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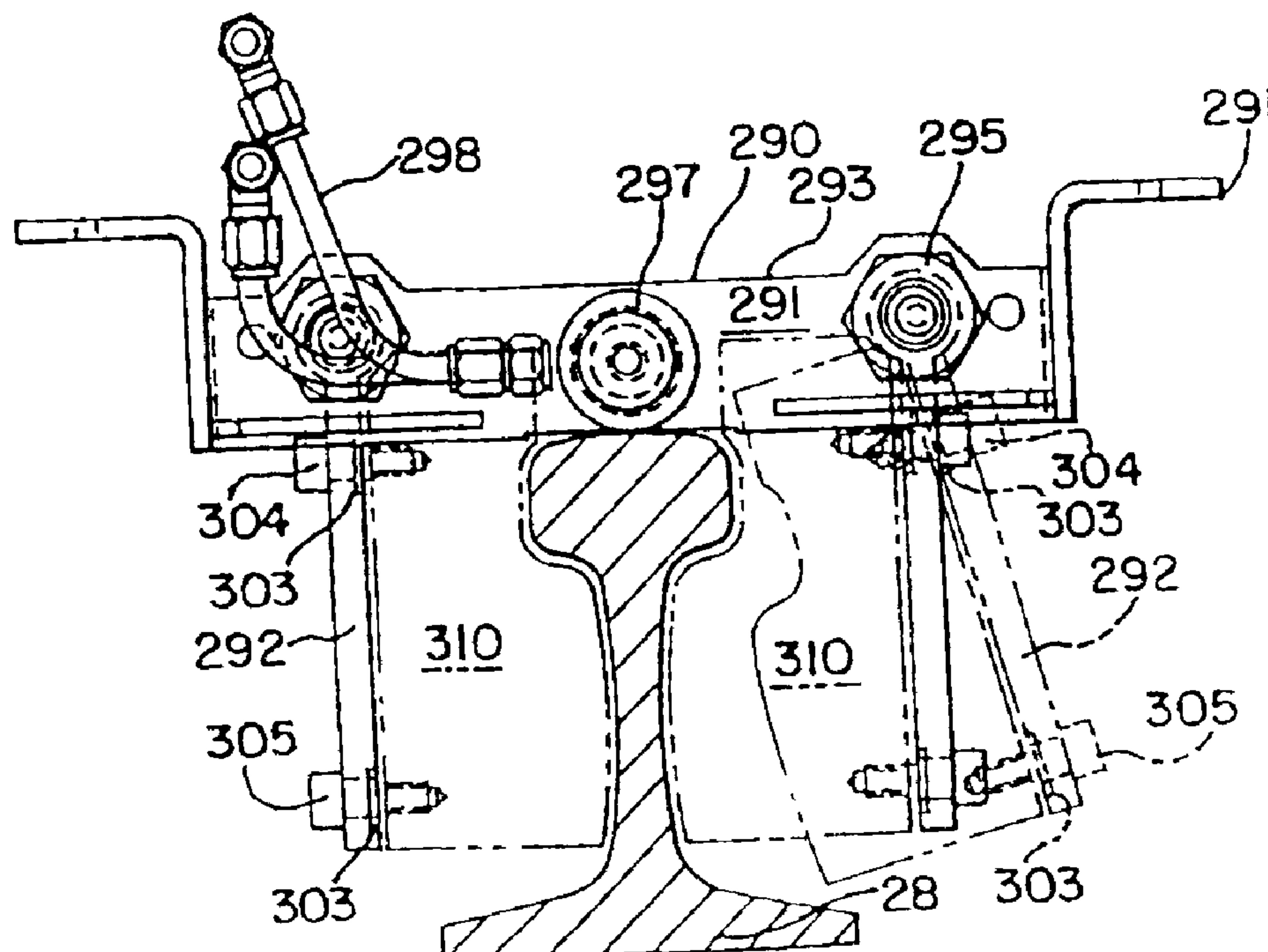
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(54) Titre : APPAREIL DE SOUDAGE DE RAILS COMPRENANT UN DISPOSITIF D'IMMOBILISATION, UN DISPOSITIF DE RETENUE DE SOUDURES ET UNE UNITE DE FORMATION DE SOUDURES
(54) Title: RAIL WELDING APPARATUS INCORPORATING RAIL RESTRAINING DEVICE, WELD CONTAINMENT DEVICE AND WELD DELIVERY UNIT



(57) Abrégé/Abstract:

A rail restraining (1) and weld delivery device (100) uses a frame for supporting a welding head with a clamp (3) for restraining a first rail end and a second rail end and a base twist assembly (17) for aligning said first end and second end. An interconnected weld containment apparatus (290) pivotally connects to the clamp by use of a cam actuated linear pin (7). This arrangement is operable in an environment in which clearance between rails is about 7 to 11 inches and sufficiently compact that it may be operated from and carried in a truck based on a standard over the road truck.

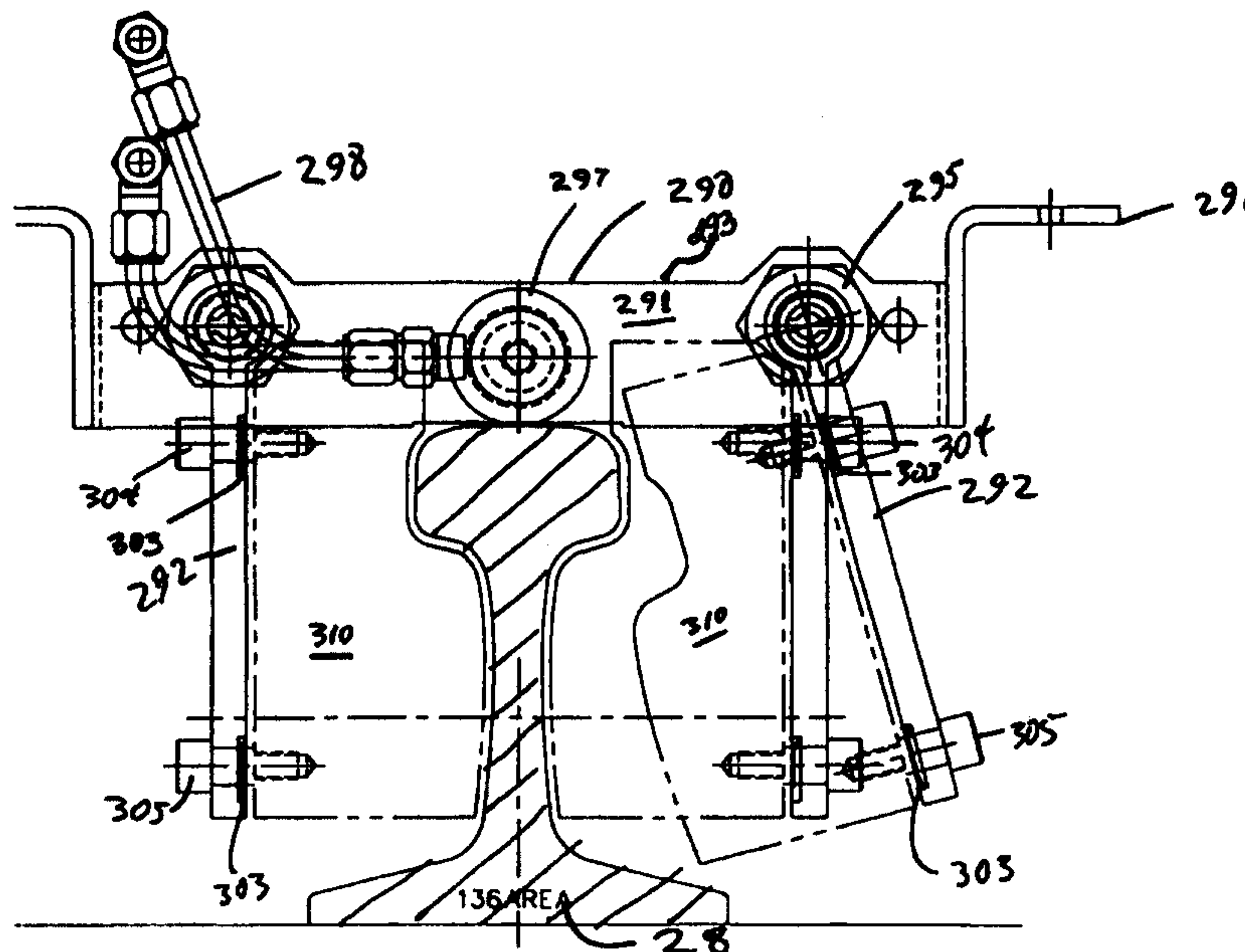


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(54) Title: RAIL WELDING APPARATUS INCORPORATING RAIL RESTRAINING DEVICE, WELD CONTAINMENT DEVICE AND WELD DELIVERY UNIT



(57) Abstract

A rail restraining (1) and weld delivery device (100) uses a frame for supporting a welding head with a clamp (3) for restraining a first rail end and a second rail end and a base twist assembly (17) for aligning said first end and second end. An interconnected weld containment apparatus (290) pivotally connects to the clamp by use of a cam actuated linear pin (7). This arrangement is operable in an environment in which clearance between rails is about 7 to 11 inches and sufficiently compact that it may be operated from and carried in a truck based on a standard over the road truck.

Field of the Invention

Description of Related Art.

In the prior art, there are three main ways to weld railroad track. These include aluminothermic welding (U.S. Patents Nos. 5,215,139 and 5,306,361), flash-butt welding (U.S. Patents Nos. 4,929,816; 5,270,514; and 5,469,791); and gas-arc welding (U.S. Patent No. 5,605,283). These all have certain advantages and disadvantages. Aluminothermic welding has low equipment requirements, is economical to perform but produces welds of less strength than the other methods. Flash butt welding uses complex equipment but produces high strength welds, however it is difficult to use to join rails in the field, and results in a loss of rail length, which can cause difficulties. Gas-arc welding requires precise alignment and a considerable length of time

to perform a weld of sufficient strength, heretofore also requiring equipment of considerable size, complexity and cost. The invention enables the use of gas-arc welding with greater ease and lower cost.

Summary of the Invention

5 The rail restraining device, weld containment device and weld delivery unit of the invention needs to handle rail sections often as long as one-quarter mile, aligning rail ends precisely for welding, yet can be made sufficiently compact to be incorporated on a hi-rail equipped over-the-road truck or shipping container on a chassis or car having economy and requiring no special licensing or equipment for over-the-road use while being sufficiently
10 small sized itself to fit in the space available to weld rails even to switch or turnouts or in frogs where the weld joint is separated from the adjacent rail portion by as little as about 7" to 11".

 The rail restraining device and weld delivery unit takes up a sufficiently small volume of space that the truck can be fitted with room for the welder itself; control devices;
15 generator; and gas bottles; as well as the welding robot mounted on the unit.

 In accordance with one aspect of the present invention, there is provided a rail restraining, weld containment and weld delivery apparatus for enabling the joining of a rail gap, the apparatus comprising: a rail restraint, a weld containment device and a mobile weld
20 delivery unit; the rail restraint having a first frame for supporting a clamp and the weld containing device, and adapted for aligning a welding head; the weld containment device connected to the clamp and engageable with the rail gap; the mobile weld delivery unit delivering an automated welder having the welding head proximate the rail gap so that a weld can be made joining the rail gap.

Brief Description of the Drawings

25 Figure 1 is a front elevation of an alternative embodiment of the rail restraining device.

 Figure 2 is a side elevation of an alternative embodiment of the rail restraining device.

 Figure 3 is a top plan view of an alternative embodiment of the rail restraining
30 device.

2a

Figure 4 is a front elevation of the rail weld containment device.

Figure 5 is a top plan view of the rail weld containment device.

Figure 6 is a sectional view of an alternative embodiment of the weld delivery unit.

5 Figure 7 is a top plan view of an alternative embodiment of the weld delivery unit.

Figure 8 is a side elevation of the guide rod of an alternative embodiment of the weld containment device.

Figure 9 is a front elevation of the guide rod of an alternative embodiment of the weld containment device.

Figure 10 is a side elevation of the cam guide of an alternative embodiment of the weld containment device.

5 Figure 11 is a front elevation of the cam guide of an alternative embodiment of the weld containment device.

Figure 12 is a top plan view of the preferred rail restraint device.

Figure 13 is a front elevational view of the preferred rail restraint device.

10 Figure 14 is a sectional view of the preferred rail restraint device showing the clamping arms in open and closed positions.

Figure 15 is an enlarged section of the twist pin and cam adjustment of the weld containment device.

Figure 16 is a side elevation of the preferred twist pin of the weld containment device.

Figure 17 is a front elevation of the preferred twist pin of the weld containment device.

15 Figure 18 is a side elevation of the preferred cam guide of the weld containment device.

Figure 19 is a front elevation of the preferred cam guide of the weld containment device.

Figure 20 is a rear elevation of the preferred embodiment of the weld delivery unit.

Figure 21 is a side sectional view of the preferred embodiment of the weld delivery unit.

Figure 22 is a top plan view of the preferred embodiment of the weld delivery unit.

20 **Detailed Description of the Preferred Embodiment**

The rail welding fixture consists of the rail restraint assembly 1 and the weld containment device 290. The weld containment device 290 prevents the molten metal from flowing out of the web and head areas during the welding. In a sense, this device is an automatically positionable and removable mold for welding. The weld delivery unit 100 is the truck and the robot lift, as well

as the ancillaries such as generator, gas bottles, tools, etc.

The rail welding fixture in a prototype and alternative embodiment has rail restraint 1 (Figures 1 - 3) which provides the structure on which a fixed clamp 2 and movable clamp 3 are mounted in pairs. One of said clamp pairs will engage the end of each of the respective rail sections to be welded. The preferred embodiment will be described in greater detail insofar as its elements may be delineated. The alternative embodiment has several features which may be advantageously adapted to other embodiments, although the preferred embodiment uses, for example, hydraulic rather than mechanical actuation. In certain circumstances, the mechanical actuation described herein may be advantageous.

In this alternative embodiment, moveable clamp member 3 has an eccentric pivoting action around pin 7 which can be clamped in place by the action of handwheel 11 fastened to screw 6 with wheel locking mounting 12, thence acting in turn on clevis pins through link pin 8 and link 4 and rollers 13, fastened by a nut. This acts through a bushing ultimately on the pad carried on ball 15 providing clamping action on the web of the rail. A horizontal plate supports the device on the crown of the rail.

Another alternative feature relates to alignment of the rails' ends to line up their respective center lines as accomplished through the clamping force on each of the four pads on the respective two clamps. Rails may also be distorted and out of line in a twisting manner. The respective clamps are provided with a base twist assembly 17 mounted on one of the frame members of the rail welding fixture. The rail welding fixture components are mounted with a variety of fasteners.

In this alternative embodiment, base twist assembly 17 bears at an angle through a shaft 25 on a pad 26 that engages the base 27 of the rail 28. In this manner, the two rail ends 30, 31 can be precisely aligned both with a calculated gap 32 and in vertical and transverse directions to

enable the next step of the operation utilizing the weld containment device.

The second component in the preferred system is the weld containment device 290 which works integrally with the rail restraint 201, fitting on frame 270 thereof. While preferably used together, and providing unique advantages in combination, weld containment device 290 may be
5 suitable for other welding operations, merely providing its advantages in compactness and rapid deployment.

The weld containment device 290 (Figures 4 - 5) is a separate part of the rail welding fixture and is placed into the rail restraining assembly 201, specifically being mounted (Figure
12) on four locating pins 286 on frame 270. It is clamped to the rail restraint 201 using four
10 clamps 287 for securing.

The weld containment device 290 is set up on a rigid frame 291. Two yokes 293 are actuated by a pair of cylinders 297 mounted exterior to frame 291 and the cylinder rods are connected to the yokes 293 causing them to move inwardly. Cylinders 297 are operated through pressure transmitted in hydraulic fittings 298 in the ordinary manner of hydraulic operation. The
15 yokes are mounted on two linear bearings or bushings 300 secured to the yoke using shoulders 301. Other fasteners, such as snap rings, might be suitable, but need to have adequate strength. The bearings 300 slide on two hardened steel shafts 302. The shafts cause the motion of the yoke to be precisely linear and parallel with each other.

A twist pin 259 is rigidly connected to the block holders 292 through the use of pins 299 preventing rotation of the twist pin 295. Cooling blocks 310, preferably constructed of copper,
20 are connected to the block holders 292 by a plurality of fasteners 304 and 305. The cooling block 310 and block holder 292 are the major components in the swinging components referred to generally as the quadrants.

A smaller non-moving cooling block 306 is held to the frame 291 by a plurality of

fasteners 307. As the cylinder extension causes the motion of the yokes inward from the open position to the closed position, the action of the twist pins 259 engaged by the cam guide 296 causes a rotation of the quadrants. The scope of the swing may be as little as about 15 degrees to about 30 degrees with about twenty degrees currently preferred.

5 In the preferred embodiment, in Figure 4 - 5 and Figures 15 - 19, adjustment of the precise rotation of the cam guides 296 is provided through the use of an adjustable hub device 295. This device 295, which is commercially available and is sold under the trademark Trantorque, uses twin tapered shaft segments 308, 309 to impinge on the cam guide 296 while at the same time impinging on the hole in the frame 291. This operates in a manner analogous to a collet, release
10 of the load on the tapered shaft segments 308, 309, by loosening adjusting nut 311, permitting movement of the guides 296.

Precise adjustment of the cam guides 296 provides for a tightening effect as the blocks 310 contact the rail on the extend stroke. A compliant fit of the blocks 310 against the rail 28 is provided by a pair of springs 303 in each block.

15 Cooling blocks 310 and 306, when in place on the rail, provide for a welding head aperture 314 through which the welding head can fill the rail web and head as described below, even when the blocks are closed and the shoe quadrants touch on the extend stroke.

During the return stroke, the yoke 293 pulls the quadrants back by engaging a shoulder 317 on the twist pin shaft 318. This shoulder 317 holds the quadrant in relative
20 proximity while still allowing a rotation about shaft 318. Since the twist pins 259 are fixedly fastened to the quadrants, parting of the containment shoes is accomplished by pulling the pins apart. The clearance is preferably somewhat less than about one and one half inches (1.5") thereby providing access to the rail gap 32 of about 1 inch, yet providing a level of preload on the yoke and quadrant arrangement.

An early prototype pin or rod 45 for right hand travel is shown in Figures 8 and 9. Cam portion 65 has twist to provide 30 degrees rotation in 3/4 inch travel. Shaft portion 66 is provided with groove 67 to receive a ring. Knurled or splined portion 68 abuts head 69. Preferably about thirty two teeth will be formed in splined portion 68. Head 69 fits in an aperture in holder 72. A press fit into the aperture is anticipated. At the quadrant end, a set screw also serves to firmly fix the unit in position. In certain embodiments, a large number of small profile splines could be used with mating splines in the frame 291 to enable some level of adjustment by removal and replacement at a different alignment. This would enable mechanical adjustment but would be limited in the increments available by the size and number of splines. The preferred arrangement permits adjustment in infinite increments and is expected to be adjustable in the field.

The early prototype cam guide 46 in Figures 10 - 11 has a body portion 80 and aperture 82 with opposed lobes 84 receiving cam portion 65. Lobes 84 could be formed with a profile enabling them to receive either the right or left hand cam portions 65. For improved strength and precision, however a left and right cam guide could also be provided.

The preferred twist pin 259 (Figure 16) is designed to have about 15 degrees of rotation in about three quarters inch (3/4") of linear travel. This limit has been evaluated as an operative range, however, as of the filing date of this application, it is believed that 20 degrees may be preferred. The difference in the drawings is not expected to be significant in light of the disclosure herein of the prototype which used 30 degrees of rotation in the same length of travel. One set of twist pins 259 and cam guides 296 will have right hand travel and the other set 259 L and 296 L left-hand travel (Figure 5).

Preferred twist pin 259 and cam guide 296 for right hand travel is shown in Figures 16 - 19. Cam portion 315 is shown having a twist of 15 degrees rotation in three quarters inch (3/4") travel. As described above, 20 degrees may be preferred. Shaft portion 316 is provided with a

shoulder 317. Shaft end 318 provides for insertion into the block holders 292 and through bushing 297 and securement with pins 259.

Cam guide 296 has a body portion aperture with opposed lobes 334 receiving cam portion 315. Preferably lobes 334 can be formed with a profile enabling them to receive either the right or left hand cam portions 315. For improved strength and precision, however a left and right cam guide could also be provided. The degree of twist will conform to that of the corresponding pin 259, 259L.

Unlike the prior art, this geometry for operating quadrants permits operation in very close clearance locations. The combination of longitudinal movement of yokes 293 into and out of engagement and the outward swinging of block holders 292 on horizontal, longitudinally aligned shafts 302 and pins 259 enables adequate clearance for the welding head to move reciprocally and vertically to weld the rail bases together, while closing the blocks to maintain the welding material in the web, and thence such clearance as is necessary to weld the head of the rail. This movement provides for both effective welding and compact size. Previously difficult to gas arc weld locations such as rail in turnouts and frog joints can be welded, when they could not easily be welded under prior art apparatus, methods, or fixtures.

The blocks 310 conform to the profile of the rail 28 for the purpose of containing molten material as the weld progresses. The welding operation will be accomplished by the following steps: placing a ceramic base mold below the rail base; placing the selected metal on the ceramic; and then commencing the welding operation whereby approximately one inch (1") gap between the rail ends is filled by welding material.

Using a continuous precisely controlled welding cycle will move the welding element back and forth across the gap resulting in the filling of the gap with metal material having mechanical properties commensurate with that of the metal in the rail itself. To control this weld, the

transverse distance the welding element will travel at the base being a long distance, while only a short distance of travel is necessary in the web portion, the blocks will be swung out of the way of the welding element at the beginning of the weld. As the welding operation progresses in a vertical manner through the web of the rail, the blocks will be closed on the web to maintain the molten material in place. The weld will progress up the web while the blocks provide the required containment yet also providing the necessary clearance for the welding element. This movement can be controlled and coordinated by processing data on positioning and the like received from a robotic controller.

A specific welding procedure will be a function of the welding unit used, which is not a part of this invention. For example, arc welding could be used, while theoretically, gas welding or aluminothermic bonding may be adapted to take advantage of certain aspects of the invention, such as the rail restraint or weld containment. The preferred welding method would be arc welding. However, great flexibility is provided by the invention adaptable to the metallurgy of the rails, the equipment available, and the equipment in operation at any particular time.

One possible weld delivery unit 100 shown in Figure 6 - 7 will have a frame 102 mounted in a truck. A vertical support piece 106 fits sliding rack 108. Vertical support pieces 106 at its lower portion 108 supports horizontal cradle 110 adapted to have rail engaging bogie wheels. Thus, the device can be raised for transportation, maintenance, or the like, and lowered for alignment on the railroad rails to reduce the load on the structure and steady the unit for operation and enable indexing to an adjacent continuous rail, the welds along any given section of rail being staggered as between the left and right rails.

The weld delivery unit 100 has sufficient volume of space to receive the welder 114 itself; control devices 116 generator 118 and gas bottles; as well as the welding robot 122 mounted on the unit 124 retracted in the body of the truck for protection and ease of transportation.

As taught in Figures 6 - 7 the weld delivery unit is basically indexed to the rails 28 by virtue of cradle 110 and the bogie wheels. This provides an advantage in quick movement and lack of bracing or other connection to the roadbed. In certain conditions this type of alignment could have significant utility. However, the preferred method is to now support the rail restraint 201 using stabilizing legs and screw assembly 280 and this structure can then be used as a reference for calibrating the welder, using touch sensing plates 279.

The preferred rail welding fixture has a rail restraint 201 (Figures 12 - 14) which provides the structure on which the fixed clamp 202 and the movable clamp 203 are mounted in pairs. One of said clamp pairs would engage the end of each of the respective rail sections to be welded. Fixed clamp 202 has downwardly depending arm 205 with a clamping member including a pad 223 that provides a base against which the rail 28 can be clamped, and provides the requisite electrical contact as may be required by the welding operation. These are paired for each clamp assembly.

The movable clamp member 203 with downwardly depending arm 219 has an eccentric pivoting action around pin 207 which can be clamped in place by the action of a cylinder 211. The rod of cylinder 211 is fastened to a clevis and pinned to a link 210 with a pin 209. The rotation of link 210 is constrained by link adjustment assembly 213 which is composed of a rotating structural beam 212, a screw 214 penetrating through the beam 212 with a rotary joint 215 connected to the clevis and pin 209 using a block. The block rotates around pin 209. The force applied by the cylinder acts through the clevis pin 209 with a variable reaction force taken by the shoulder bolts 220 directing a clamping force downward against moveable clamp. The structural beam 212 is held in the rail restraint 201 using shoulder bolts 220.

It will be seen that said arm 203 has an inverted L shape with pin or pivot 207 being located proximate the end of the short leg of the L. Pin 221 provides the second pivot, this being located proximate the intersection of the short leg of the L and the long leg of the L. A clamping pad is located at the end of the long leg of the L.

The length of this link adjustment assembly 213 is controlled by rotation of a handwheel 216 attached to the screw 214. The length of the final adjustment length of the link adjustment assembly 213 is held in place using a check nut for locking.

Link adjustment assembly 213 provides one arm in a scissors arrangement with link 210 providing a second arm and the top portion of clamp 203 a third. The extension or retraction of cylinder 211 acting on pivot 209 results in the pivoting of link adjustment assembly at pin 209 and bolts 220. Link 210 pivots at pins 209, 221 and the top portion of clamp 203 around pins 207, 221 results in exertion of a substantial clamping force owing to the fixed positions of pins 207 relative to bolts 220 in beam 212.

The force applied by the cylinder acts through the clevis pin 209 with a variable reaction force taken by the shoulder bolts 220 directing a clamping force downward against moveable clamp 203 and carried on ball unit 224 fastened by nut 226. The cylinder is mounted in the beam 212 of restraint 201 with cylinder mounting pins 204.

Stabilizing legs 274 are adjustable and provide additional stability of the rail restraint support. The legs 274 are allowed to slide in the bushing 275 and held in place with set screws 276 which may alternatively be actuated with wingnuts (Fig. 13) or handles (Figure 12) or other appropriate manual gripping end. The rail restraint 201 is lifted into place by the use of two handles 277 located opposite each other on the top of the frame 270.

By comparison to the alternative embodiment, the use of legs 274 provides a platform fixed relative to the ground or roadbed. This enables the use of various bars, clamps and jacks, familiar to one in the track art, which may be hooked or otherwise fixed to a rail and jacked against the ground or roadbed to directly control twist. In addition to the greater precision of

alignment this also enables track workers to use familiar alignment and adjustment tools as may be necessary to specific jobs.

In robotic welding operations, touch sensing plates 279 are attached to blocks 278 which are attached to the frame 270 to allow the robotic controller to establish the location of the rail restraint 201 and thence the weld gap by touching the plates with an electrically live torch tip. Pluralities of these plate assemblies are mounted on the frame 270 for accurate location of the weld gap. Around the perimeter of the frame 270 are located a plurality of windscreens or flaps 281 for prevention of ambient winds affecting the gas shield of the welding process.

The rail restraint 201 is supported on the rail using jacking screw assemblies 280 in which handle 282 rotates screw 283 mounted in a fixed horizontal plate 286 by threading, and having rotary shoes 284 attached to the end of screw 283. Shoe 284 is positioned so as to be centered on and bear against the head of the rail 28. In this manner, clockwise rotation of a right hand threaded screw 283 will raise rail restraint 201.

Improvements in the preferred embodiment when compared to our earlier prototype include the use of the hydraulic cylinder and scissors mechanism; use of adjustable legs 274 and screw assembly 280 and addition of touch sensing blocks 278 and wind screens 281 for superior weld control.

The preferred weld delivery unit 400 (Figures 20-22) will consist of a common truck chassis 402 specially equipped to be operable on railroad rails by use of front and rear rail-engaging bogies 404. Mounted on the truck chassis 402 is a van-style cargo box 406, which houses and protects all of the associated process equipment. The process equipment includes a welder 408, a robot 409 (mounted on its side), a robot controller 410, and an induction heating system 412.

Auxiliary equipment includes an electric power generator 414, driven from the truck

engine through a power take-off transmission 416 and drive shaft 418 through a right angle gear box 420 and a belt drive 422. Gas bottles 424 for welding shielding gas are also provided. A hydraulic system 428 belt-driven from the truck engine provides hydraulic power to operate the rail restraint 201 and weld containment device 290. Various tools and devices to assist in alignment of the rail are also stored on board in a tool case and storage rack. A drop-down tool shelf 437 allows for temporary storage of frequently used tools and supplies.

The cargo box is stabilized by use of external stabilizer legs 439 which are hydraulically operated to keep the cargo box from swaying and disrupting the robot orientation while welding.

The robot 409 is mounted to a horizontally moving machinery ways 426, which acts to extend the robot from the interior of the truck to the welding position on the exterior. It will be seen that the robot, as is known to one in the robotics art, has a base 430 mounted to rotational bearing 432 which enables the robot to rotate around a rotational axis 434. As is typical of robot devices, robot 409 has articulated arm 436 which is articulated to bearing 432 and base 430 having a series of joints 438, 438a and, for this application, terminates in welder head 440. While the robot 409 is typical in that it operates in three dimensions using controller 410, the initial orientation of robot 409 provides a major departure from known art. Base 430 and in particular axis 434 are horizontal, rather than their heretofore known vertical orientation. This orientation provides considerable advantages in use in the field in a mobile, portable welding apparatus. Instead of a workpiece being brought to and located proximate a fixed robot, this apparatus brings the welder to the workpiece - in this case railroad rails 28 - and uses interfacing with rail restraint 201 to automatically weld the rails. The use of touch sensing plates 279 enables controller 410 to precisely align and operate the welder head 440 to form a precisely controlled and metallurgically sound weld on extremely long rails and in very tight spaces. The alignment of axis 434 coaxial with the longitudinal axis of the vehicle also provides benefits in retraction for protection and added mobility.

Thus the device may be moved to a safe position for transportation, and storage. It may also be extended for maintenance or for welding of the rails. The robot has sufficient operating area to reach both the right and left side rails in turn. thus the robot can be readily and quickly stored or deployed for use. The robot receives its control power and ancillary service via a cable track 431.

CLAIMS:

1. A rail restraining, weld containment and weld delivery apparatus for enabling the joining of a rail gap, said apparatus comprising:
 - a rail restraint, a weld containment device and a mobile weld delivery unit;
 - said rail restraint having a first frame for supporting a clamp and said weld containment device, and adapted for aligning a welding head;
 - said weld containment device connected to said clamp and engageable with said rail gap;
 - said mobile weld delivery unit delivering an automated welder having the welding head proximate said rail gap so that a weld can be made joining said rail gap.
2. The apparatus of claim 1 wherein the rail gap is defined by a rail head of a rail.
3. The apparatus of claim 1 wherein the rail gap is defined by a rail head and a rail web of a rail.
4. The apparatus of claim 1 wherein the rail gap is defined as a sectional profile between first and second rail ends, each having a rail head, a rail web and a rail base, and said clamp is adapted for restraining the first and second rail ends.
5. The apparatus of claim 4 which is operable in an environment in which clearance between said first and second rail ends is about 7 to 11 inches, and the weld containment device is engageable with the rail gap by movement having a pivotal and longitudinal component.
6. The apparatus of claim 4 or 5 wherein said weld containment device is pivotally operated by use of a cam actuated linear pin in which longitudinal movement of the pin imparts pivotal movement in quadrants, said quadrants having cooling blocks mounted thereto.
7. The apparatus of claim 6, wherein said weld containment device further comprises:

said quadrants being pivotally connected to yokes;

said yokes being slidably mounted on longitudinal shafts, said shafts being mounted on a frame member, such that longitudinal movement of said yokes on said shafts impart inward and outward pivotal swinging of said quadrants;

said inward and outward pivotal swinging enabling the engagement of the cooling blocks with said first and second rail ends during welding and also enabling movement for clearance for the welding head to move reciprocally and vertically to weld, while closing the blocks to maintain the welding material in the web, and thence swinging to provide such clearance as is necessary to weld the rail heads together.

8. The apparatus of claim 7, wherein said weld containment device further comprises:
said pin having a fixed end and a cam end opposite said fixed end;
said fixed end being fixed relative to said quadrant, and being pivotable in said yoke;

said cam end fitting a cam mounted in said frame member, such that said longitudinal movement is imparted from said frame to said yoke, and as said frame member moves longitudinally relative to said yoke, said cam imparts rotational movement in said cam end, said cam end rotating said pin and said fixed quadrant, thereby engaging and disengaging rail welding cooling blocks from said rail ends.

9. The apparatus of claim 8, wherein said weld containment device further comprises:
said cam end being formed and arranged with between about 15 to 30 degrees twist in three quarters of one inch travel;
said cam being formed and arranged with between about 15 to 30 degrees twist in three quarters of one inch travel.

10. The apparatus of claim 8 further comprising:
said first frame being adapted to support a robotic welding device;
said clamp being adapted for restraining the first and second rail ends;
said first frame having a fixed downwardly depending arm and a movable downwardly depending arm spaced therefrom defining a rail receiving space therebetween;

said movable arm being eccentrically pivoted on said first frame to enable capturing of a rail in said space;

said movable arm being pivoted about a first pivot and a clamping force being applied to and released from a second pivot displaced from said first pivot;

said first frame supporting a third pivot and said third pivot connecting with a link to said second pivot whereby an actuating force applied to said link transmits said clamping force through said link;

said link being a scissors link;

said scissors link having a fourth pivot joining a first part connected to said third pivot and a second part connected to said second pivot, said actuating force being applied at said fourth pivot;

said mobile weld delivery unit having a vehicle body and a welder;

said welder being retractably and deployably carried on said vehicle body;

said welder being automatically controlled by a controller, said controller calibrating the operation of said weld relative to the location of said rails;

said weld operation calibration being performed based on touch sensing members located on said rail restraint;

said vehicle body having a longitudinal axis;

said welder and controller coacting with said robotic welding device to position said welder head based on said calibrated reference; and

said robotic welding device having a base and a main axis, said main axis being aligned with the vehicle longitudinal axis of said vehicle body.

11. The apparatus of claim 4 wherein said rail restraint further comprises:

said first frame having a fixed downwardly depending arm and a movable downwardly depending arm spaced therefrom defining a rail receiving space therebetween;

said movable arm being eccentrically pivoted on said frame to enable capturing of a rail in said space.

12. The apparatus of claim 4 wherein said rail restraint further comprises:

said movable arm being pivoted about a first pivot and a clamping force being applied to and released from a second pivot displaced from said first pivot.

13. The apparatus of claim 12 wherein said rail restraint further comprises:

said frame supporting a third pivot and said third pivot connecting with a link to said second pivot whereby an actuating force applied to said link transmits said clamping force through said link.

14. The apparatus of claim 13 wherein said rail restraint further comprises:

said link being a scissors link;

said scissors link having a fourth pivot joining a first part connected to said third pivot and a second part connected to said second pivot, said actuating force being applied at said fourth pivot.

15. The apparatus of claim 14 wherein said rail restraint further comprises:

said clamp being a first clamp, said first clamp being disposed adjacent a first end of said frame;

said first frame having a second clamp disposed at a second end of said first frame, said second end being opposite said first end;

said second clamp being in form and operation analogous to said first clamp.

16. The apparatus of claim 15 wherein said rail restraint further comprises:

said arm having an inverted L shape with said first pivot being located proximate the end of the short leg of the L the second pivot being located proximate the intersection of the short leg of the L and the long leg of the L and a clamping pad being located at the end of the long leg of the L.

17. The apparatus of claim 16 wherein said rail restraint further comprises:

said actuating force being applied to said link by force application means for imparting force acting between a mounting pin and said fourth pivot.

18. The apparatus of claim 10 wherein said rail restraint further comprises:
said clamp being a first clamp, said first clamp being disposed adjacent a first end of said frame;
said first frame having a second clamp disposed at a second end of said first frame, said second end being opposite said first end;
said second clamp being in form and operation analogous to said first clamp.
19. The apparatus of claim 1 or claim 4 wherein said weld delivery unit further comprises:
a vehicle body;
said welder being retractably and deployably carried in said vehicle body;
said welder being automatically controlled by a controller, said controller calibrating the operation of said welder relative to the location of said rail gap.
20. The apparatus of claim 19 wherein said weld delivery unit further comprises:
said calibrating being performed based on touch sensing members located on said rail restraint.
21. The apparatus of claim 20 wherein said weld delivery unit further comprises:
said vehicle body having a longitudinal axis;
said welder and controller coacting with a robotic welding device to position said welder head based on said calibrated reference;
said robotic welding device having a base and a main axis, said main axis being aligned with the longitudinal axis of said vehicle body.
22. The apparatus of claim 21 wherein said weld delivery unit further comprises an induction heater for preheating said rail gap prior to welding.
23. A weld containment apparatus for enabling the joining of a first rail end and a second rail end, each end being formed in a sectional profile with a rail head, a rail web and a rail base, comprising:

said weld containment apparatus being connectable to a clamp and engageable with said rail ends by movement having a pivotal and longitudinal component;

said weld containment apparatus further being pivotally operated by use of a cam actuated linear pin in which longitudinal movement of the pin imparts pivotal movement in quadrants, said quadrants having cooling blocks mounted thereto.

24. The weld containment apparatus of claim 23 further comprising:

said quadrants being pivotally connected to yokes;

said yokes being slidably mounted on longitudinal shafts said shafts being mounted on a frame member, such that longitudinal movement of said yokes on said shafts impart inward and outward pivotal swinging of said quadrants;

said inward and outward pivotal swinging enabling the engagement of the cooling blocks with said rail ends during welding and also enabling movement for clearance for the welding head to move reciprocally and vertically to weld, while closing the blocks to maintain the welding material in the web, and thence swinging to provide such clearance as is necessary to weld the rail heads together.

25. The weld containment apparatus of claim 24 further comprising:

said pin having a fixed end and a cam end opposite said fixed end;

said fixed end being fixed relative to said quadrant, and being pivotable in said yoke;

said cam end fitting a cam mounted in said frame member, such that said longitudinal movement is imparted from said frame to said yoke, and as said frame member moves longitudinally relative to said yoke, said cam imparts rotational movement in said end, said end rotating said pin and said fixed quadrant, thereby engaging and disengaging rail welding cooling blocks from said rail ends.

26. The weld containment apparatus of claim 24 or 25 further comprising:

said cam end being formed and arranged with between about 15 to 30 degrees twist in three quarters of one inch travel;

said cam being formed and arranged with between about 15 to 30 degrees twist in three quarters of one inch travel.

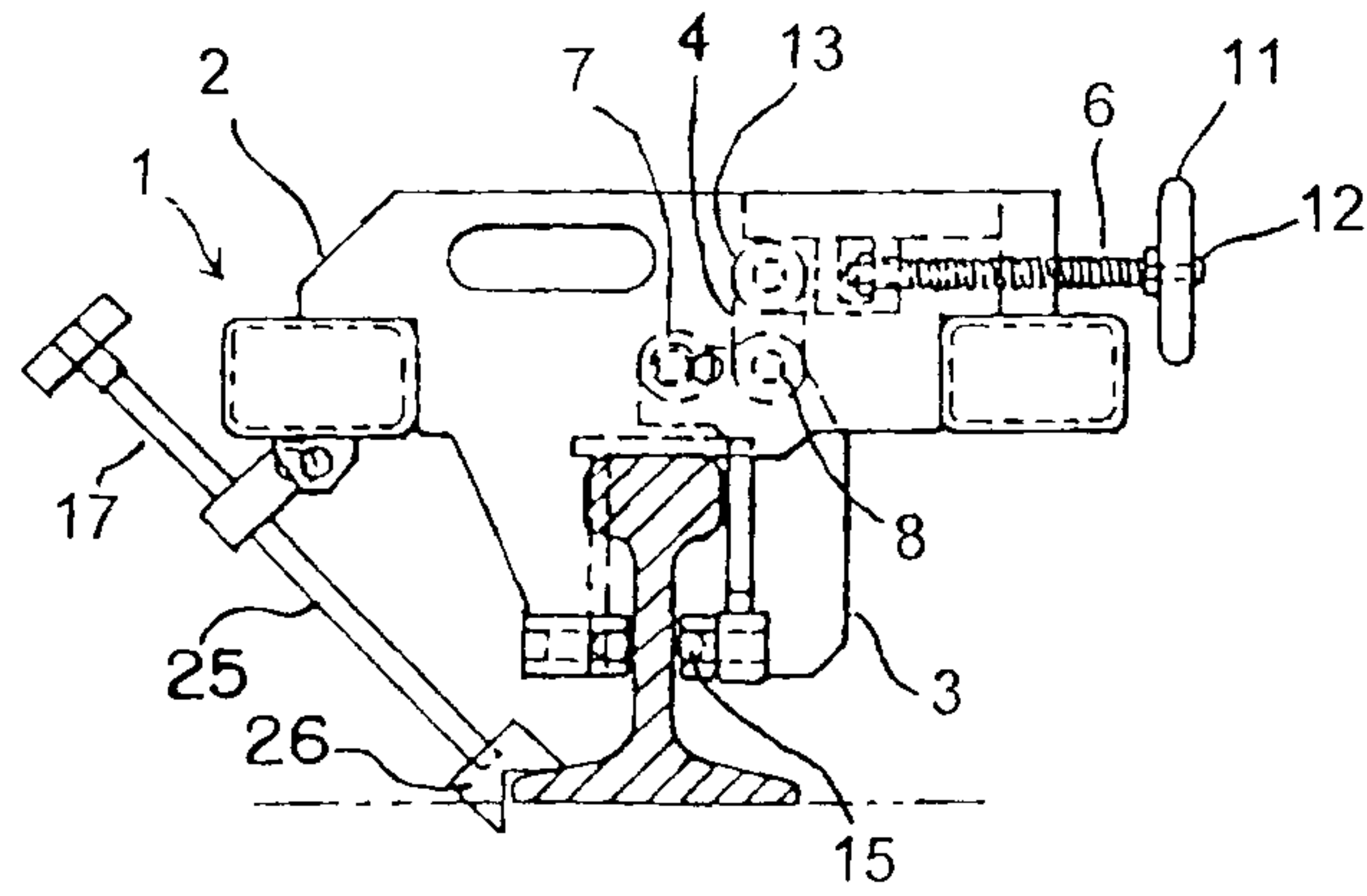


FIG. 1

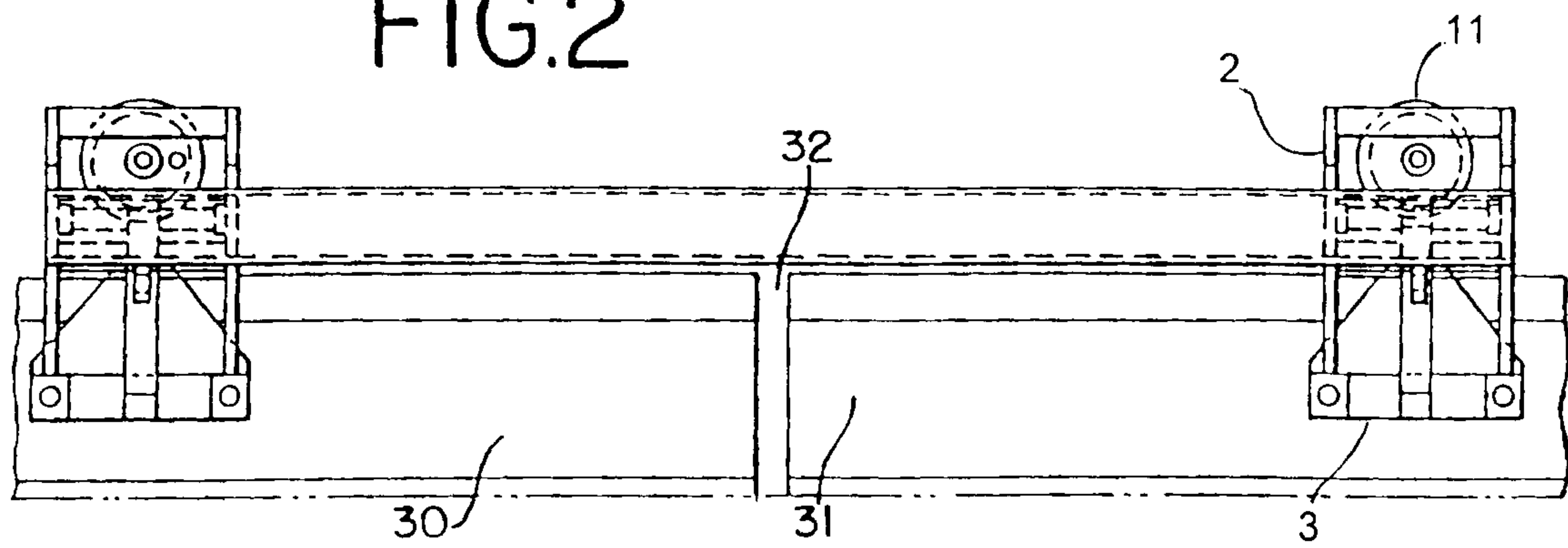


FIG.3

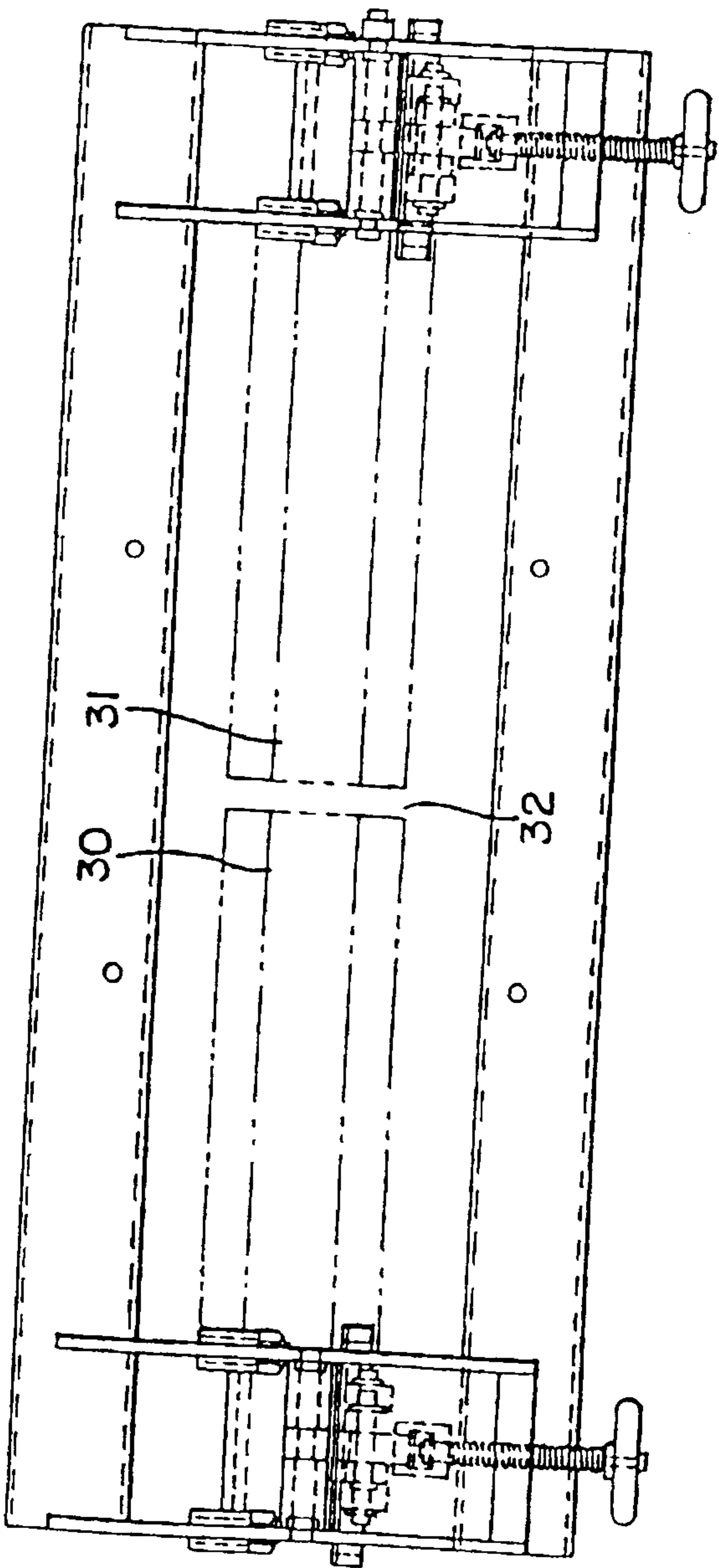


FIG.5

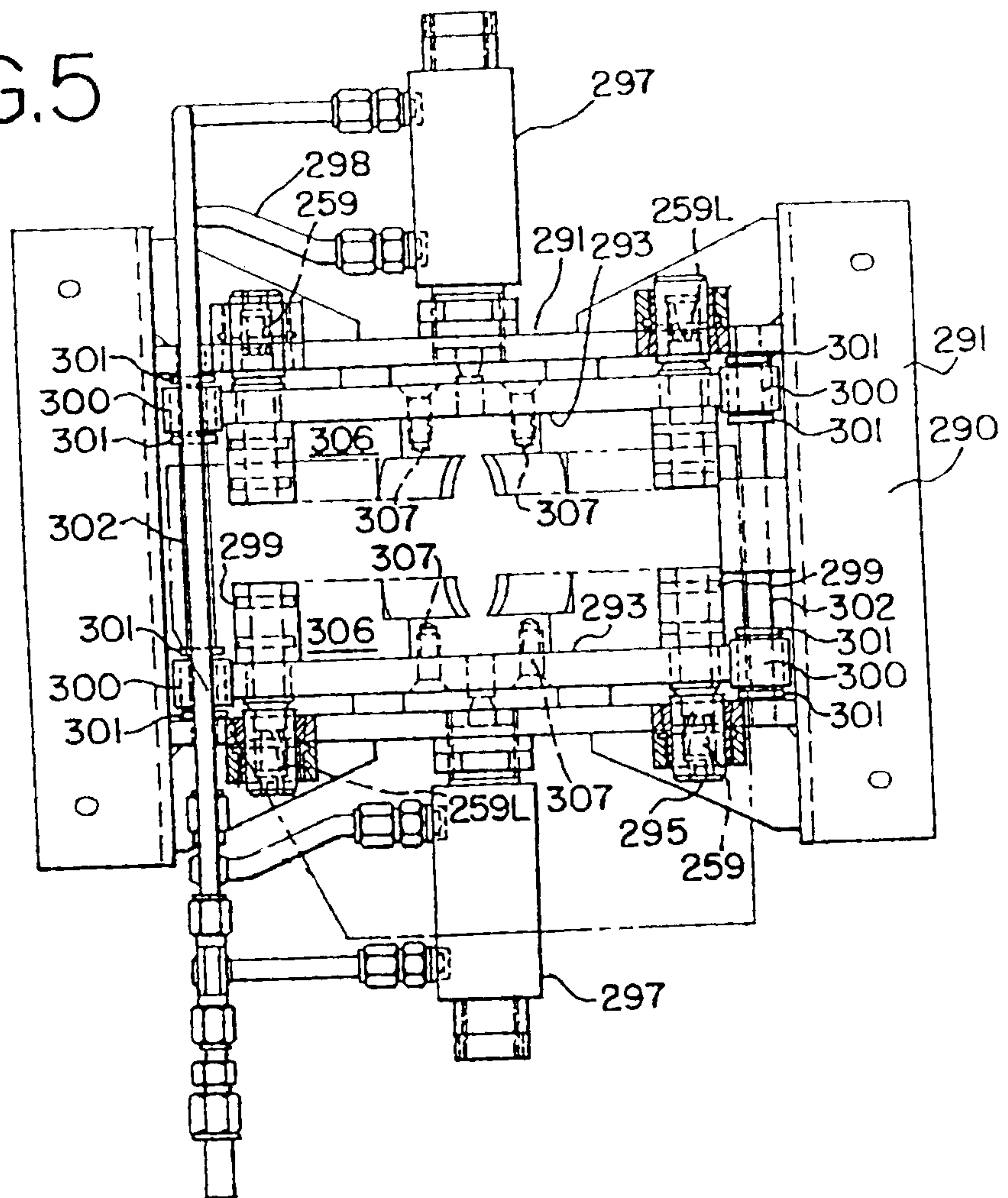


FIG.4

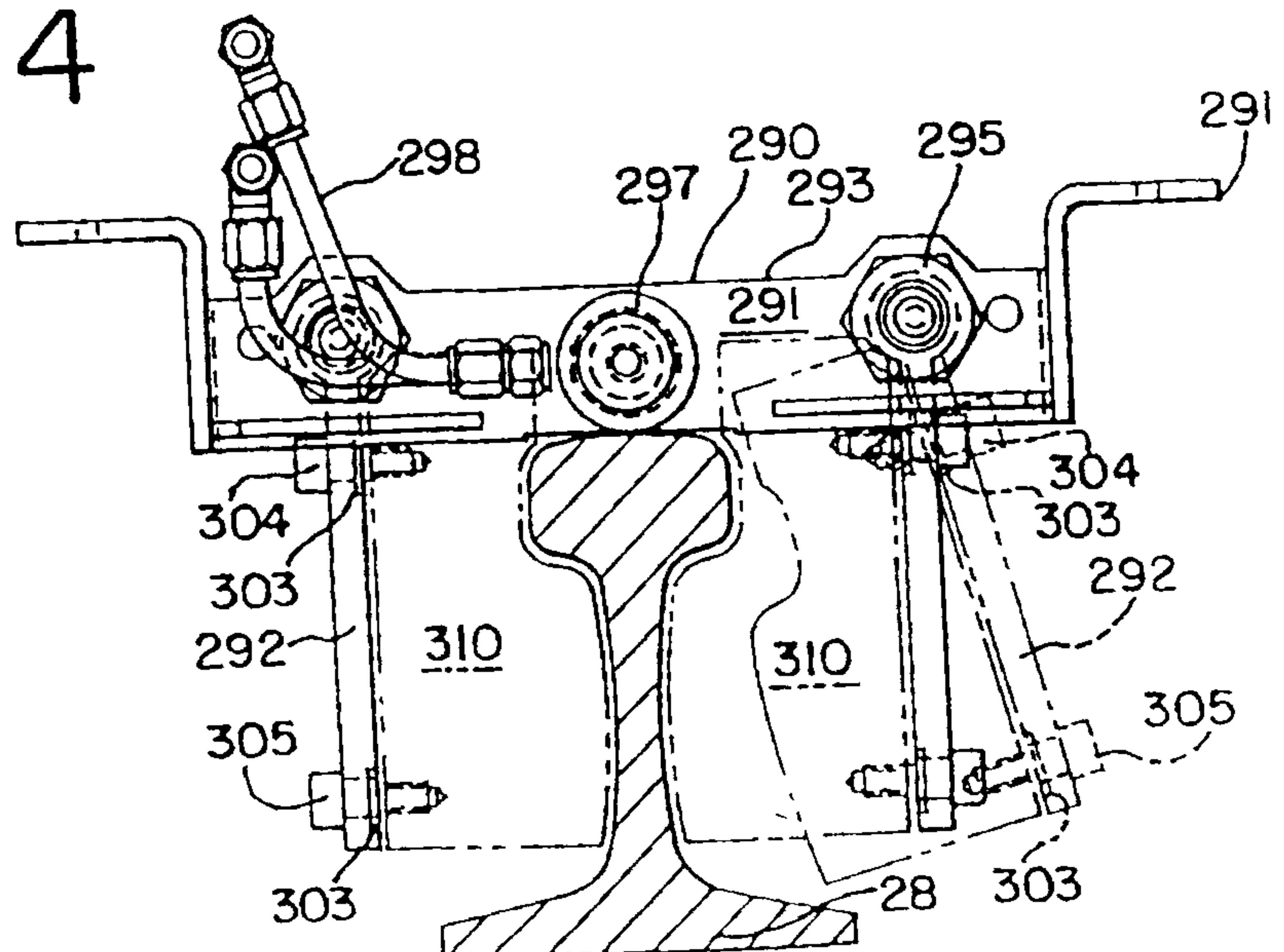


FIG.6

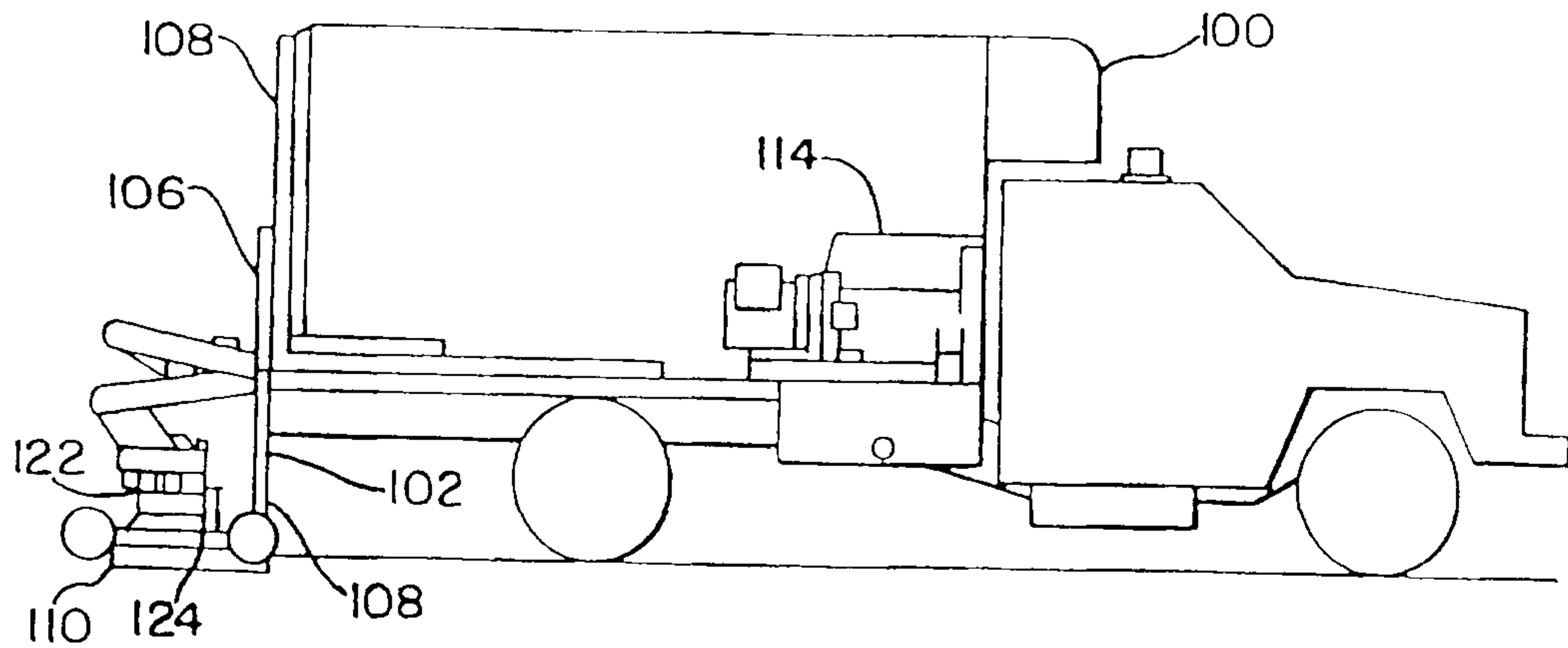


FIG.7

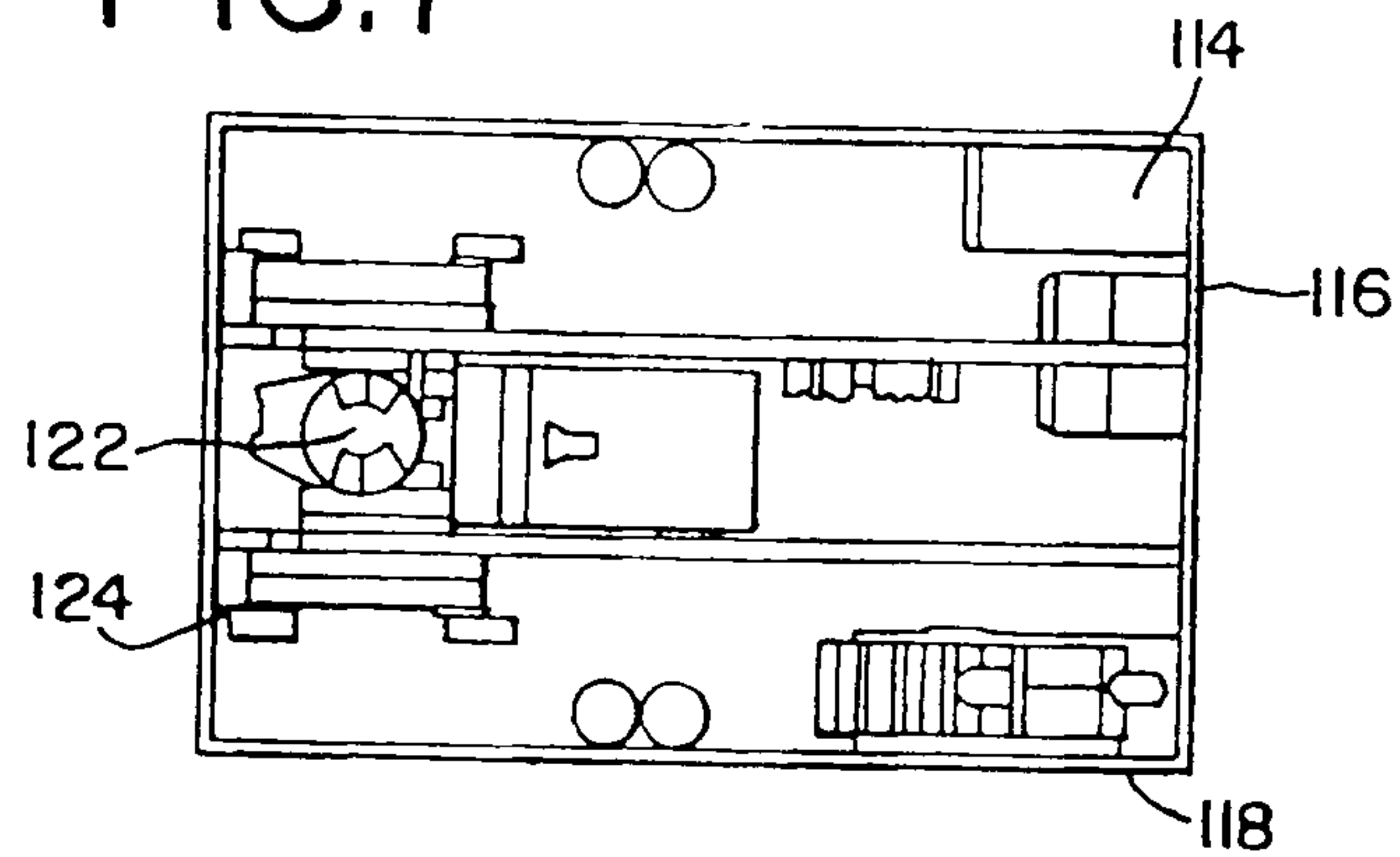


FIG.8

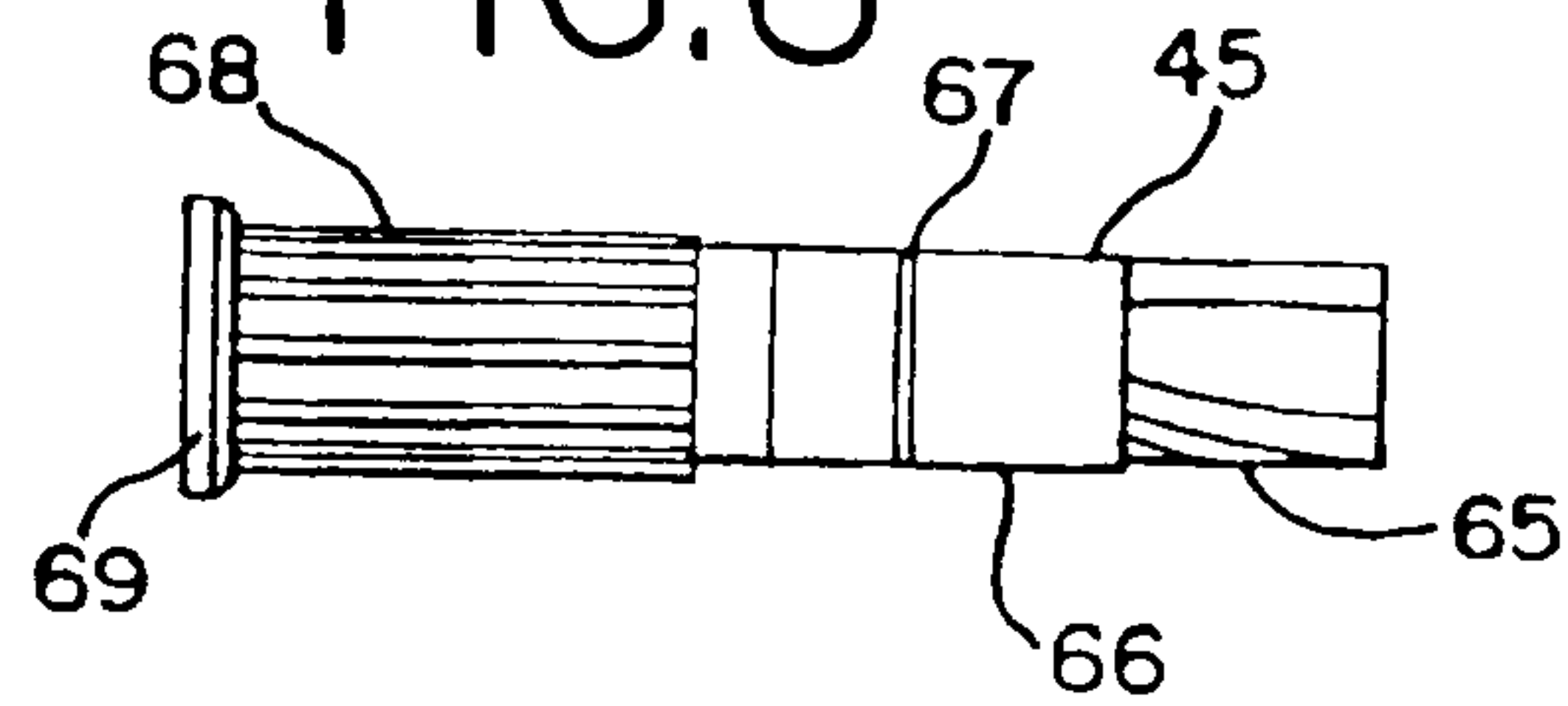


FIG.9

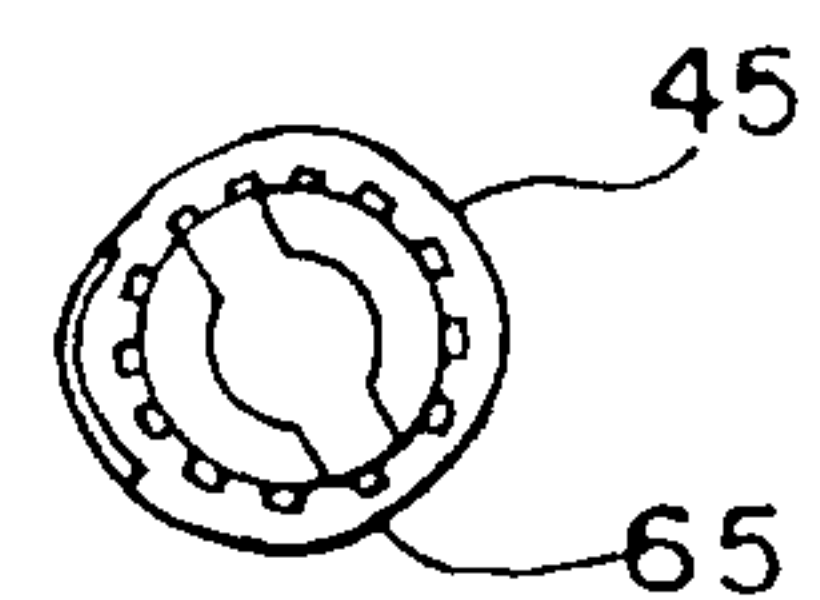


FIG.10

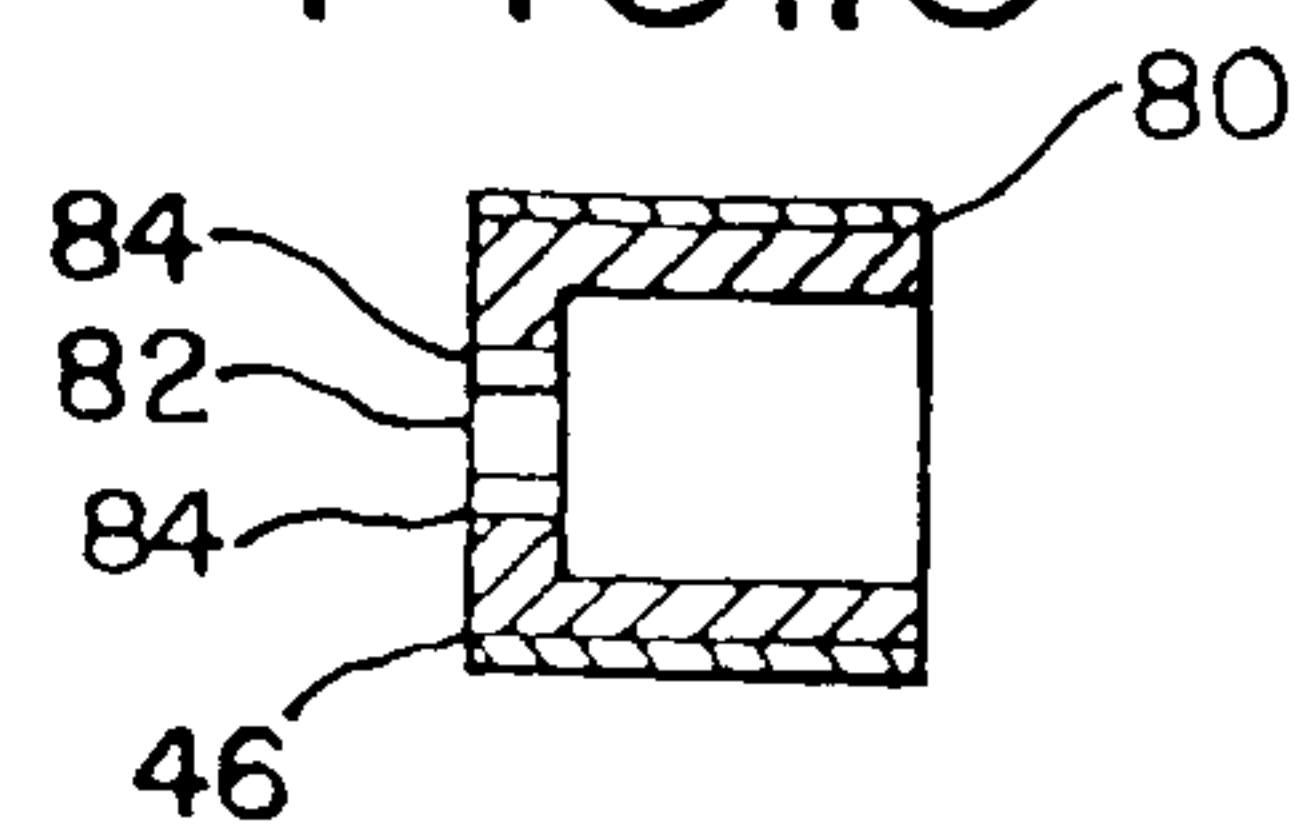


FIG.11

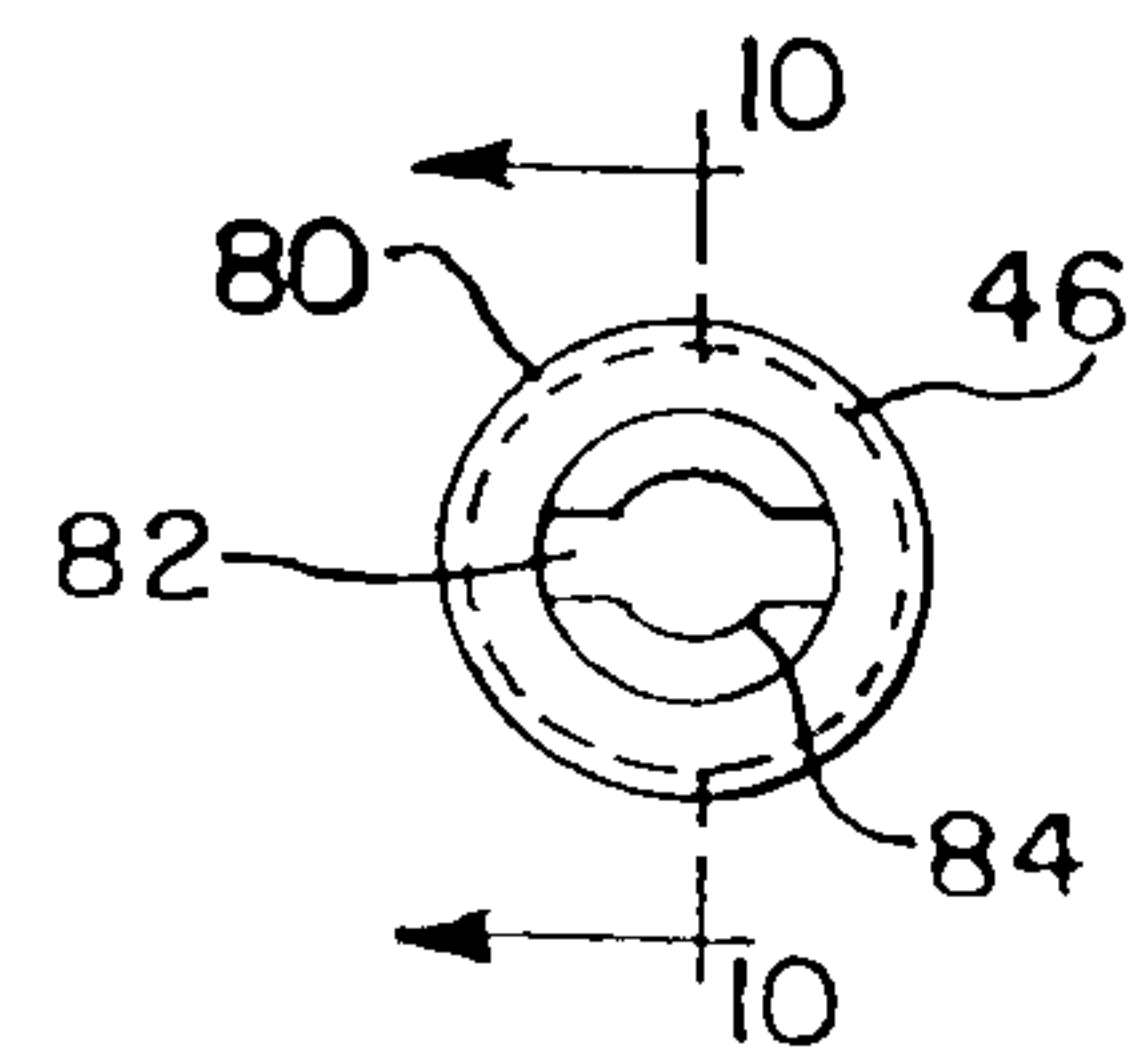


FIG.12

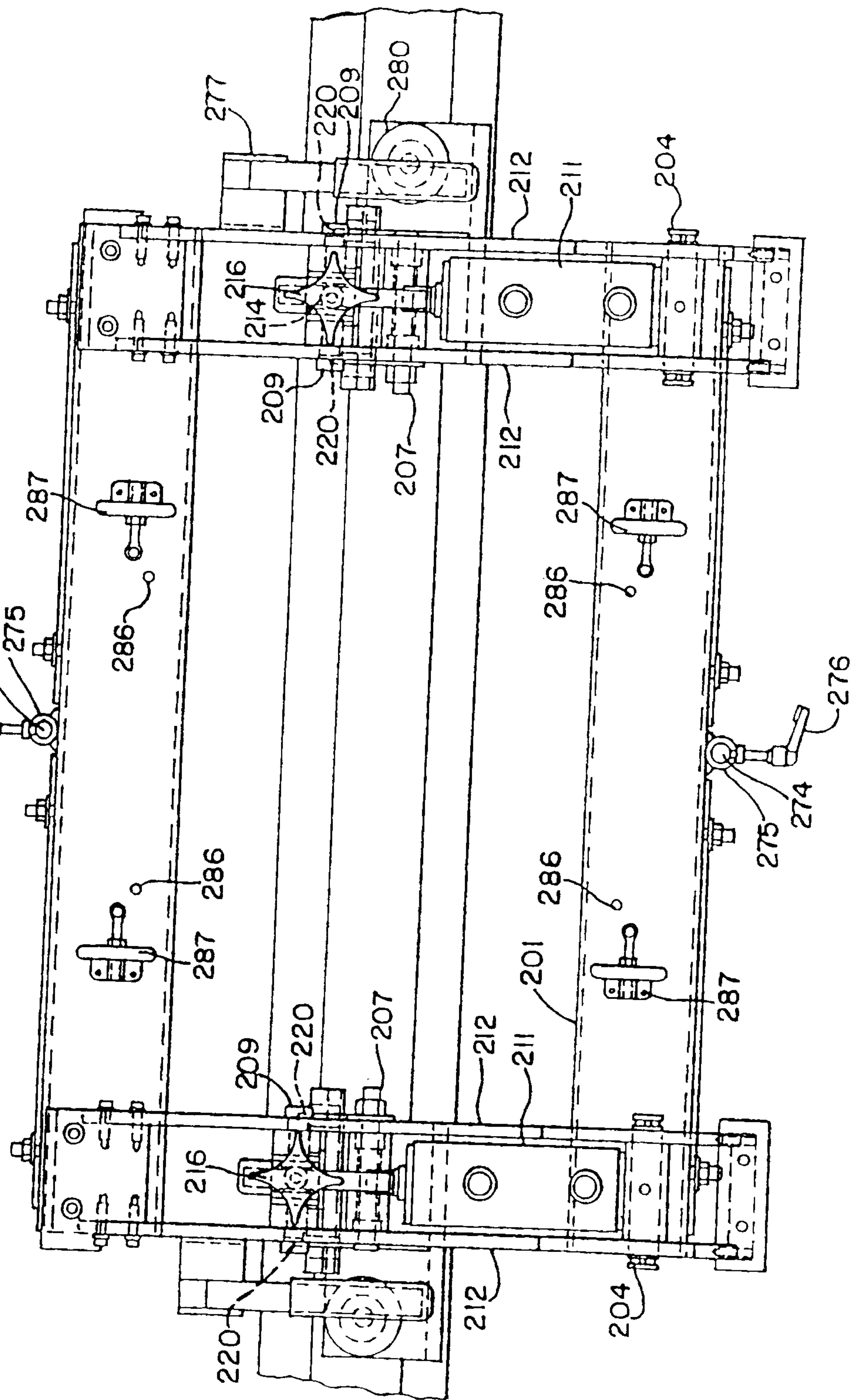


FIG.13

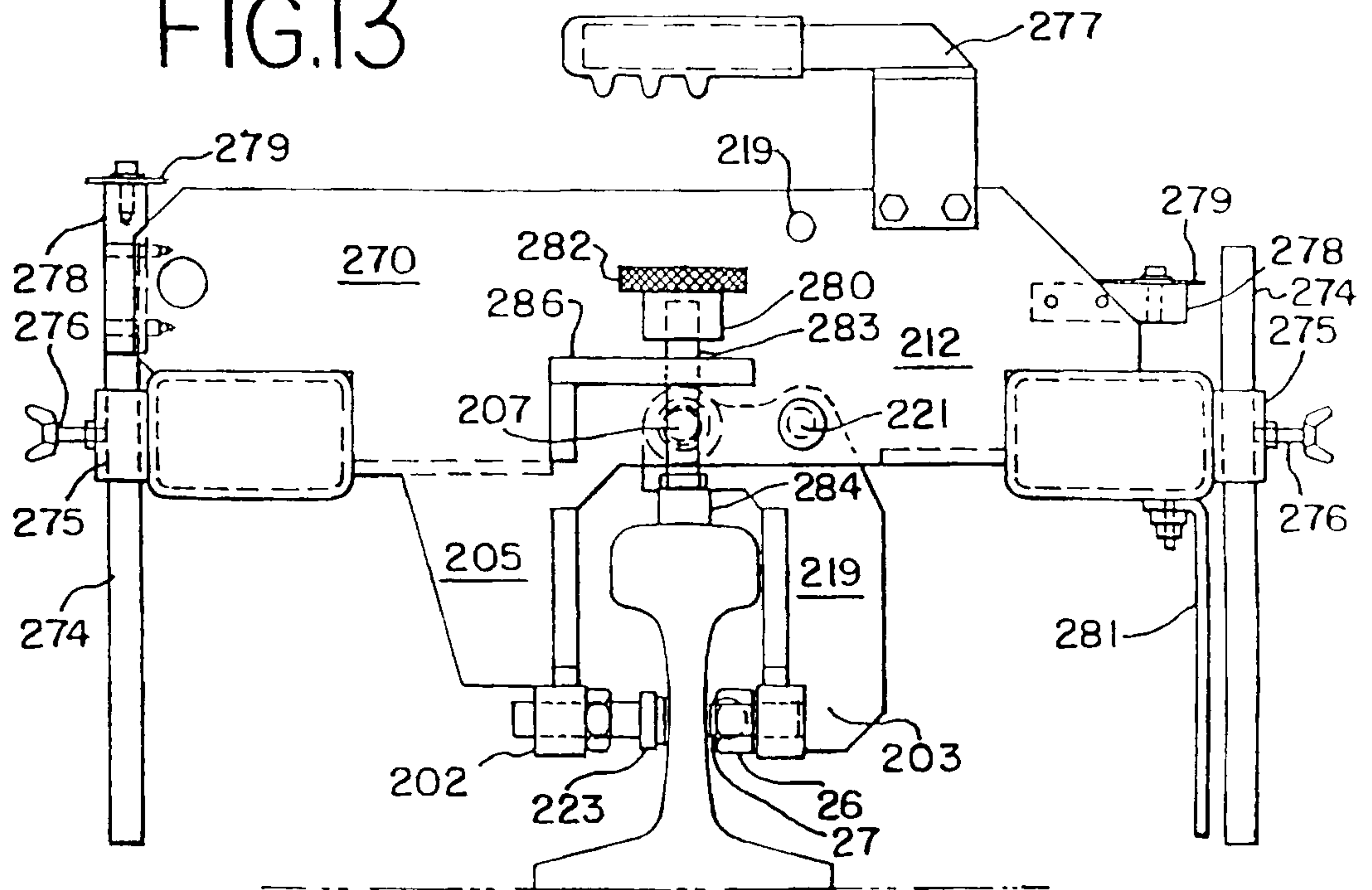


FIG.14

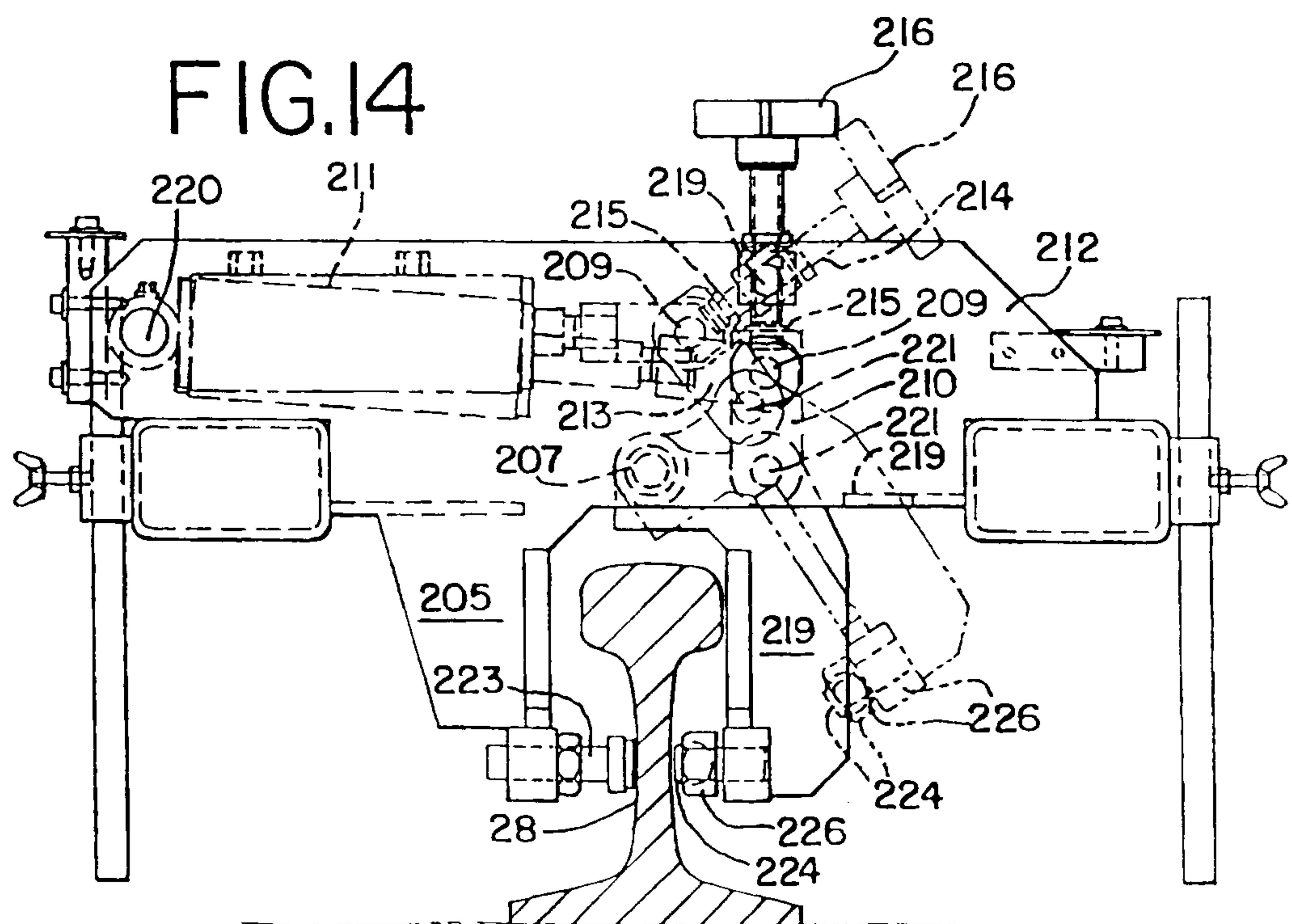


FIG.15

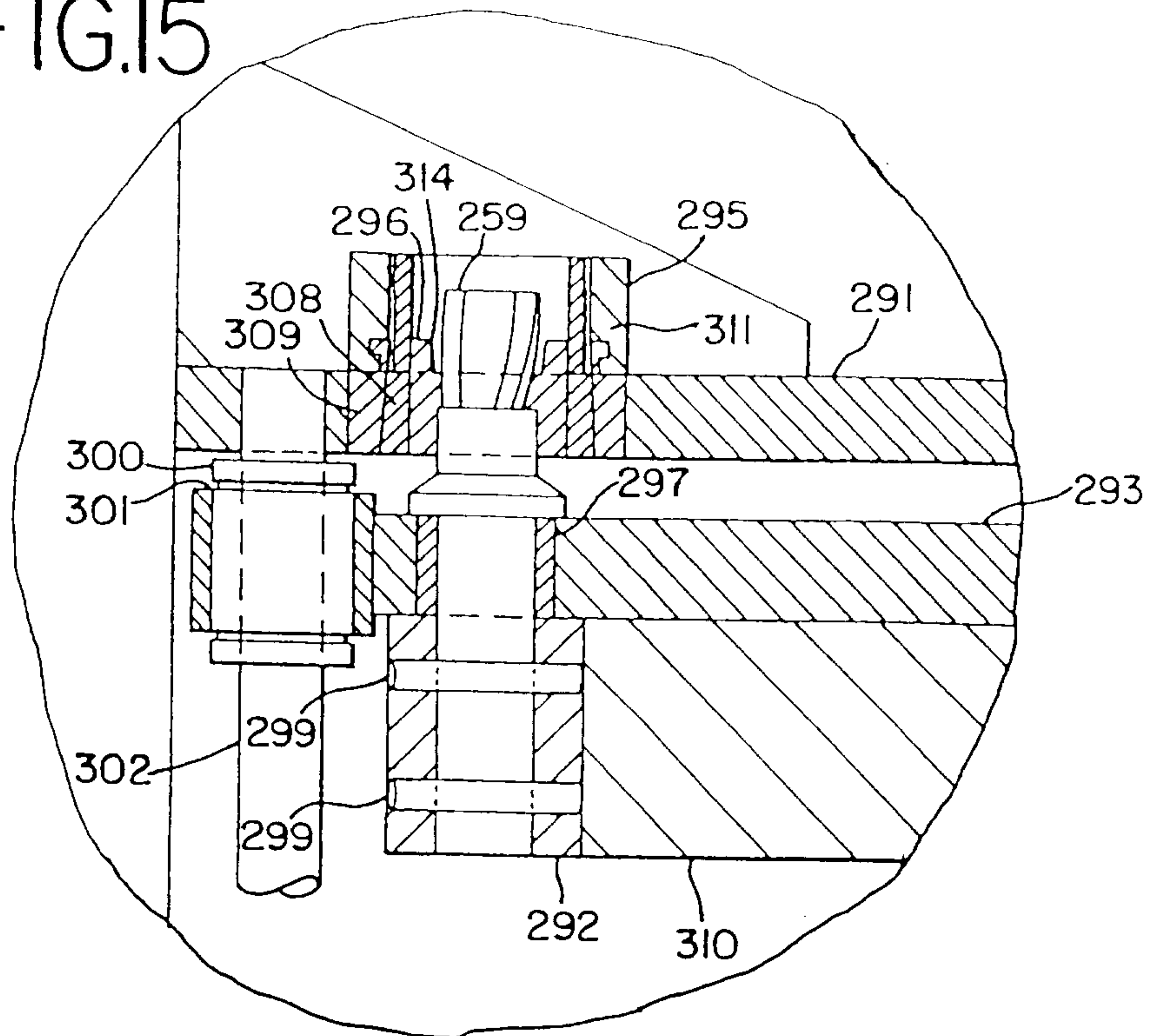


FIG.16

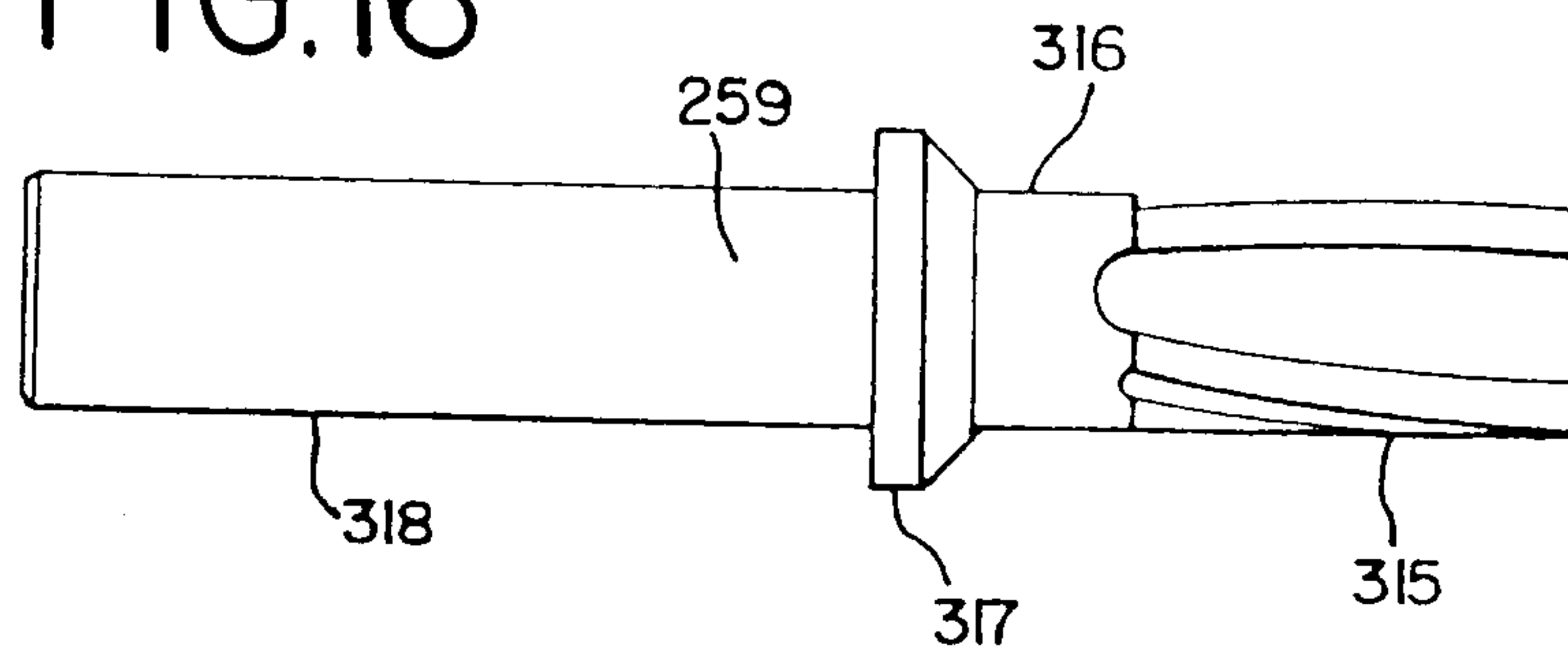


FIG.17

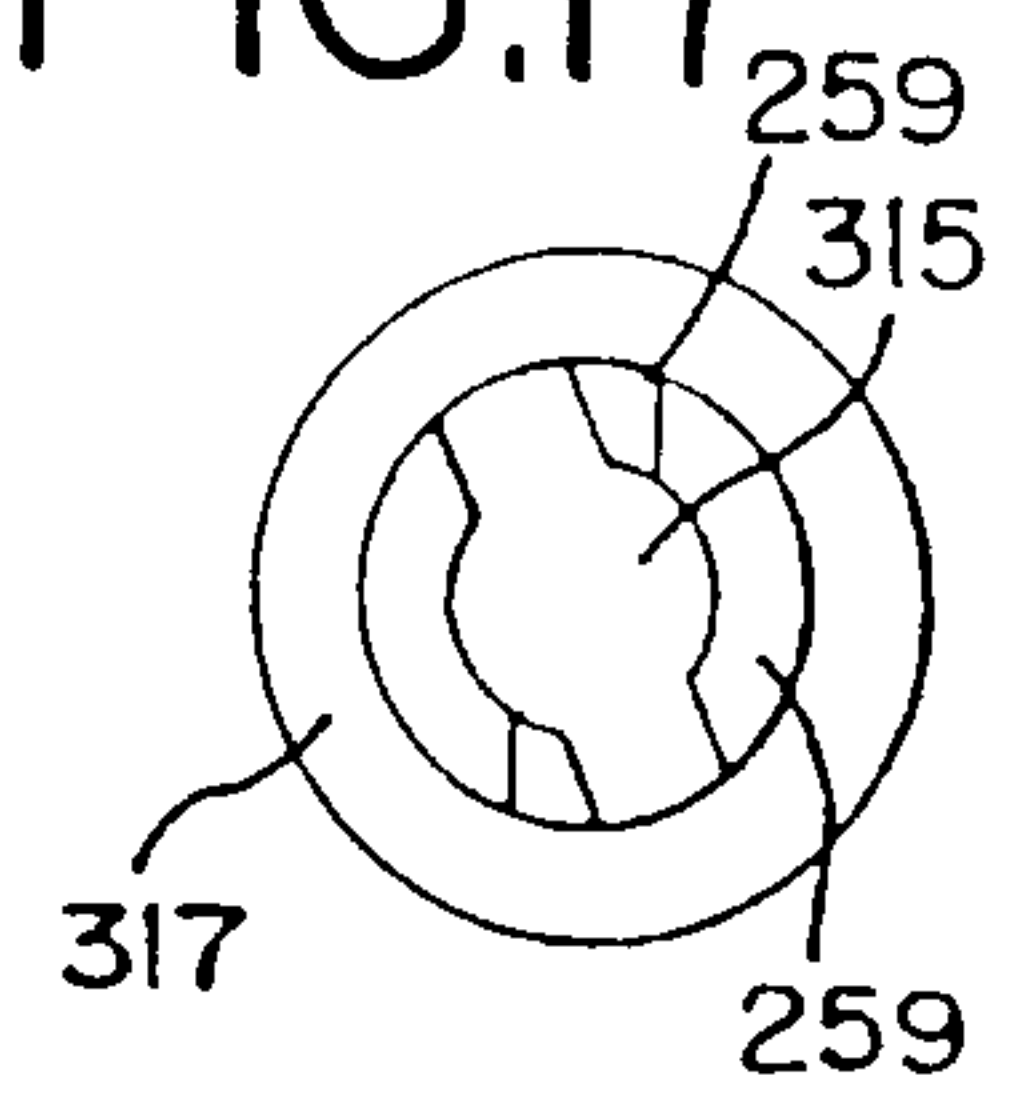


FIG.18

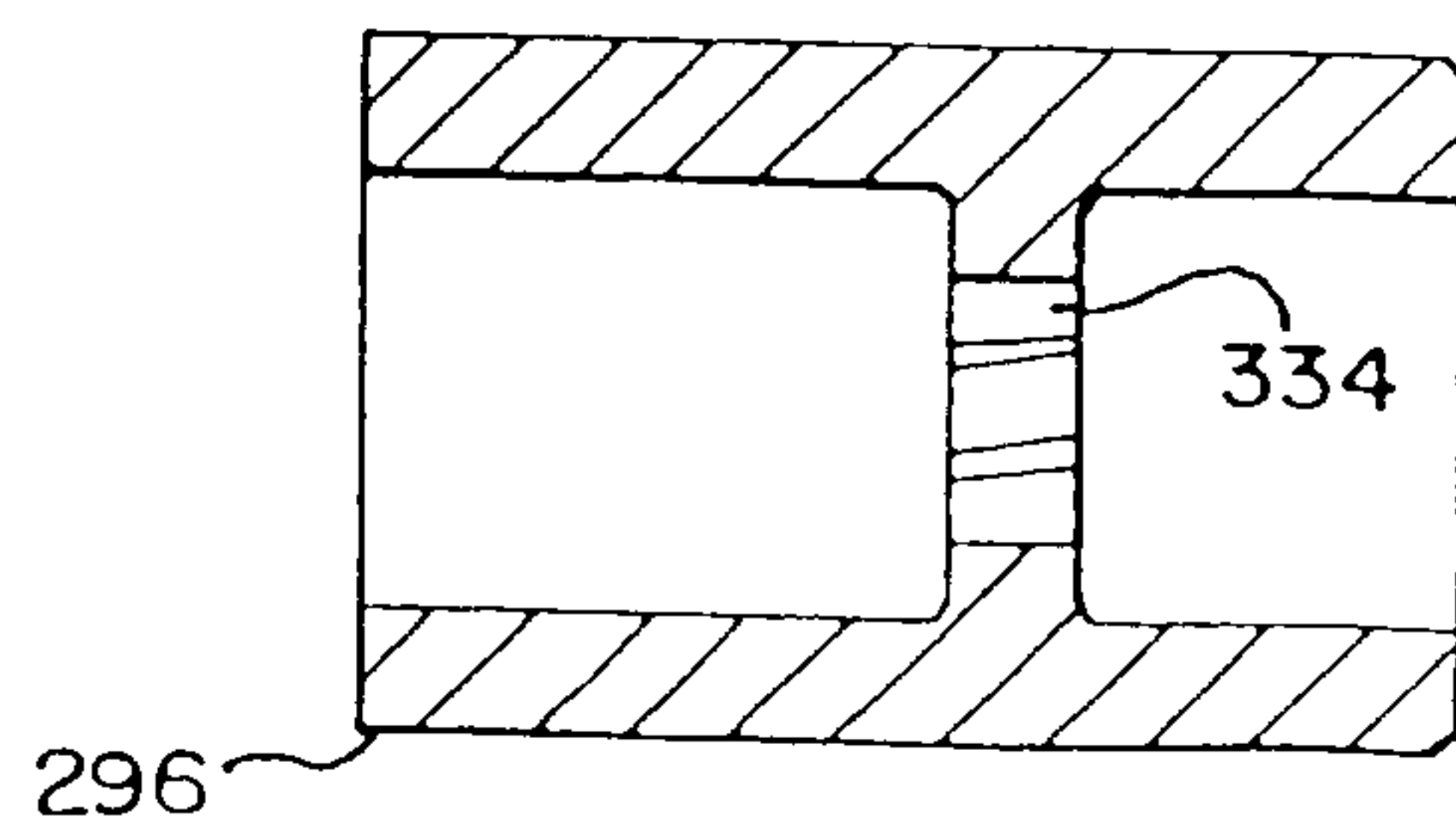


FIG.19

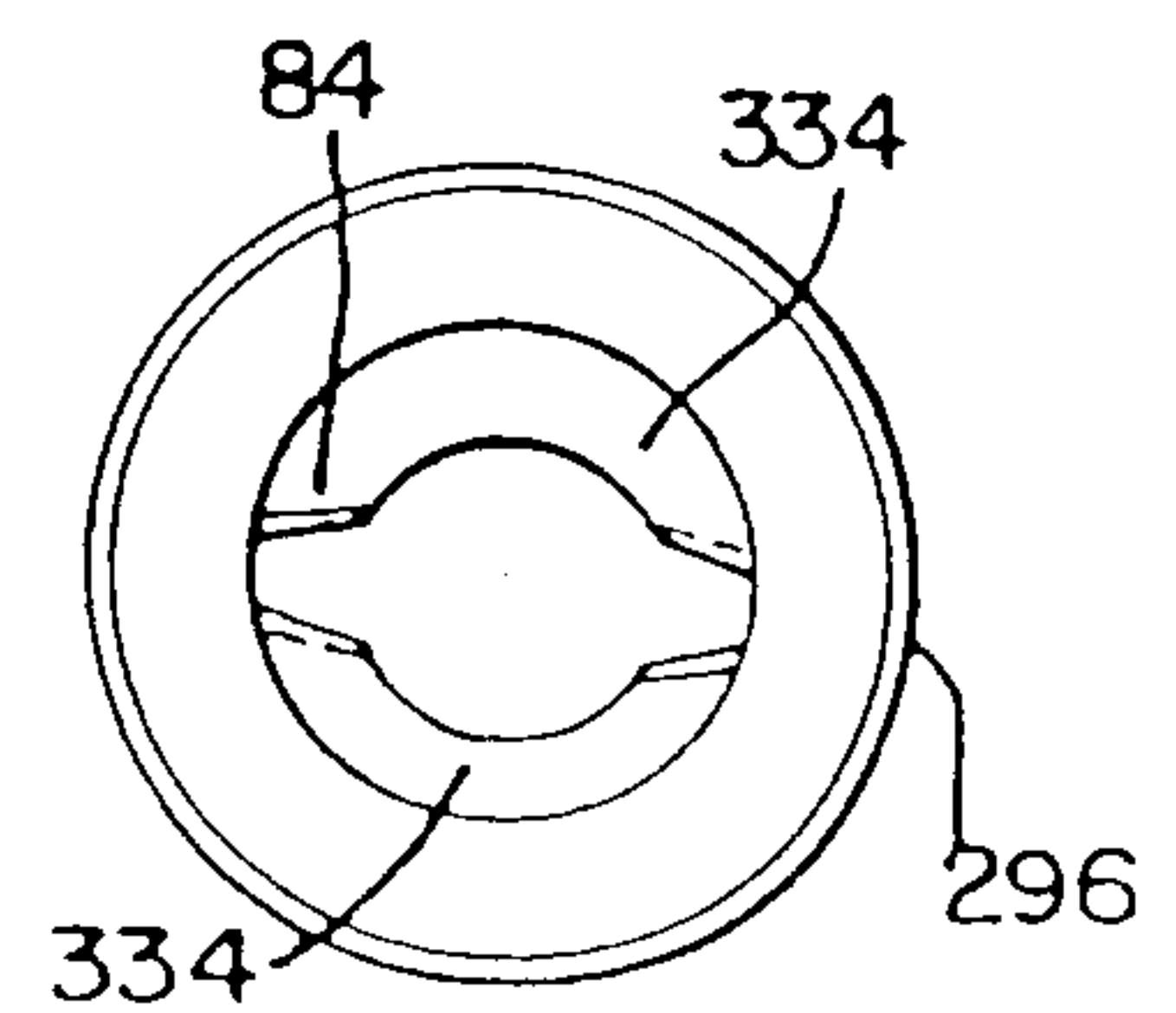
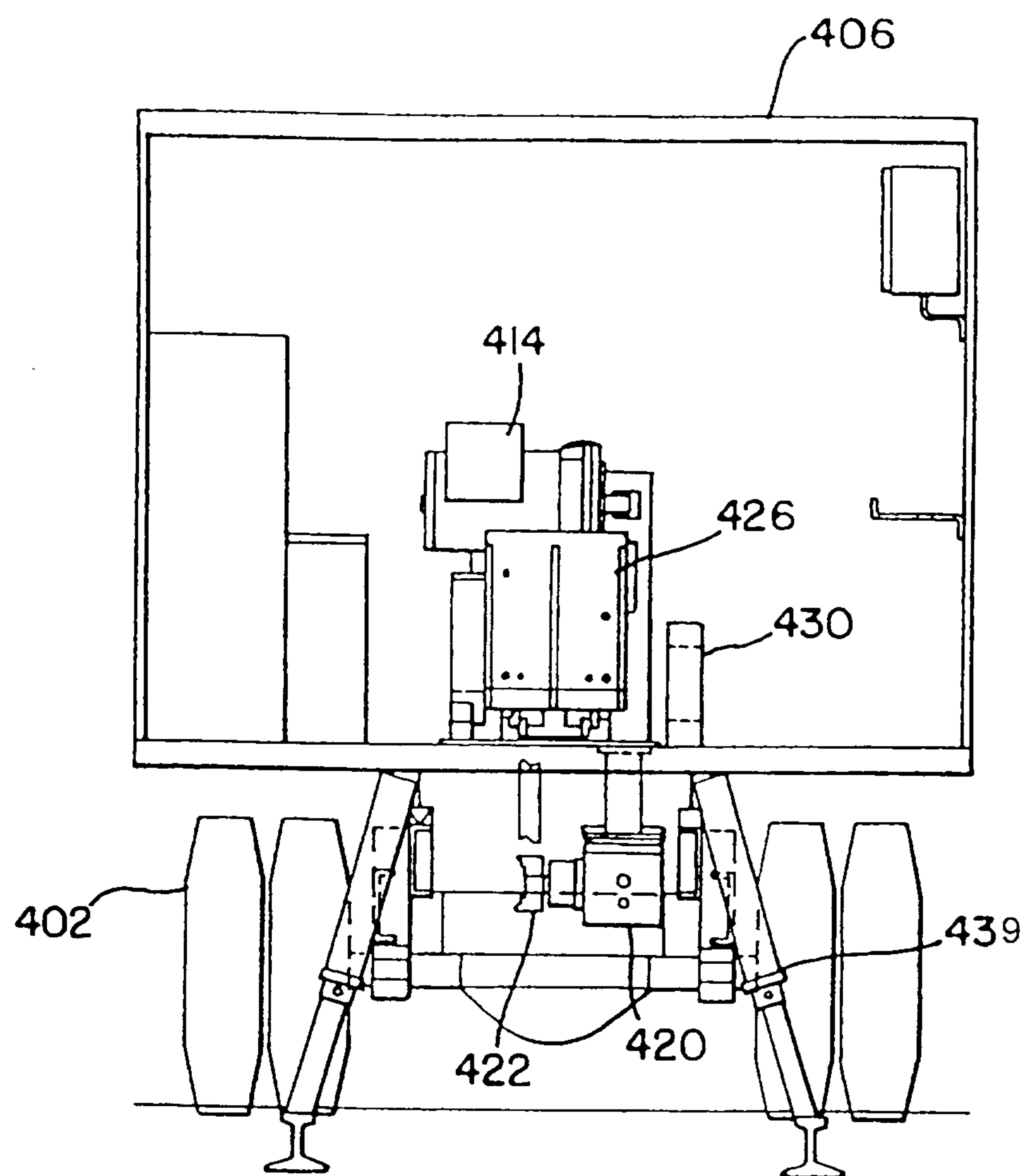


FIG.20



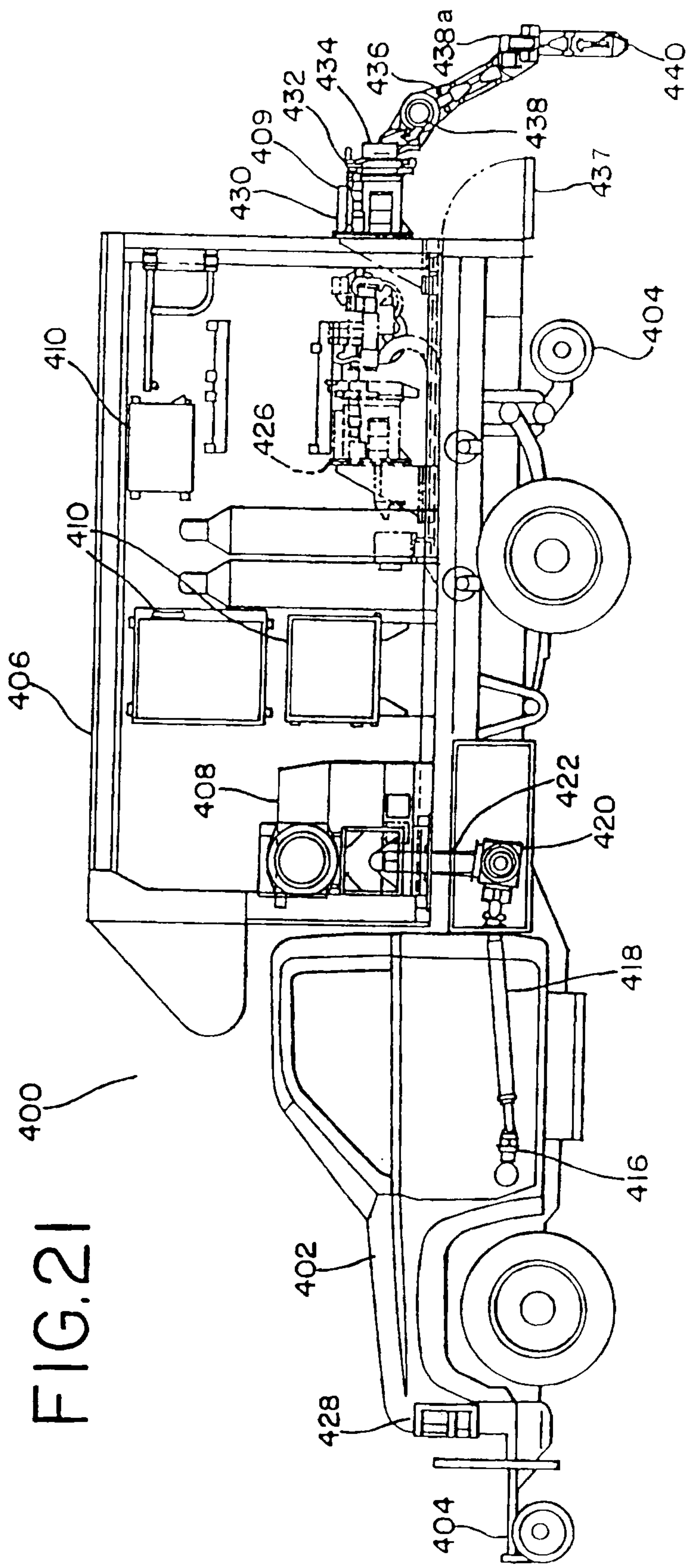


FIG.22

