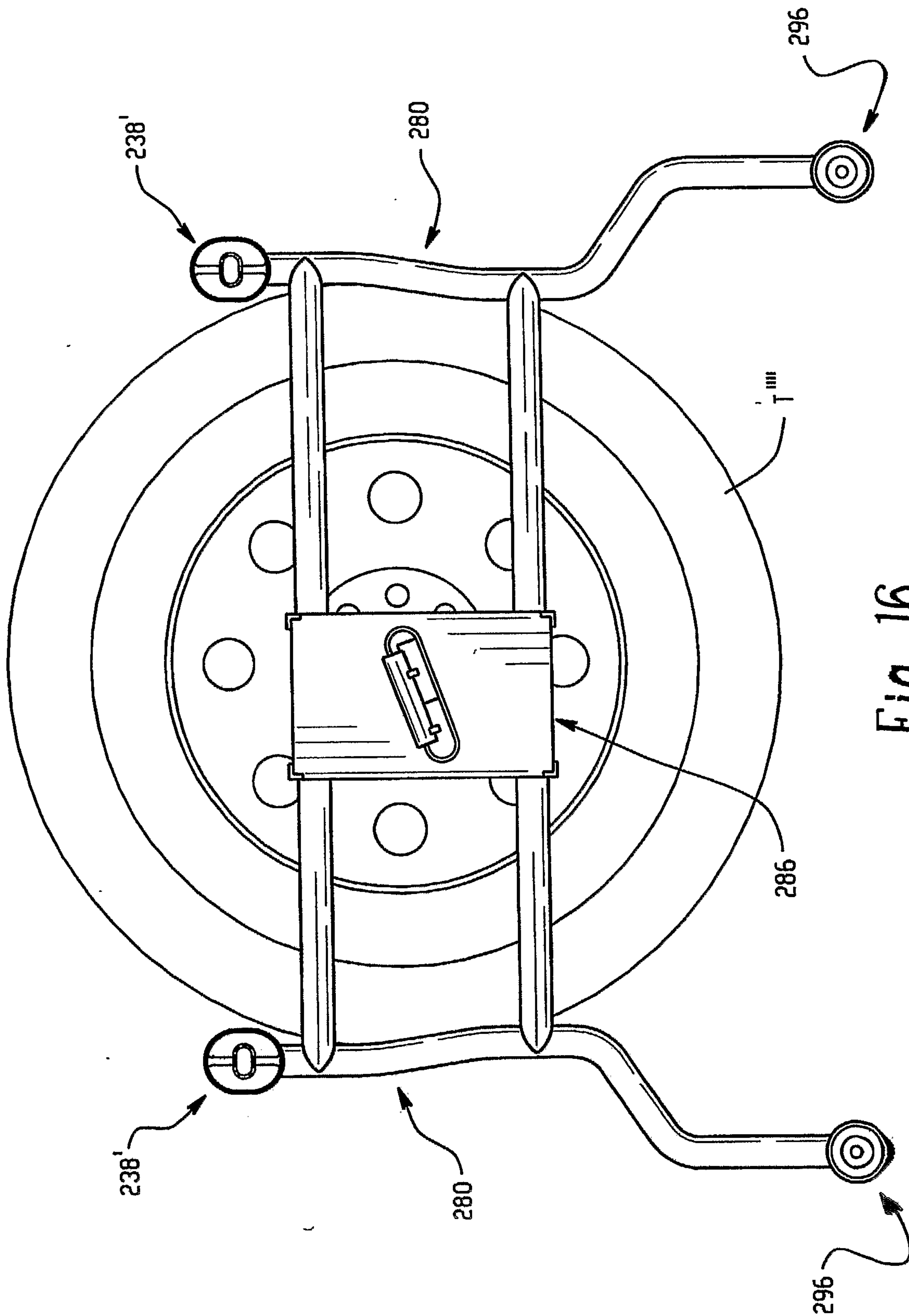


Fig. 16

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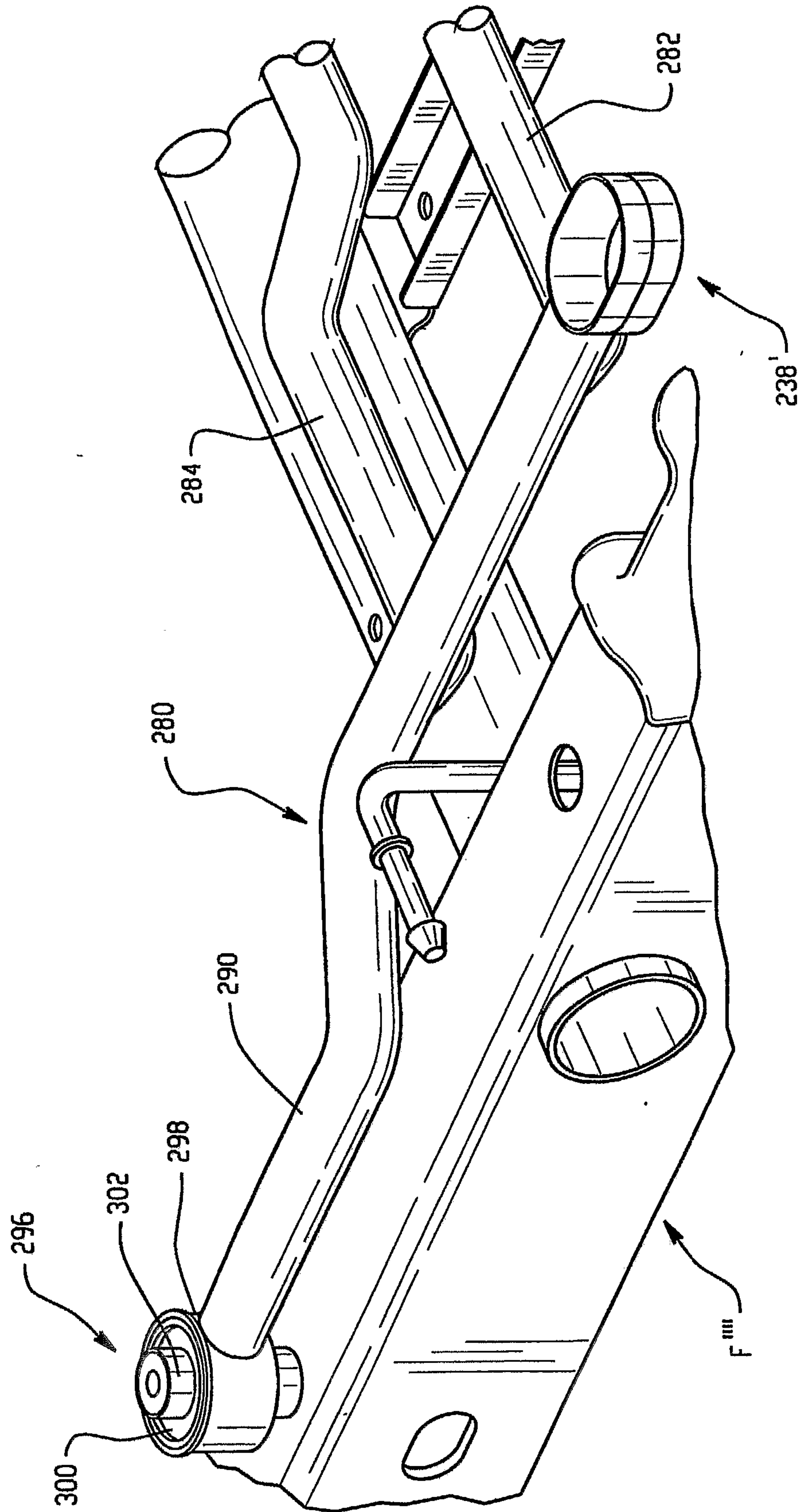


Fig. 17

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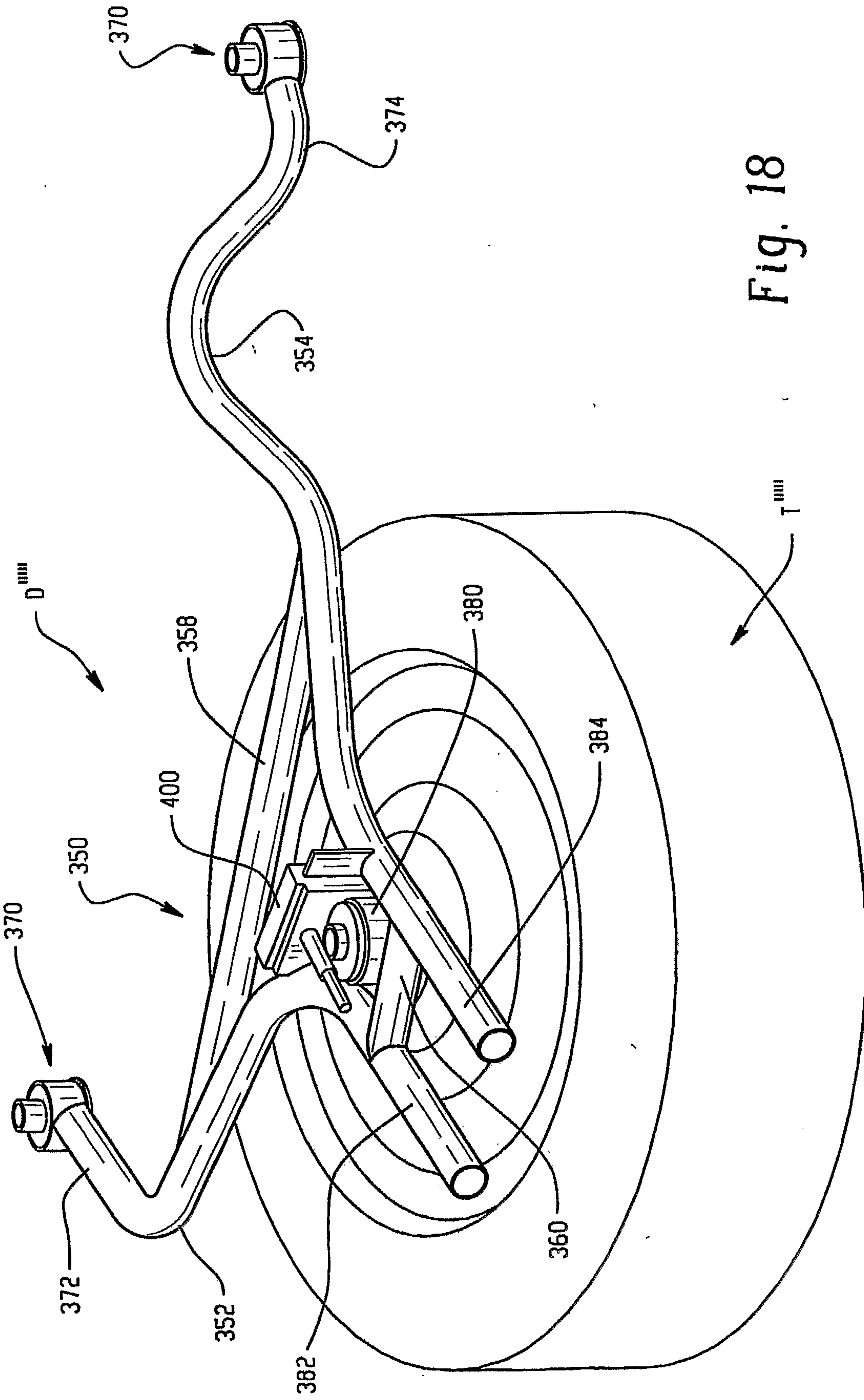


Fig. 18