Office de la Propriété Intellectuelle du Canada
Un organisme d'Industrie Canada

Canadian Intellectual Property Office
An agency of Industry Canada

CA 2210148 C 2003/04/01

(11)(21) 2 210 148

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(86) Date de dépôt PCT/PCT Filing Date: 1996/02/14
(87) Date publication PCT/PCT Publication Date: 1996/08/22
(45) Date de délivrance/Issue Date: 2003/04/01
(85) Entrée phase nationale/National Entry: 1997/07/10
(86) N° demande PCT/PCT Application No.: US 1996/002088
(87) N° publication PCT/PCT Publication No.: 1996/025350
(30) Priorité/Priority: 1995/02/15 (08/389,097) US

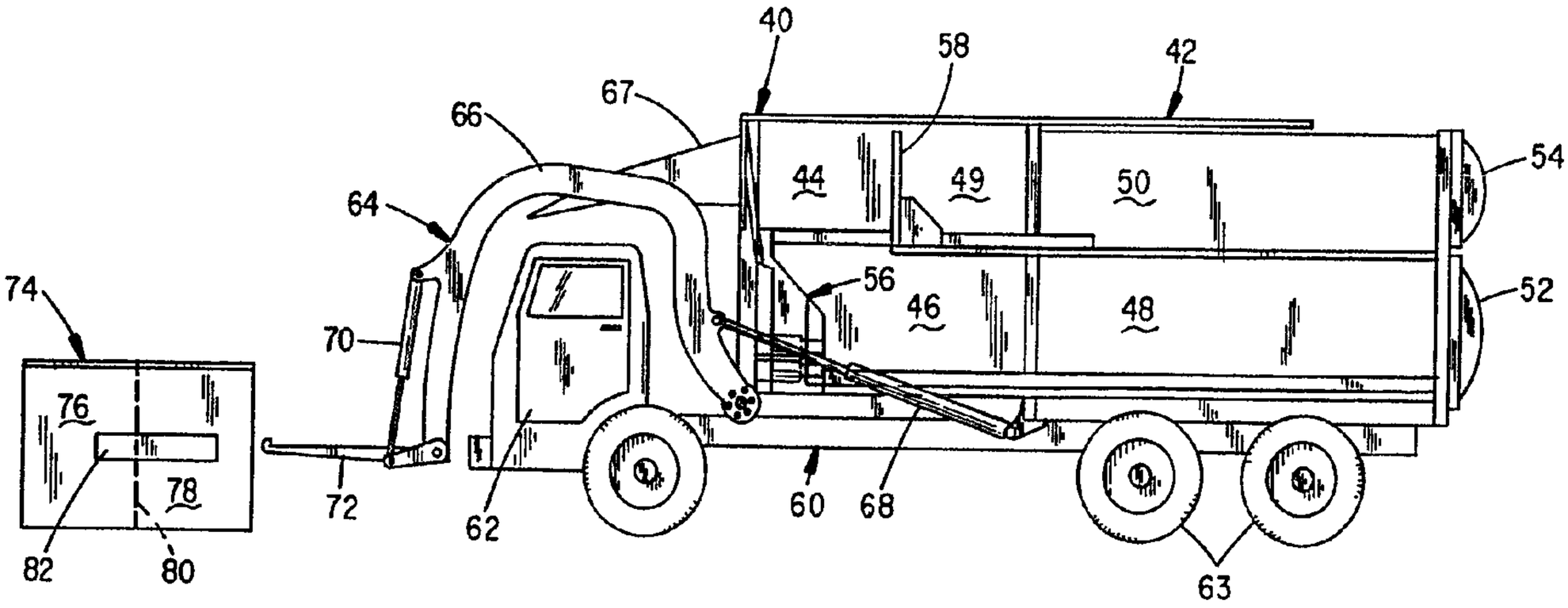
(51) Cl.Int.^{6}/Int.Cl.^{6} B65F 3/14, B65F 3/24

(72) Inventeur/Inventor:
CHRISTENSON, RONALD E., US

(73) Propriétaire/Owner:
MCNEILUS TRUCK AND MANUFACTURING, INC., US

(74) Agent: SMART & BIGGAR

(54) Titre : CARROSSERIE A COMPARTIMENTS MULTIPLES POUR MATIERES DE DECHETS
(54) Title: MULTIPLE COMPARTMENT BODY FOR WASTE MATERIALS



(57) Abrégé/Abstract:
A multi-compartment removable vehicle body (620) for collecting, packing, hauling and unloading refuse material including recyclable materials is disclosed, including a truck body enclosing a material-receiving volume which includes a horizontal wall (116) within the volume which divides the volume into separate upper and lower storage body compartments (624, 625). A longitudinally-spaced loading opening at the top of the body contains separate openings (44, 49) being in continuous communication each with one of the separate compartments. Preferably, non-recyclable refuse is stored in the lower compartment. The truck body includes a primary compacting system (92) associated with one of said compartments for compacting non-recyclable materials and an auxiliary compacting system (88) linked to the primary compacting system for compacting recyclable materials. The auxiliary compacting system includes a device (108) for limiting the force of compaction against the recyclable material such that it will not exceed a predetermined maximum regardless of the force applied to the non-recyclable refuse material. Embodiments of up to six separate longitudinal compartments are illustrated.

CA 02210148 1997-07-10

CORRECTED VERSION*

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **B65F 3/14, 3/24**

A1

(11) International Publication Number: **WO 96/25350**

(43) International Publication Date: 22 August 1996 (22.08.96)

(21) International Application Number: PCT/US96/02088

(22) International Filing Date: 14 February 1996 (14.02.96)

(30) Priority Data:
08/389,097 15 February 1995 (15.02.95) US

(71) Applicant *(for all designated States except US)*: McNEILUS TRUCK AND MANUFACTURING, INC. [US/US]; P.O. Box 70, Highway 14 East, Dodge Center, MN 55927 (US).

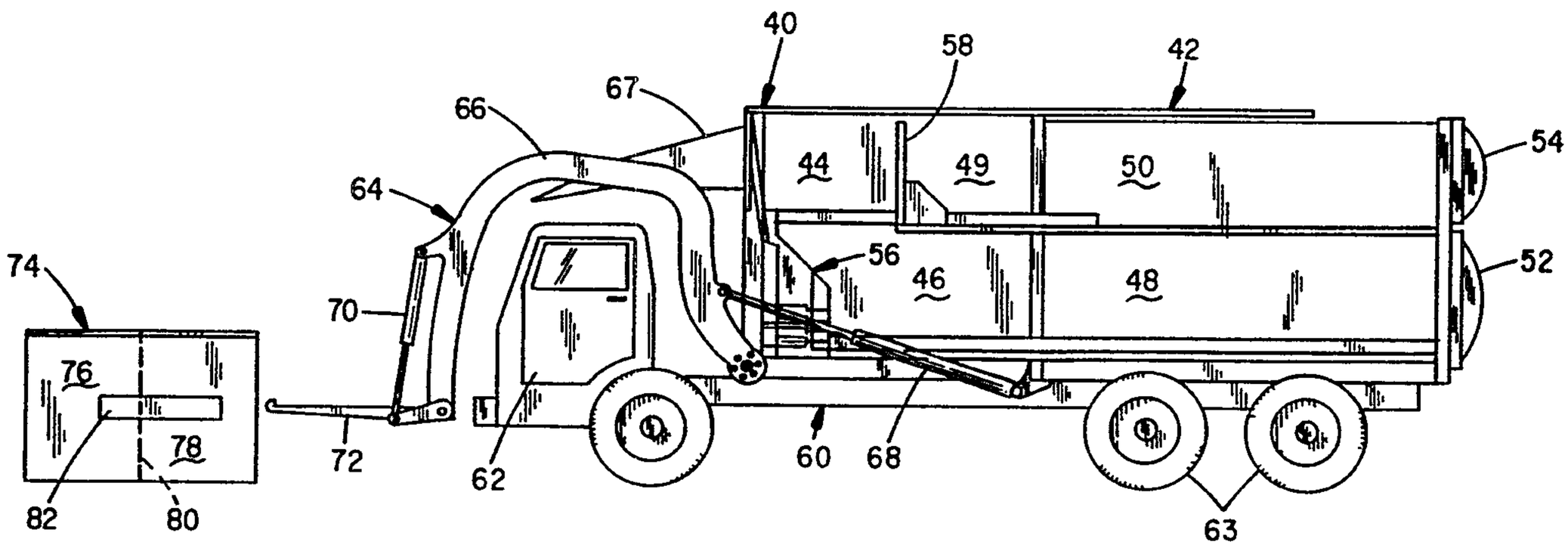
(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: CHRISTENSON, Ronald, E. [US/US]; Route 2, Box 87C, Parsons, TN 38363 (US).

(74) Agent: MERSEREAU, C., G.; Haugen and Nikolai, P.A., 820 International Centre, 900 Second Avenue South, Minneapolis, MN 55402-3325 (US).

(81) Designated States: AU, CA, NZ, US, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
With amended claims.

(54) Title: MULTIPLE COMPARTMENT BODY FOR WASTE MATERIALS



(57) Abstract

A multi-compartment removable vehicle body (620) for collecting, packing, hauling and unloading refuse material including recyclable materials is disclosed, including a truck body enclosing a material-receiving volume which includes a horizontal wall (116) within the volume which divides the volume into separate upper and lower storage body compartments (624, 625). A longitudinally-spaced loading opening at the top of the body contains separate openings (44, 49) being in continuous communication each with one of the separate compartments. Preferably, non-recyclable refuse is stored in the lower compartment. The truck body includes a primary compacting system (92) associated with one of said compartments for compacting non-recyclable materials and an auxiliary compacting system (88) linked to the primary compacting system for compacting recyclable materials. The auxiliary compacting system includes a device (108) for limiting the force of compaction against the recyclable material such that it will not exceed a predetermined maximum regardless of the force applied to the non-recyclable refuse material. Embodiments of up to six separate longitudinal compartments are illustrated.

* (Referred to in PCT Gazette No. 55/1996, Section II)

69841-40

MULTIPLE COMPARTMENT BODY FOR WASTE MATERIALS

BACKGROUND OF THE INVENTION

I. Field of the Invention

The present invention relates generally to vehicles for collecting, packing, hauling and unloading refuse materials including recyclable materials; more particularly, the invention is directed to refuse vehicles wherein the refuse hold or body is removable and divided into a plurality of separate dedicated compartments capable of coordinated operation in handling a plurality of recyclable and waste materials.

II. Related Art

The business of collecting, hauling and disposing of waste products is becoming increasingly complex. This includes a proliferation of the types of materials collected for recycling in addition to refuse collected for landfill disposal. It is preferable that recyclable materials be sorted or separated at the point of origin and for that separation to be continued through the collection process. To this end, many specialty vehicles have been provided with a plurality of separated volumes or compartments each dedicated to the accumulation of a specific species of recyclable material; for example, glass, aluminum, plastic and paper might each occupy one of four compartments in such a truck body. Such a vehicle, while ideal from the standpoint of maintaining integrity of the load of recyclables, represents a relatively inefficient collection system as it requires point of origin separation of all recyclables and necessitates a separate vehicle dedicated to address non-recyclable waste materials.

Truck-type vehicles generally include a heavily constructed structural chassis frame which provides the cab and the truck body support structure and includes the

engine, drive train and associated hydraulic systems and/or other power take-off mechanisms. The chassis are generally combined with a permanently mounted single-function body. Thus, a chassis designed to support a permanently attached delivery box, dump body or other special-function device such as a refuse compaction body is limited to that function once assembled. Even where the single function is all that is desired, such as with the collection and transport of refuse, much of the working time of the vehicle is spent traveling to and from landfills to empty full containers.

Common types of refuse trucks include front-end loading and side loading embodiments in which the refuse is compacted rearward and removed and discharged through a rear access. The front-end loading version is particularly adapted to pick-up and dump large commercial refuse containers or storage bins in which the filled container is addressed at the front of the truck, picked up by a pair of side mounted lifting arms and fork arms which engage the container to raise it above the storage body of the refuse truck and invert it to dump its contents into a top opening in a truck body just behind the cab. The sequence is then reversed and the empty refuse container is returned to the ground. The material received from the storage container is then compacted through the rearward movement of a compaction panel within the storage body. In the receiving position, the compaction panel is positioned forward of the top opening and after the refuse is received in the body, the panel is advanced rearward to propel and compact the refuse into a rear storage section and against a heavy tailgate which is hinged to the storage body to close a rear discharge opening. After the rearward movement of the compaction panel to pack the refuse, the panel is again moved forward and positioned to address and compact new refuse.

In this manner, the rear portion of the storage container eventually becomes completely filled with

compacted refuse. At this point, the truck containing the filled refuse container must be driven to a landfill or other point of discharge which may be many miles away to be unloaded before it can be returned to service to pick up additional refuse. The time required for driving to and from the loading and the unloading site, of course, is wasted or "down" time with respect to collecting refuse.

The refuse truck represents or illustrates one type of specialty-use vehicle which could be utilized much more efficiently and effectively were the time directed to transporting and unloading the refuse reduced during collection hours. If the traditional dedicated permanently fixed refuse receiving and compacting truck body could be replaced by an easily exchangeable truck body temporarily connected to the truck chassis for refuse collection such that each filled container could be disconnected quickly, left at a convenient location and replaced by an empty container, the truck could be kept in service virtually the entire usable refuse collecting time and the efficiency of the collection operation could be greatly enhanced.

Other vehicles have been proposed that assimilate refuse materials in a smaller number of compartments which allow for a commingled or partially commingled condition respecting recyclable materials. Horning et al, in U.S. Patent 5 316 430, disclose a recycle hauling apparatus including a truck body divided into two separate compartments by a horizontal wall mounted within the truck body of the side-loading hauler. Openings for loading the upper and lower compartments are provided in a fore and aft arrangement in the front portion of the refuse body. The body is designed to accept paper recyclables fore and commingled glass, aluminum and plastic materials aft. The forward opening is in continuous communication with the lower compartment only and the aft opening is in continuous communication with the upper compartment only. Separate doors close the rear of each compartment with the door closing the upper compartment being spaced rearward of the

door closing the lower compartment and extending over the entire rear of the truck body such that material filling the upper compartment spills down and occupies space behind the lower compartment prior to discharge. Another device is described in Horning et al U.S. Patent 5 316 430 which may utilize a movable dividing wall or panel between upper and lower compartments.

Truck bodies having side-to-side separation rather than upper and lower and which can be manufactured as either front loading or side loading vehicles are depicted in Patents 5 303 841; 5 205 698; and 5 035 563, 5 163 805 to Mezey. The Mezey references illustrate a front loading, multi-compartment refuse vehicle with side-by-side compartments in conjunction with a corresponding side-by-side compartmentalized container. Such a side-by-side configuration, while convenient for loading, may lead to serious load imbalance and vehicle stabilization problems if the heavier, compacted waste materials are concentrated on one side of the truck body. Other multiple compartment bodies are shown in U.S. Patents 5 122 025; 5 094 582 and 5 078 567.

Methods and devices have been proposed for interchanging various truck body configurations on a single chassis. In this manner, it has been suggested, for example, to exchange such diverse configurations as a dump body, tank body and stake body on a single chassis to transform a single-use vehicle to a multi-use device. Devices designed to allow quick release coupling of interchangeable bodies which may be the same body design include devices such as that illustrated and described by Williams in U.S. Patent 4 456 414, which uses a system in which a plurality of interlocking hooks and tabs provided on a chassis and the truck body are engaged by moving the truck body horizontally along on the chassis using external means. A latch pin, or the like, prevents dislodgement of the body from the chassis once in place. While this system does provide for a quick-releasable positive hold-down for

the truck body, no mechanized means are provided on the truck itself to accomplish the latching and unlatching, which must depend on means external to the truck.

Other devices accomplish latching and unlatching using tilt mechanisms and other systems which require the truck to be addressed by large external devices to move the vehicle body relative to the chassis. None of the prior devices provides a simple chassis-mounted, self-contained automated system capable of exchanging truck bodies on a chassis.

There remains a need, however, for a removable multi-compartment truck body apparatus which can accommodate segregated or commingled recyclables with or without separated non-recycled waste materials in a front or side loading truck body which compensates for the inability of formed glass articles to withstand the high compressive forces normally associated with the compaction if disposable refuse even though the glass be commingled with other recyclable materials such as aluminum and plastic containers. There is also a need for a removable multi-compartment truck body of the front-loading type which is configured to accomplish top and bottom separation in the manner of separating recyclable materials or recyclable and non-recyclable materials. There is also a need to provide a removable multi-compartment truck body including provision for the compaction of both disposable and recyclable materials which can accomplish this utilizing a single direct powered packing mechanism. This needs to be accomplished while minimizing the breakage of glass and formation of gluts of compacted materials such as aluminum cans in the body of the removable compartmentalized collection vehicle such that emptying of the vehicle becomes difficult.

Accordingly, it is a primary object of the invention to provide a collection vehicle having a removable multi-compartment body that improves the collection and hauling

of mixed (compactable/non-compactable) loads, particularly loads with commingled recyclables.

SUMMARY OF THE INVENTION

The present invention provides a multi-compartment apparatus for collecting, packing, hauling, and unloading a plurality of types of material, comprising: (a) a truck body mountable to a chassis of a vehicle, wherein the truck body includes at least first and second material-receiving compartments; (b) a charging hopper attached to said vehicle, said charging hopper including a plurality of openings each opening being in continuous communication with a corresponding material-receiving compartment of said truck body; (c) a primary compactor contained within said charging hopper for compacting materials into said first material-receiving compartment; (d) an auxiliary compactor contained within said charging hopper mechanically linked to said primary compactor for compacting materials into said second material-receiving compartment; and (e) force limiting system associated with said auxiliary compactor capable of limiting the compaction force exerted by said auxiliary compactor to an amount less than that of said primary compactor.

The disclosed system for compacting mixed loads including non-compactable recyclables in a removable compartmentalized body of a collection vehicle provides for variation in compaction forces between compactable rubbish and recyclables and non-compactable recylables that minimizes glass breakage and glut formation. The system can be operated by a single ram system.

The removable compartmentalized body of the collection vehicle can be either a front loading system or a

side loading system. The number of compartments and the compacting systems can be tailored to the desired end use.

The compacting force of an auxiliary ramming system can be tailored to the particular material being compacted and need not be that of a main driving ram. The invention contemplates the concept of an independent exchangeable multi-compartment container or truck body itself, which may or may not have independent means of support but which, in any event, is a separate exchangeable module and which may be designed for receiving and discharging refuse of several types, for example.

In the illustrated embodiment, a mechanized sub-frame is attached to the chassis of the collection vehicle and is capable of both tilting and lifting the container or removable body in a mechanical sequence that can be used to unload the contents of the truck body by tilting and also remove or mount the truck body using the same sub-frame system to accomplish all the necessary motions. This embodiment avoids cylinders or guiding devices mounted on the outside surfaces of the truck chassis frame. The sub-frame further provides continuous support for the removable body along its entire length when the body is lifted or lowered and the need for discrete alignment and lifting mechanisms is eliminated.

The container or truck body may be provided with independent means of support deployable with the truck body or container in the lifted position. For example, pivotal, removable or telescoping legs attached thereto, optionally with feet, may be deployed on either side of the container

allowing the lifting devices to be retracted leaving the container independently supported and enabling the chassis to move away from under the container.

A filled refuse body containing refuse, recyclable or both, for example, can be dropped at a convenient location and later reloaded onto the same or possibly a different chassis for removal to a remote landfill, or other place of load disposal, or loaded onto a different type of vehicle, possibly one designed for carrying a plurality of such

containers to be emptied. A separate trailer may be also provided to transport a second replaceable truck body behind the mounted one. Also, a dumping arrangement may be integrally provided to tilt truck bodies for emptying. The self-contained vehicle mounted system and subframe for handling the exchange, positioning, lifting and tilting of truck bodies to be carried by a vehicle chassis and variations thereof are discussed in greater detail in U.S. Patent No. 5,725,350 filed December 28, 1995 and assigned to the same assigns as the present application.

In accordance with the invention, any number of compartments may be used, fed by as many or fewer primary compaction systems. For example a primary refuse or highly compactable recyclable compacting panel system may be linked to another upper recyclable compacting panel system as by a follower system to operate in another compartment. This is useful for a truck body having a single upper and a single lower compartment or in a truck body having a plurality of upper and/or lower compartments separated by telescoping divider panels or walls connected with the relevant compacting panel. While not preferred, it is understood that the auxiliary system can occupy the lower, and the primary system, the upper section or sections of the truck.

In this manner, one or more high pressure main or primary compaction systems for compacting disposable refuse may be linked to corresponding auxiliary or compliant compacting systems for compacting segregated or mixed recyclables. The linkage between a primary and an auxiliary compacting system preferably provides for a force application differential such that while full compaction force is applied to the disposable refuse, the force applied

to recyclables such as glass is limited. This is accomplished by a spring biased telescoping tube linkage in one embodiment. In another embodiment, a compliant fluid

cylinder system operates a telescoping tube linkage. A hydraulic system that allows pressure relief and yet allows for anti-cavitation protection for the compliant cylinders is also provided. In still another embodiment, the force application differential is accomplished by providing a spring biased plunger engaged within a detent socket formed in the auxilliary compacting system, whereby a predetermined forces overcomes and disengages the plunger.

An embodiment is shown in which a direct linkage is used for a situation in which lower force from the auxiliary compaction system is not necessary. Embodiments are also illustrated for from two to six compartments and from one to three main compaction systems, it being understood that any number can be used. The multi-compartmental vehicle body of the invention may be incorporated into either a front loading or a side loading vehicle. It should be understood that any compatible method of loading can be combined with the multi-compartmental vehicle body, as the method of loading is not critical.

BRIEF DESCRIPTION OF THE DRAWINGS

In these drawings, where like numerals are utilized to designate like parts throughout the same:

FIGURE 1 is a side view of a compartmented collection vehicle of the front loading variety addressing a divided container to be lifted;

FIGURE 2 depicts an enlarged partial view of the truck body of the vehicle of Figure 1 with a divided container in the dump position;

FIGURE 3 is an enlarged end sectional view of the refuse vehicle body of Figure 2 taken substantially along lines 3--3 of Figure 2;

FIGURE 4 is an enlarged sectional end view of the refuse truck body of Figure 2 taken substantially along lines 4--4 in Figure 2;

FIGURE 5 is a greatly enlarged fragmentary cross-sectional view of a compliant linkage associated with an

auxiliary compacting mechanism taken substantially along lines 5--5 of Figure 2;

FIGURE 6 is a side view of a multi-compartment removable body collection vehicle of the front loading variety;

FIGURE 7 is a perspective view partially in phantom and with broken parts of an embodiment of a mechanized removable body subframe and truck chassis frame system;

FIGURE 8 is an enlarged fragmentary perspective view of the front portion of Figure 7;

FIGURE 9 is an enlarged fragmentary perspective view of the body/subframe locking pin area of the system of Figure 7;

FIGURE 10 is an enlarged fragmentary perspective view of the body positioning pawl system area of Figure 7;

FIGURE 11 is an enlarged fragmentary perspective view of the rear portion of Figure 7;

FIGURE 12 is a fragmentary side view of the pawl system shown in conjunction with corresponding cooperating devices on the lower surface of a truck body;

FIGURE 13 is a side view of a multi-compartment removable body collection vehicle, wherein the removable body is horizontally moved to its aft position;

FIGURE 14 is an enlarged partial view of the multi-compartment truck body as depicted in Figure 13;

FIGURE 15 is an enlarged partial view of the multi-compartment removable truck body, wherein the removable body is raised and moved horizontally to its aft position;

FIGURE 16 is an enlarged partial view of the multi-compartment removable truck body, wherein the removable body is detached and elevated above the truck frame, and supported by its own supports;

FIGURE 17 is an enlarged partial view of the multi-compartment removable truck body removed from the truck frame and elevated above the ground by supports;

FIGURE 18 is an enlarged partial view of the multi-compartment removable truck body, wherein the removable body is shown tilted in its dumping position;

FIGURE 19 is a simplified schematic side view (details omitted), showing the subframe of Figure 7 in the lowered, fully rearward position;

FIGURE 20 shows the system Figure 19, with the subframe in the raised, level position;

FIGURE 21 depicts Figure 19 with the subframe in the lowered and fully tilted position;

FIGURE 22 is an enlarged fragmentary side view, with side panels removed, of the forward portion or loading hopper area of a compartmentalized collector truck body having upper and lower compaction panels connected by a solid linkage in a fully retracted position;

FIGURE 23 is a view of the solid linkage embodiment of Figure 22 with both compactor panels in their fully extended position;

FIGURE 24 is a view similar to Figure 22 depicting a compliant spring linkage between the compaction panels with both compaction panels shown in their fully retracted position;

FIGURE 25 is a view similar to that of Figure 24 with both compaction panels extended;

FIGURE 26 is a view similar to that of Figure 24 with the lower compaction panel fully extended and the upper compaction panel partially extended due to force limitation;

FIGURE 27 is a view similar to Figure 22 utilizing a collapsible compliant hydraulic cylinder linkage between the compaction panels with both compaction panels in the fully retracted position;

FIGURE 28 is a view similar to that of Figure 27 with both compaction panels in their extended position;

FIGURE 29 is a view of the system of Figure 28 in which the lower compaction panel is fully extended and the

upper compaction panel partially extended due to force limitations;

FIGURE 30 is an enlarged fragmentary side elevational view of an alternate embodiment of an upper compaction panel and compliant linkage;

FIGURE 31 is an enlarged fragmentary partial sectional back view of the upper compaction panel of Figure 30 with the compliant linkage engaged;

FIGURE 32 is an enlarged fragmentary partial sectional front view of a compliant linkage and plunger of the type shown in Figure 30;

FIGURE 33 is an enlarged fragmentary partial sectional top plan view of the compliant linkage and plunger of the type shown in Figure 30;

FIGURE 34 is an enlarged fragmentary partial sectional top plan view of the packing ram system partially extended and showing the plunger of the upper compaction panel engaged with the compliant linkage;

FIGURE 35 is an enlarged fragmentary partial sectional top plan view of the packing ram system partially extended and showing the plunger of the upper compaction panel disengaged from the compliant linkage;

FIGURE 36 is an enlarged fragmentary partial sectional top plan view of the packing ram system fully extended and showing the plunger of the upper compaction panel disengaged from the fully collapsedor retracted compliant linkage;

FIGURE 37 is a side view similar to Figure 24 of a three-compartment body with a divided upper compartment utilizing a compliant spring upper panel compaction system and a telescoping divider panel;

FIGURE 38 is a sectional view substantially along lines 38--38 of Figure 37 showing the three compartments;

FIGURE 39 is a sectional view of the three-compartment body with divided upper compartments taken substantially along lines 39--39 of Figure 37;

FIGURE 40 is a side view with outer panels removed, of a four-compartment (two upper, two lower) compartmentalized collection vehicle body;

FIGURE 41 is a sectional view substantially along lines 41--41 of Figure 40 showing dual side-by-side compacting panel systems;

FIGURE 42 is a sectional view taken substantially along lines 42--42 of Figure 40;

FIGURE 43 is a side view similar to Figure 37 of a four-compartment collection vehicle body with three upper compartments;

FIGURE 44 is a sectional view taken substantially at 44--44 of Figure 43;

FIGURE 45 is a side view with side panels removed of a five-compartment collection vehicle body having three upper and two lower compartments;

FIGURE 46 is a sectional view taken substantially at 46--46 of Figure 45 with a single lower and linked upper compaction mechanism with two upper telescoping dividers and one lower telescoping divider;

FIGURE 47 is a sectional view similar to Figure 46 showing a six-compartment body with three lower and three linked upper compaction mechanisms;

FIGURE 48 is a schematic view of a hydraulic system for one embodiment of a compliant hydraulic cylinder concept; and

FIGURE 49 depicts an enlarged partial view of a side loading truck body with a divided container in the dump position.

DETAILED DESCRIPTION

The removable, compartmented collection vehicle body system or design of the invention is generally applicable to rearward compacting (front and side loading) refuse vehicles and is characterized by a continuous, permanent, horizontal divider separating one or more upper from one or more lower horizontal compartments with the number and location of the compartments being variable and possibly

commensurate with locations of the loads in separated boxes to be dumped into segregated or separated load hoppers. The lower storage body includes one or more fluid-operated rams or compaction panels dedicated to high force compaction of non-recyclable waste materials. The lower compaction systems operate auxiliary upper ram devices which are mechanically linked. Compressive forces exerted by the upper or linked auxiliary compacting devices can be adjusted in any of several ways to compensate for the requirement to avoid breakage of recyclable glass materials, and to prevent blockage or gluts of compacted plastic or aluminum which make it difficult to unload the affected truck body compartment.

It will be appreciated that the vehicle mounted multi-compartment truck body handling apparatus of the invention represents a system that can be entirely self-contained with respect to a vehicle chassis. Thus, the entire exchange operation including receiving, engaging, locking and releasing of truck bodies, can be accomplished utilizing the invention in conjunction with self-supporting truck bodies without the need for any external means. It is further contemplated that the invention has broad application and will readily adapt to a variety of chassis/truck body or container applications.

In accordance with the drawings, several embodiments will now be described in detail. Figure 1 depicts the side view of a front loading refuse hauling vehicle, generally at 40, with the sides removed to show the interior details. The refuse hauling body includes a refuse receiving area which is a chamber generally divided into a forward section 44 which connects with a lower loading hopper 46 and a lower storage body 48. An upper loading hopper 49 has a receiving opening rearward of the lower loading hopper 46 and connected to an upper storage body 50. Lower storage body 48 and upper storage body 50 are provided, respectively, with top hinged arcuate tailgates 52 and 54. These tailgates are designed to absorb the forces of

compaction and maintain a pressurized load when closed. They swing open to allow discharge of the refuse in the corresponding storage body. Each of the loading hoppers is provided with packing ram mechanism including a lower panel, generally at 56, and an upper panel, generally at 58. The body 42 is attached to a frame or chassis 60 which also carries a cab section 62 and wheels 63. A lift and dump mechanism, shown generally at 64, is provided to empty refuse containers into the receiving hoppers 44 and 49. The truck is shown about to address a refuse/recycle box 74 separated into a forward compartment 76 and rear compartment 78 by a vertical wall 80. The lift and dump mechanism contains identical devices addressing either side of the vehicle, one side being depicted in Figure 1 including a heavy lift arm 66 which operate outside cab protector 67, lift and dump hydraulic cylinders 68 and 70 and lifting fork 72. Lift handles designed to be addressed by the forks 72 are shown at 82.

Figure 2 depicts a slightly enlarged version of the truck body 42 of Figure 1 in side view with the divided refuse box 74 raised above the loading hoppers by the lifting forks 72 received in the handling pockets 82 in a well-known manner. Two separate covers 84 and 85 used to cover the forward and rearward portions of the divided container 74 open on either side of panel 86 to assure proper separation of the discharging materials between the upper and lower loading hoppers. Of course the top cover (not shown) is in the open position. Pictured also are an upper compaction panel 88 which rides in an upper guide track 90 and a lower compaction panel 92 which rides in a corresponding lower guide track 94 as will be described.

Figure 3 depicts a sectional view along 3--3 of Figure 2 which view also depicts a truck windscreen 100 and the vehicle body top cover track is shown at 102, the top being in the opened position behind the line of the sectional view. In addition, upper hopper sides as at 104 and upper panel guide tracks 106 together with upper

compactor/lower compactor connecting link system (solid or compliant spring or hydraulic cylinder) is shown at 108. The lower panel supports are shown at 114 in track guides 94. The dividing panel between the upper and lower track body compartments, otherwise known as the upper loading hopper floor, is depicted at 116. The connecting link system 108 is connected with the lower panel mechanism with lower linking levers 118.

Figure 4 depicts a somewhat different end view, looking rearward from the upper and lower storage bodies behind the compaction mechanisms along lines 4—4 of Figure 2. This view shows the divider panel or upper loading hopper floor 116 as a permanently mounted structure spanning between the sides 104. The lower panel guide rails or guide tracks 94 are clearly shown as is the generally arcuate shape of the upper panel at 122. The upper and lower surfaces of the divider panel 116 have relatively smooth surfaces to reduce compacting friction.

Figure 5 is a sectional view taken along lines 5—5 of Figure 2 depicting a greatly enlarged view of a compliant linkage system which links the operation of the upper compaction panel to that of the lower, controlling compaction panel in accordance with the invention. The compliant linkage system includes a pair of identical systems each of which is situated within an upper panel guide rail 90 and includes an inner telescoping linkage tube 130 that floats inside of an outer telescoping linkage tube 132. A pivot pin 134 is connected through an opening in the inner telescopic linkage tube 130 and rides in a sleeve member 136 retained as by a cotter pin 138. The sleeve 136 is affixed to the inner lower linkage lever 118 so that the lower linkage lever connection is free to rotate about the

pivot pin 134 as it produces reciprocal motion of the pin 134 and the inner telescoping linkage tube 130. A panel operating means or forcing means 140 which may be in the form of an hydraulic cylinder 180 (Figure 28) or compliant spring linkage member 150 (Figure 24) has a forward end connected to the inner telescoping linkage tube 130 and an aft end connected to the outer telescoping linkage tube 132 in a manner that produces expansion or retraction of the telescopic tube system based on relative external/internal forces. The lower linkage lever connects to the lower compaction panel assembly as by being bolted at 142. Pairs of oppositely disposed wear liners or wear bars 144 and 146, respectively, attached to the upper compactor rail 90 and the outer wear bar 144 respectively, are provided to reduce wear on the rail and outer tube caused by repeated reciprocal motion of the outer tube 132.

Figure 6 depicts the side view of a front loading refuse hauling vehicle, similar to that shown in Figure 1 and having a removable multi-compartment truck body. Figures 7-12 depict the mechanical details of an exemplary subframe system for use in conjunction with a removable multi-compartment truck body, including the fastening, lifting and tilting systems. Other subframes may be used including those described in the aforementioned U.S. Patent No. 5,725,350. The subframe of Figures 7-12 features a sub-frame mounted on the chassis of a truck or trailer that positions an exchangeable truck body or modular container with respect to the sub-frame and chassis and tilts about a rear pivot. The system employs a cylinder-operated raising and pivoting system and truck body latching and locking system that does not require a cam arrangement.

69841-40

Figure 7 is a perspective view of a sub-frame in accordance with the embodiment, generally at 460 showing part of the truck chassis, generally at 462. The chassis position includes main spaced longitudinal chassis members 464 and 466 and respective rear side shapes 468 and 470 joined by upper cross brace 471 and lower cylinder supporting cross brace 472. A forward cylinder-supporting transverse or cross brace member is shown at 474. Other

structural and brace members have been omitted from the figure to maintain the clarity of other parts.

The sub-frame 460 includes a raisable front end and a pivoting rear end with limited raising characteristics. It is constructed using a pair of main spaced parallel longitudinal structural shaped members 476 and 478 joined by a series of spaced, transverse cross brace members or stiffeners as at 480, 482, 484, 486 and 488 (front-to-back) to form a rigid frame. The sub-frame and chassis further include a bi-directional ratcheting positioning system (best seen in Figures 10 and 12) and a lift and tilt system which includes a front raise and tilt-up system, best seen in the enlarged view of Figure 8, and a rear raise and pivot system best illustrated by Figure 11. These systems are fixed to, and operate with reference to, the truck chassis frame. As will also be described below, the sub-frame positioning system for moving a mounted body or modular container fore and aft is in the form of a sliding ratchet or double pawl assembly (detailed in Figure 10) and a body locking system is shown in the enlarged fragmentary view of Figure 9.

The truck frame or chassis system may also include a series of sub-frame guide plates mounted to the longitudinal chassis members as shown at 489 on member 464 to help center the sub-frame when it is lowered to contact the truck frame. Heavy truck chassis-mounted hold-down hooks or truck body locking hooks are also fastened to the members 464 and 466 as at 491 and 493.

As best seen in Figure 8, a pair of telescoping, fluid-operated cylinders shown by dashed lines at 490 and 492 are mounted between lower pivot joints along common transverse shaft 494 and a common upper cylinder pivot shaft 500. The shaft 494, in turn, is secured to truck frame structural cross member 474 as by journal mounting through spaced pairs of lug members 496 and 498. Upper pivot shaft 500 also carries a heavy truck body forward latch hook 502 of limited pivot travel biased in a raised

position by a compression spring 504 which operates against a stop at 506. The latch hook is one of two retaining a truck body when the sub-frame 460 is tilted. The latch hook 502 is depressed against the spring 504 when a truck body slides over it.

Figure 9 depicts a dual side pin locking mechanism for securing the truck body to the sub-frame in the case of a truck chassis-mounted sub-frame. It includes a double acting operating cylinder 510 with rod 511 that operates a pair of latch pins 512 and 514 in respective pin guide tubes 516 and 518 connected by a common central scissors-type over-center link system with members 520 and 521 shown held in the retracted position by retainers 522. The system locks over-center when the piston 511 of cylinder 510 is retracted and the locking pins extended so that loss of fluid pressure will not allow the pins to retract.

As one proceeds rearward along the sub-frame, details enlarged in Figure 10 are next encountered. This includes the system for shifting the position of a mounted truck body along the sub-frame. The system includes a sliding frame, generally at 528, having a pair of laterally spaced longitudinal side slide tube members 530 and 532 joined at their forward ends and intermediately by side tube crossed bracing members 534 and 536, respectively. Side members 530, 532 are configured to travel along and within structural members 476 and 478, respectively. Respective cross bracing members 534 and 536 are further adapted to carry a pair of oppositely disposed rear-facing and front-facing pawl members 538 and 540. The pawl member 538 is journal mounted to pivot vertically about a pin shaft 542 between gusset members 544 and 546 and is further biased in an upward direction by compression spring 548; likewise pawl 540 is vertically pivotally mounted on the pin 550 between gusset members 552 and 554 and biased upward by compression spring 556. A positive pawl stop 557 limits upward travel of pawl 540 while the upward travel of Pawl 538 is limited by cover plate 606 (Figure 12). Other cover

segments may be provided over the mechanisms with provision for pawls and hooks to protrude therethrough.

The frame 528 is reciprocally operated by a pair of double acting fluid (hydraulic) cylinders 558 and 560 mounted between sub-frame cross brace member 486 and intermediate sliding frame cross brace 536. As will be detailed below in conjunction with Figure 12, a series of pawl-receiving notches are located on the underside of a corresponding truck body or modular container which enable the system to "ratchet" the corresponding truck body forward or rearward to lock and unlock the truck body with respect to the truck frame. A rear latch hook similar to forward hook 502 is shown at 562, with a rotation stop member similar to 506 (Figure 8) shown at 563 (Figure 12), pivotally mounted on a pin shaft 564 between members 566 and 568 and biased upward by a spring 570. The biasing springs associated with all of the vertically pivoting latch hooks and pawls of course allow the truck body to slide over and depress these devices when moving away from an engaging direction.

The rearmost segment or portion of the sub-frame appears in the enlarged fragmentary view of Figure 11. This area houses the mechanism for raising the rear portion of the sub-frame with respect to the truck frame and also the pivot mechanism for tilting the sub-frame during refuse discharge. The system includes a truck chassis-mounted lifting pivot shaft 580 journalled in spaced chassis mounting housings, shown at 582 and 583, and a pivot link cross tube 584 connected by a pair of spaced parallel pivot link members 586 and 588 which are journalled on the chassis mounted pivot shaft 580 and are rigidly connected to cross tube 584. Pivot link cross tube 584 is journalled on a sub-frame tilt pivot shaft 587 which is journal mounted in sub-frame pivot housings 599 and 599a. The pivot link cross tube 584 is connected to the rods 589 and 591 of a pair of hydraulic cylinders 590 and 592 as by fixed lugs 594 and 596 and swivel joints 597 and 598,

respectively. The cylinders 590, 592 are also pivotally mounted at 593 and 595, respectively, and operate to raise and lower the rear portion of the sub-frame. The cylinders are allowed to collapse as the sub-frame pivots about the shaft 587 during tilting.

As best seen in Figure 12, the underside of a truck body designed for use with the sub-frame of the embodiment of Figures 7-12 includes several serial spaced notches 600 which cooperate in the nature of a rack during reciprocation of the spring biased pawl 540 to ratchet the truck body forward on the sub-frame. Reverse or rearward motion is accomplished using notch 602 in conjunction with pawl 538 as operated by the double-acting cylinders 558 and 560, discussed previously. Notch 604 is designed to engage rear safety hook 562 during tilt-up and a further forward notch (not shown) is provided to engage forward later hook 502. As previously indicated, cover plates or top plates as at 606 may be provided to protect the sub-frame mechanism from incursion of debris or the like with openings provided to accommodate pawls 538 and 540 and hooks as at 562 as needed.

A series of figures, Figures 13-18, depict the operation of the sub-frame of the embodiment of Figures 7 et seq. with a truck body in place. Referring again to Figure 6, the truck body, generally at 620, is shown in its fully forward and locked position on the sub-frame. Note that the upper and lower packing chutes 622 and 623 are received in the storage volumes 624 and 625 and is in position to transfer refuse. In this position, the truck body is locked directly to the truck chassis by heavy duty chassis hooks as at 491 and 493 which engage corresponding truck body hooks 619 and 621 respectively. Pairs of spaced support legs, two of which are shown at 626 and 628, are depicted in the raised or stowed position. Dual tailgates are shown at 630 and 631.

In Figures 13 and 14, the truck body has been displaced rearward, by shifting sliding frame 528 (Figure

10) rearward thereby engaging pawl 538 and unhooking the truck body 620 from the chassis hooks and positioning it for removal or tilting for discharge of contained materials. In this position pins 512, 514, align with side openings in the body (Figure 9) and can be extended to provide an additional safety locking mechanism to lock the forward portion of the truck body to the sub-frame 460 for tilting. In addition, fore and aft hooks 502 and 562 (Figure 7) engage the corresponding truck body notches as at 604 (Figure 12) to provide further stability for tilt-up.

Figure 15 shows the truck body lifted and poised above the truck frame. Pairs of spaced support legs, two of which are shown at 626 and 628, are depicted in their deployed and supporting position in Figures 16 and 17. Figure 18 depicts the system with the sub-frame fully tilted and the tailgates 630 and 631 fully opened as by cylinders 632 and 633 for gravity discharge of the contents.

The operation of the sub-frame itself is illustrated by the schematic or simplified side views of Figures 19-21. In Figure 19, the lift/tilt cylinders as at 490 and the pivot link cylinders as at 590 are retracted and the sub-frame is in the fully lowered position. Figure 20 shows these cylinders 490 partially extended and cylinders 590 fully extended to elevate the sub-frame to a raised, level position; and Figure 21 depicts the sub-frame in the fully tilted position with the tilt cylinders fully extended and the pivot link cylinders and the link fully collapsed. This aspect provides a lower center of gravity for the system during the dumping sequence. The relative position of truck wheels is also illustrated as at 610.

Figures 24-26 depict a side view of a linkage system such as that depicted in the cross-sectional view of Figure 5 in which the forcing means is a compliant spring 150 progressing from the retracted position (Figure 24) to a position where both compaction panels are fully extended (Figure 25), with Figure 26 depicting the situation in

which the lower compaction panel is fully extended and the upper compaction panel partially extended. The inner telescoping tube pivot connection or connecting link pin 134 connects the linkage lever 118 to the inner tube 130. The forward end of spring member 150 at 152 is fixed to the tube 130 such that reciprocation of the member 118 exerts forward and aft force on the end 152 of spring 150. The other or rearward directed end of spring 150, at 154, is attached to the outer tube member 132.

The lower compaction system includes a lower compaction panel 156 operated by one or more fluid cylinders 158. The compaction panel is typically operated by a pair or spaced cylinders operating in unison. These cause the reciprocal motion of the lower compaction panel 156 to compact the refuse entering the lower loading hopper rearward into the lower storage body.

The upper compaction panel 160 is connected to the outer tube 132 to move with the resiliently telescoping system including inner and outer tubes 130 and 132 with interconnecting spring 150. The outer tube 132 contains a stop member on its forward end which engages the end of the slot 148 (Figure 5) in the inner tube to limit the extension of the telescoping tube linkage and allow the spring 150 to be under partial compression or some desired pre-load.

As can be seen in Figure 24, when the lower compaction panel 156 is retracted, the tube linkage is at its maximum length with the spring fully extended to pull the upper compaction panel forward into its retracted position. In Figure 25, the load in the upper compartment is not exerting sufficient forward pressure to compress the spring beyond its pre-loaded position and the tube linkage remains at its maximum length forcing the upper compaction panel to its further extended position when the lower panel is fully extended as by telescoping cylinders 158.

Figure 26 depicts the system in the condition in which the upper compaction panel is extended against a fully

loaded upper storage compartment. Note that the spring 150 is compressed to a position in which the maximum desired force is exerted by the upper compaction panel against the load as determined by the force constant of the spring chosen for the application. If the lower storage body is not full, more material can be loaded and compacted without affecting the compaction of the upper load. In this manner, if the upper compaction panel is extended against a fully loaded upper storage compartment, the force is limited to a set value, with the spring collapsed and the telescoping tube linkage compressed. This allows the lower compaction panel to fully extend without placing additional compaction force onto the load in the upper compartment. This is one manner in which the compaction forces can be limited to a predetermined value in the upper storage compartments. This amount is normally determined by the allowable force to be exerted on commingled recyclables including shaped glass material such as bottles which lose a great deal of their value if broken.

Each of the compaction panels is provided with a follower panel. The lower follower panel 162 is pivotally connected by a roller 164 attached to an upper guide 166 and has its other end attached to a pivot system 168 attached to the rear of the lower compaction panel 156 so that the lower follower panel pivots as the lower compaction panel reciprocates to prevent material coming into the lower loading hopper from falling behind the lower compacting panel. Likewise, the upper compaction panel 160 is provided with a telescoping upper follower panel 170 which is pivotally connected by a roller 171 to upper follower guide member 172 which extends across the width of the upper storage body to a pivotal system 174 attached to the rear of the upper compactor panel 160. This, in like manner, prevents material from falling behind the upper compaction panel when same is extended.

Figures 22 and 23 depict a coordinated upper/lower compaction panel system similar to that depicted in Figures

24-26 except that the connection between the linkage lever 118 and the upper packer blade 160 is a single member 176 which provides a solid linkage such that the upper panel moves in unison with the lower panel in both directions. Figure 23, accordingly, illustrates the system of Figure 22 in the fully extended position which is similar to the system of Figures 24-26 in the unloaded condition. Note in Figure 26 the rather large amount of cushion space the spring 150 allows the recyclables in the upper storage body. The solid linkage embodiment is mechanically simple and virtually maintenance-free. In applications where breakage or glutting of the material is not a problem, this approach may be preferred.

Another embodiment of a coordinated packing system is illustrated by Figures 27-29 which employs a compliant fluid operated cylinder linkage 178 in place of the compliant spring 150 or direct linkage member 176 which includes a cylinder 180 having a cylinder end connected to the inner telescopic linkage tube 130 at 182 and a rod end 184 connected to the outer telescopic linkage tube 132. In Figure 27, the packer blades 156 and 160 are fully retracted and the hydraulic cylinder 180 is in its fully extended position, i.e. with rod 186 fully extended. It is the fully extended cylinder that pulls the outer telescoping linkage tube 132 and with it the upper compaction panel to assume a retracted position in which case, the lower compaction panel is fully retracted. It will be noted that the cylinder 180 is a cushioning or compliant hydraulic or pneumatic cylinder which operates in a passive rather than active manner with respect to the deployment of the packer panel 160.

In Figure 28, the lower ram fluid cylinders 158, and so the ram 156, is shown fully extended rearward so the

connecting linkage lever 118 along with the cylinder connection 182 are also at their fully rearward position with respect to the upper storage body. In the illustration of Figure 28, the upper compaction panel 160 is

not exerting sufficient force to collapse the hydraulic cylinder; therefore, it remains fully extended, thereby moving the upper compaction panel to its fully rearward extended position in coordination with the full extension of the lower compacting panel 156. In Figure 29, the effect of extending the upper compaction panel against a fully loaded upper storage compartment is illustrated. The force against the upper compaction panel 160 causes the rod 186 to collapse or retract into the cylinder 180 to thereby limit the travel of the compaction panel 160 against the load. The hydraulic or pneumatic cylinder 180, in this case acts like a cushion somewhat in the manner of the familiar door-closer cylinder which cushions closure. The force required to initiate the retraction of the cylinder can be set to any desired value such as that required to prevent damage to glass materials in commingled recyclables in the upper storage body 50. In this manner, the lower compaction panel 156 is allowed to extend to its fully extended position without forcing the connected upper compaction panel to exceed a desired maximum compression force.

Another embodiment of the coordinated packing system is illustrated by Figures 30-36. As seen in Figures 30 and 31, the ends of a transverse packer blade 710 are attached to flanking longitudinally disposed outer telescopic linkage tubes 712. An opening is provided in each of the outer tubes 712, allowing outwardly directed spring biased plunger members 714 to slide in and out of the opening. The outer tube 712 slides over an inner telescopic linkage tube 716 having a detent 718 formed in the side of the tube 716 which is aligned to slide past the plunger 714 (see Figure 33).

Figure 32 shows the outer and inner tubes 712 and 716 aligned, and having the plunger 714 aligned and engaged in the detent 718 and Figure 33 shows the plunger 714 disengaged. A spring 720 forces the plunger 714 into detent 718. The amount of force exerted by spring 720 is

adjustable by stop 722. In this manner, as the inner tube 716 is pushed forward by the compacting force of the lower packer panel, a force is applied against the angled edge of plunger 714. If this force is large enough to overcome the force exerted by spring 720, the plunger 714 is displaced from detent 718, thereby disengaging the upper packer panel 710 from the compliant linkage. Hence, the user adjusts the spring 720 depending upon the maximum packing force desired of the upper packing panel 710.

Figures 34-36 show the sequence of the inner tube moving aft, to the fully extended position. In Figure 34 the plunger 714 is engaged within detent 718. Figure 35 shows the plunger 714 disengaging from the detent 718 of the inner tube 716. Figure 36 shows the inner tube 716 in its fully collapsed or retracted position, having disengaged from the upper packer panel assembly.

Figure 37 depicts an open side view of a three compartment body in which the upper storage body is further divided into a pair of side-by-side upper compartments. This can best be appreciated in conjunction with the forward and aft directed sectional views of Figures 38 and 39. A telescoping divider wall or panel 190 divides the upper compartment into compartments 192 and 194 in conjunction with the operation of the compaction panel 160 and allows the single upper compaction panel 160 to provide compaction for two side-by-side compartments and maintain separation while, at the same time, allowing for fore and aft motion of the upper compaction panel 160.

Figures 40 and 41 depict a four compartment storage body in which lower compaction cylinders, one of which is shown at 200 in Figure 40 operate separate compaction panels as at 202 and 204 in Figure 41. Four linkages of the solid, spring (illustrated) or cylinder type connect two upper compaction panels 206 and 208 such that each upper compaction panel operates in conjunction with a corresponding lower compaction panel as described above. Figure 42 is a cross-sectional view taken substantially

along lines 42--42 of Figure 40 and illustrates the aft-oriented view beyond the reach of the upper compaction rails and showing the divided compartments including lower compartments 210 and 212 with their corresponding guide rails 214 and 215. Upper and lower divider panels 216 and 218 are permanently mounted in this embodiment between separate coordinated upper and lower compaction panel devices, as illustrated in Figure 41. In this manner, the upper left compaction panel 206 is linked with the lower left compaction panel 202 and, likewise, the upper right compaction panel 208 with the lower right compaction panel 204 in the manner previously described utilizing any of the linkage types desired. Figure 42 also depicts a top door cylinder 220.

Figures 43 and 44 depict a side view and forward directed sectional view, respectively, of alternate four-compartment storage body with three upper compartments. It will be noted that the pair of upper divider panels 230 and 234 telescope in the manner of the panel 190 described in conjunction with Figures 37-39, above. In this manner, a single full-width lower compaction panel system having a panel as at 158 and operated single upper compaction panel 160 enable a single upper compaction panel to address all three upper compartments utilizing any of the connection mechanisms previously herein described.

An embodiment that features a plurality of upper and lower storage body compartments is shown in Figures 45 and 46 which, like the multi-compartment embodiment of Figures 43 and 44 uses a single lower and upper compaction system. Figures 45 and 46 depict an arrangement of a five compartment body in which the upper storage body is divided as in Figure 44 into three substantially equal compartments 236, 238 and 240 by a pair of telescoping divider panels 230 and 234 attached to a single upper compaction panel 160. The lower storage body is also divided in two by a lower telescoping divider panel 242 which is operated by a single lower compaction panel 156.

An additional configuration is depicted in Figure 47 in which the upper storage body is divided into three longitudinal compartments 250, 252 and 254 and the lower storage body into three compartments 256, 258 and 260. The upper and lower bodies are separated by permanent horizontal panel 262 and, likewise, the upper and lower compartmentalized storage bodies may be separated by permanent panels 262, 264, 266 and 268. Pairs of coordinated upper and lower compaction panels as at 270/272, 274/276, and 278/280 are depicted which operate in coordinated fashion utilizing any of the linkage systems previously described.

A schematic diagram of a hydraulic system for a compliant hydraulic cylinder operation as with the embodiment of Figures 27-29 is shown in Figure 48. The system includes a reservoir 290 and a hydraulic pump 292, associated high pressure line 294, and a return line 296 connected to a four-way (four position) control valve 298. A pair of double acting lower compaction cylinders 300 and 302 are provided along with upper compaction cylinders 304 and 306 which are tapped into common rod port line 308 of the lower compaction cylinders 300 and 302. The system also contains a check valve 309 and relief valve 310 and bleed line 311 associated with the compliant operation of the upper compaction cylinders 304 and 306.

The system is operated utilizing a four-way valve 298 (three position) control. At the start of the compaction or power stroke, the lower compaction cylinders 300 and 302 are fully retracted and the upper cylinders 304 and 306 fully extended as shown in Figure 27 during the extension stroke, high pressure fluid is provided at the cylinder end ports 312 and 313 of cylinders 300 and 302 and is forced out of the rod end ports 314, 315 to return to the reservoir. This also allows fluid to drain through the relief valve 310 from the cylinder ends of the upper compaction cylinders 304 and 306 at ports 316 and 317 if the upper compactor panel meets with sufficient resistive

force to open the relief valve 310. In the retraction or return stroke of the lower compaction cylinders, the rod ports 314 and 315 of cylinders 300 and 302 are pressurized and the cylinder end ports 312 and 313 opened to the return line. Pressurization of the rod ports 314, 315 of the lower compaction cylinders also imparts a positive pressure through the upper circuit including check valve 309 to the cylinder ends at ports 316 and 317 and through direct connection to the rod ports 318 and 319 of the cylinders 304 and 306. This insures that as the lower cylinders retract, positive pressure is applied to both ends of the upper cylinders, thereby enabling them to extend while, at the same time, preventing vacuum cavitation from occurring in the upper cylinders as they extend during the retraction stroke. In this manner, the hydraulic system both allows for pressure relief, thereby limiting the force applied by the upper compaction panel, while also preventing cavitation during the extension in those cylinders.

Figure 49 depicts a side view of a side loading vehicle, generally at 320, with a side-loading lift and dump mechanism shown generally at 322 including a pair of lift arms 324 with lifting forks 326 inserted into a pair of lift handles 328 associated with a divided refuse box 330 with covers 332 and 334 covering separate compartments indicated by 336 and 338 to keep the dumped materials separate, i.e., fore and aft of panel 340. Upper and lower storage body compartments 342 and 344 connect with upper and lower loading hoppers 346 and 348, respectively. An upper (auxiliary) compaction panel 350 and lower compaction panel 352 are provided as in other embodiments. Separate access doors or tailgate closures 354 and 356 are also provided as is a cab protector hood 358. Those skilled in the art will appreciate that the multi-compartment bodies and compacting means described above and shown in Figures 1-4 and 37-49 may equally be adapted to a removable multi-compartment as detailed above.

The invention has been described herein in considerable detail in order to comply with the Patent Act and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use embodiments of the example as required. However, it is to be understood that the invention can be carried out by specifically different devices and that various modifications can be accomplished without departing from the scope of the invention itself.

What is claimed is:

69841-40

CLAIMS:

1. A multi-compartment apparatus for collecting, packing, hauling, and unloading a plurality of types of material, comprising:

(a) a truck body mountable to a chassis of a vehicle, wherein the truck body includes at least first and second material-receiving compartments;

(b) a charging hopper attached to said vehicle, said charging hopper including a plurality of openings each opening being in continuous communication with a corresponding material-receiving compartment of said truck body;

(c) a primary compactor contained within said charging hopper for compacting materials into said first material-receiving compartment;

(d) an auxiliary compactor contained within said charging hopper mechanically linked to said primary compactor for compacting materials into said second material-receiving compartment; and

(e) force limiting system associated with said auxiliary compactor capable of limiting the compaction force exerted by said auxiliary compactor to an amount less than that of said primary compactor.

2. An apparatus as in claim 1, wherein said force limiting system comprises a compliant spring-biased telescoping arrangement connected between said primary compactor and said auxiliary compactor.

3. An apparatus as in claim 1, wherein said force limiting system comprises a compliant fluid cylinder-biased

telescoping arrangement connected between said primary compactor and said auxiliary compactor.

4. An apparatus as in claim 1, wherein said force limiting system comprises an adjustable spring-biased plunger engagable within a detent socket of a compliant linkage which

links said primary and auxiliary compactor, whereby a predetermined force overcomes said spring bias and disengages said plunger.

5. An apparatus as in claim 1 wherein said truck body is removably mounted to said chassis.

6. An apparatus as in claim 5 further comprising:

(f) a sub-frame for carrying said truck body, said sub-frame being carried on said chassis;

(g) a sub-frame operating mechanism connected between said sub-frame and said chassis for manipulating said sub-frame relative to said chassis; and

(h) a truck body manipulation mechanism carried by said sub-frame for positioning said truck body along said chassis and said sub-frame.

7. An apparatus as in claim 1 wherein said material-receiving compartments are divided by one or more spaced substantially vertical panels.

8. An apparatus as in claim 1 wherein said material-receiving compartments are divided by one or more spaced substantially horizontal panels.

9. An apparatus as in claim 7 wherein said vertical panels are telescoping panels.

10. An apparatus as in claim 6 wherein said sub-frame operating mechanism includes a rear lift and pivot system having:

(1) a chassis mounted lift pivot shaft positioned in fixed relation to said chassis toward the rear thereof;

(2) a sub-frame mounted tilt pivot shaft in spaced parallel relation to said lift pivot shaft and positioned in fixed relation to said sub-frame;

(3) a plurality of spaced connecting link members connecting between said lift pivot shaft and said tilt pivot shaft;

(4) lift means for displacing said tilt pivot shaft vertically with respect to said lift pivot shaft for raising the rear portion of said sub-frame;

(5) lifting means for raising the front end of said sub-frame and pivoting the rear portion thereof about said tilt pivot shaft.

11. An apparatus as in claim 6 wherein said sub-frame operating mechanism further comprises means for locking said truck body to said sub-frame.

12. An apparatus as in claim 11 wherein said truck body manipulation mechanism further comprises a reciprocally operated pawl system for laterally displacing said truck body fore and aft relative to said sub-frame and wherein said sub-frame operating mechanism further comprises a device for raising and lowering said sub-frame relative to said chassis.

13. An apparatus as in claim 12 wherein said reciprocally operated pawl system comprises spaced oppositely directed pawls mounted on a longitudinally reciprocating frame slidably mounted in said sub-frame and powered by bidirectional linear actuating means.

14. An apparatus as in claim 6 wherein said truck body manipulation system includes positioning guide means for assuring proper positioning of said truck body on said sub-frame.

15. An apparatus as in claim 6, wherein said force limiting system comprises a compliant spring-biased telescoping arrangement connected between said primary compactor and said auxiliary compactor.

16. An apparatus as in claim 6, wherein said force limiting system comprises a compliant fluid cylinder-biased

telescoping arrangement connected between said primary compactor and said auxiliary compactor.

17. An apparatus as in claim 6, wherein said force limiting system comprises an adjustable spring biased plunger engagable within a detent socket of a compliant linkage which links said primary and auxiliary compactor, whereby a predetermined force overcomes said spring bias and disengages said plunger.

18. An apparatus as in claim 6, wherein said material-receiving compartments are divided by one or more spaced substantially vertical panels.

19. An apparatus as in claim 6, wherein said material-receiving compartments are divided by one or more spaced substantially horizontal panels.

20. An apparatus as in claim 18, wherein said vertical panels are telescoping panels.

21. An apparatus as in claim 6 wherein said truck body includes a self supporting means for supporting said truck body independent of a vehicle.

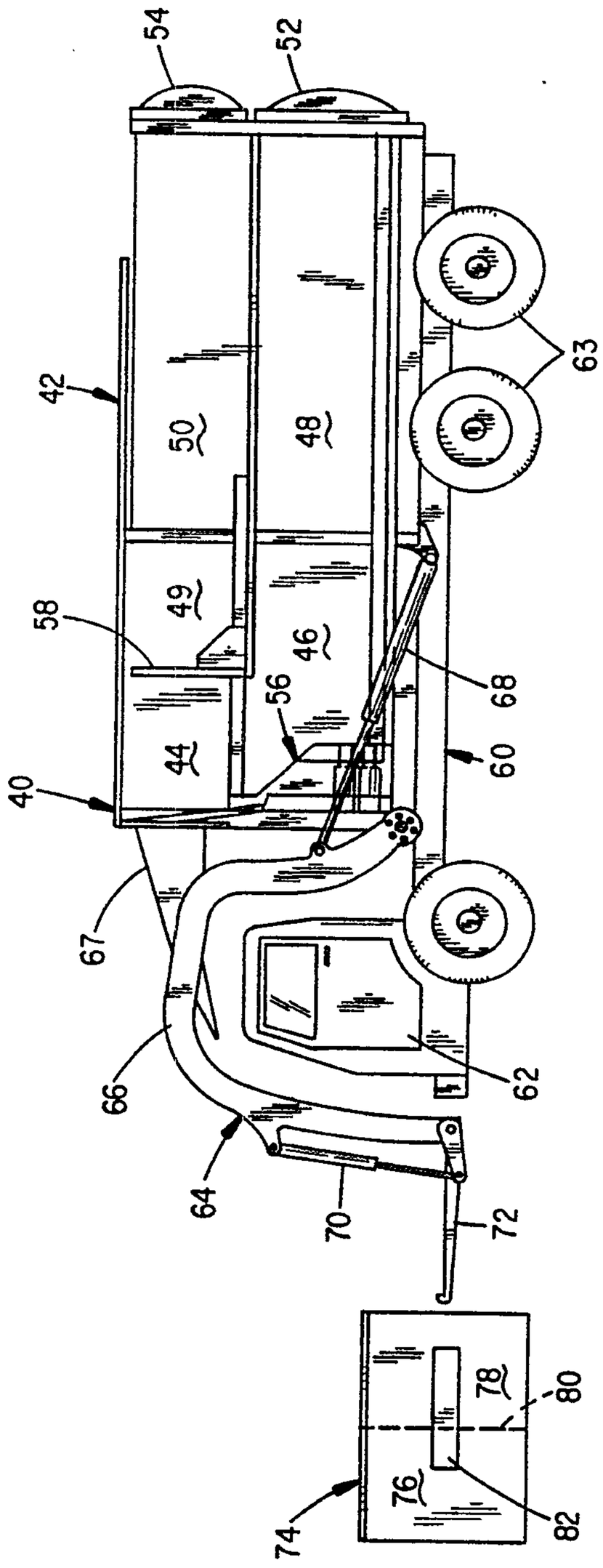

54
52
63
42
50
48
49
46
58
56
68
44
60
40
67
66
62
64
70
72
78
80
76
82
74

FIG. 1

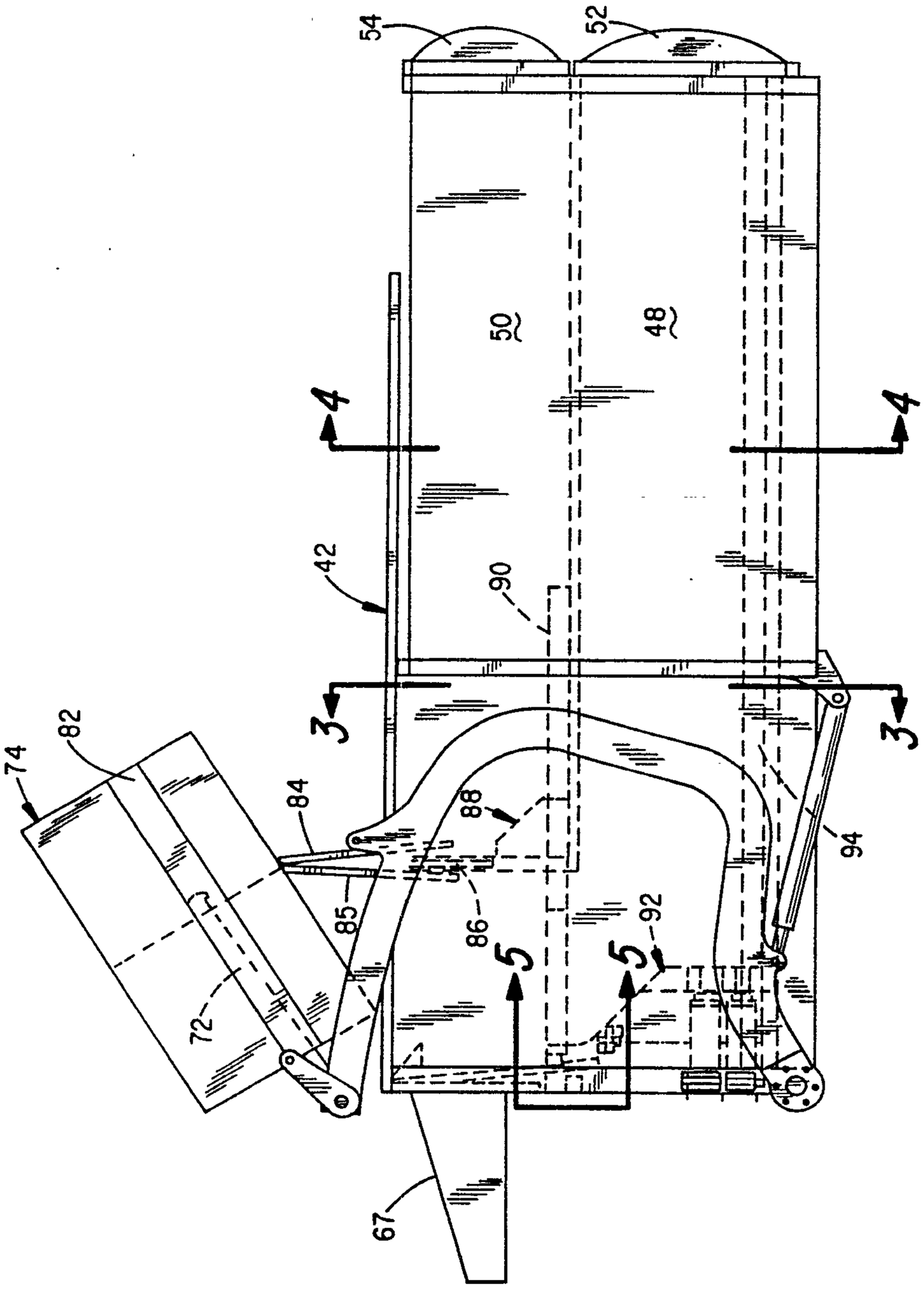


FIG. 2

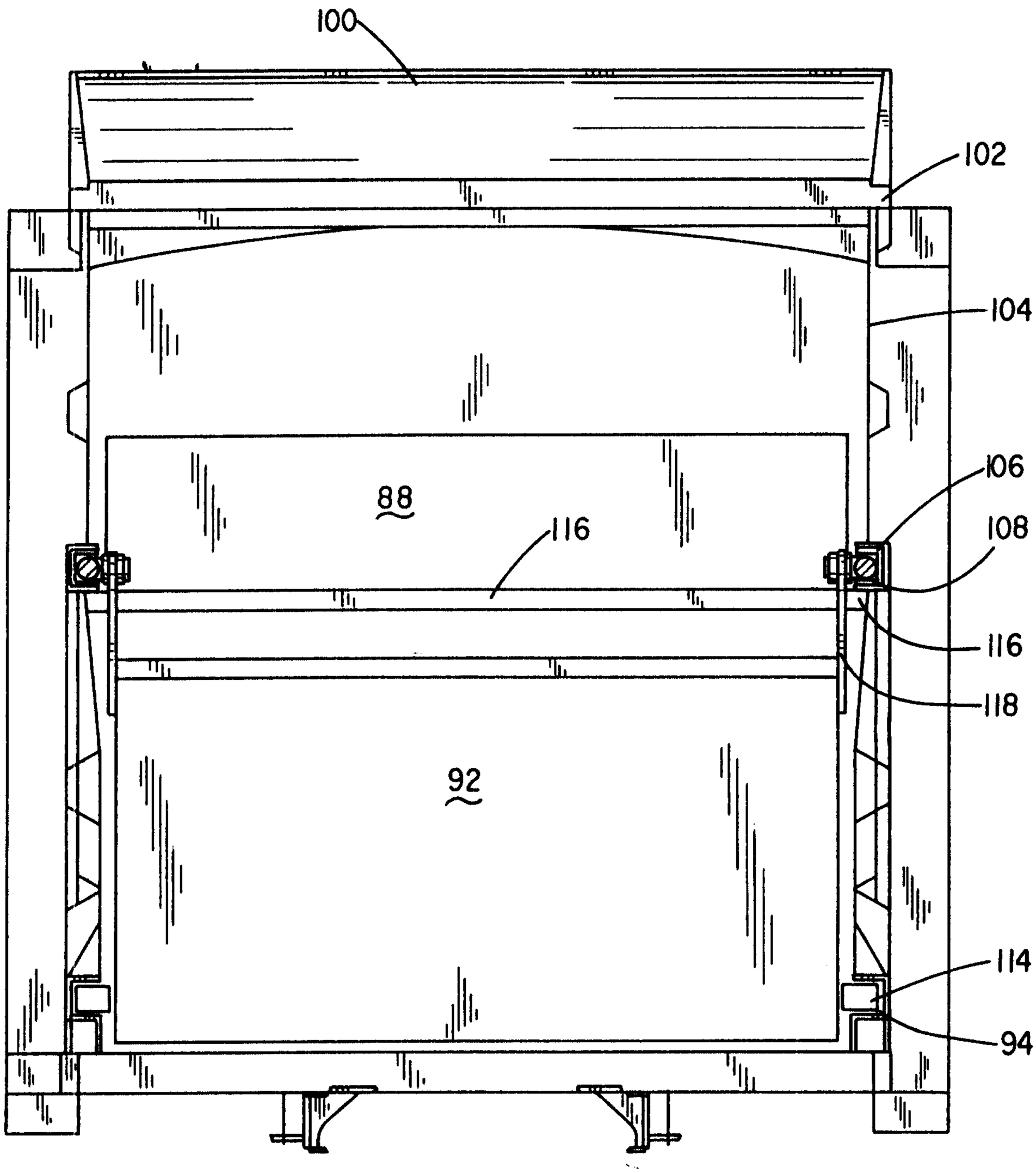


FIG. 3

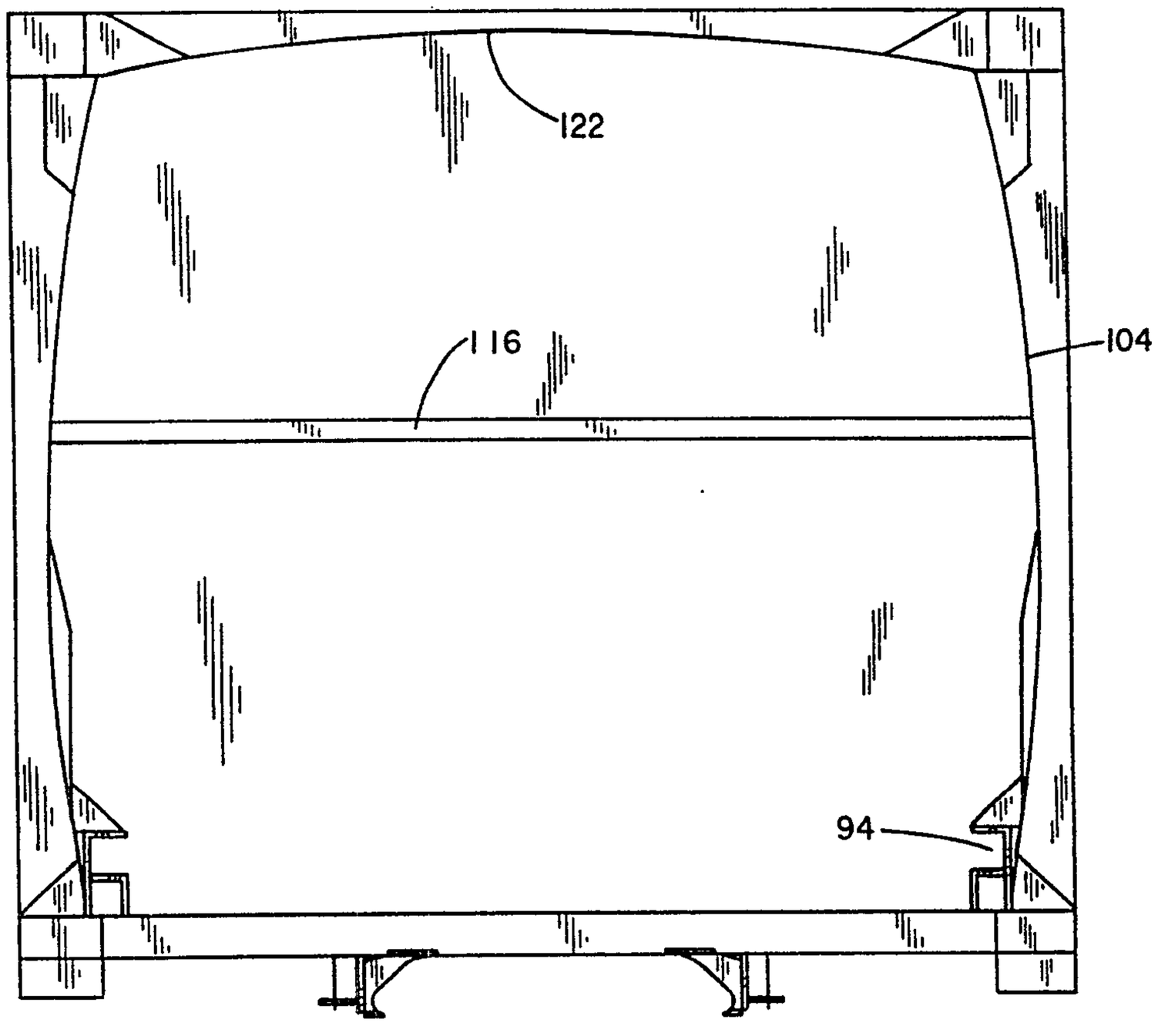


FIG. 4

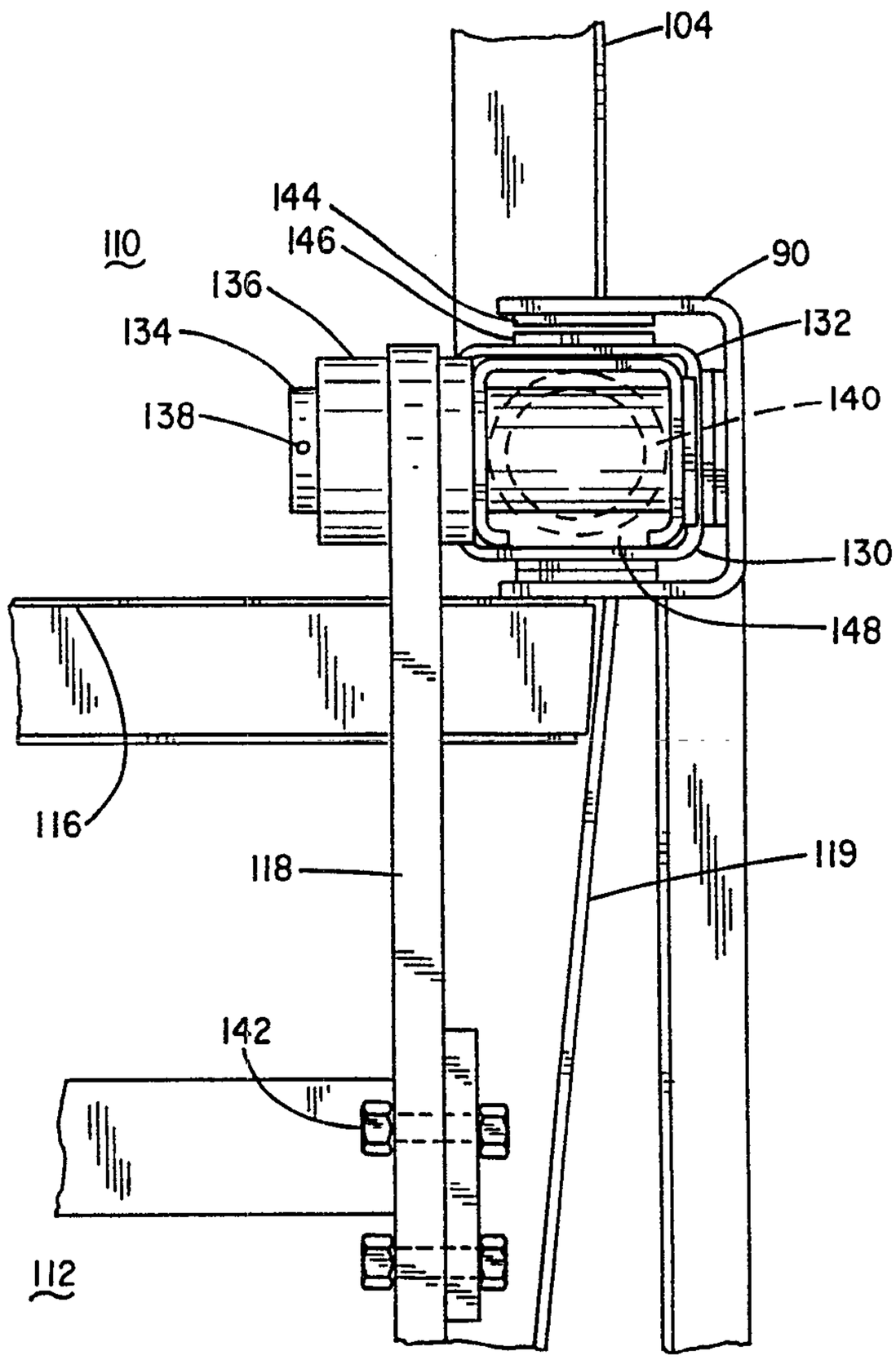

104
144
146
110
136
134
138
90
132
140
130
148
116
118
119
142
112

FIG. 5

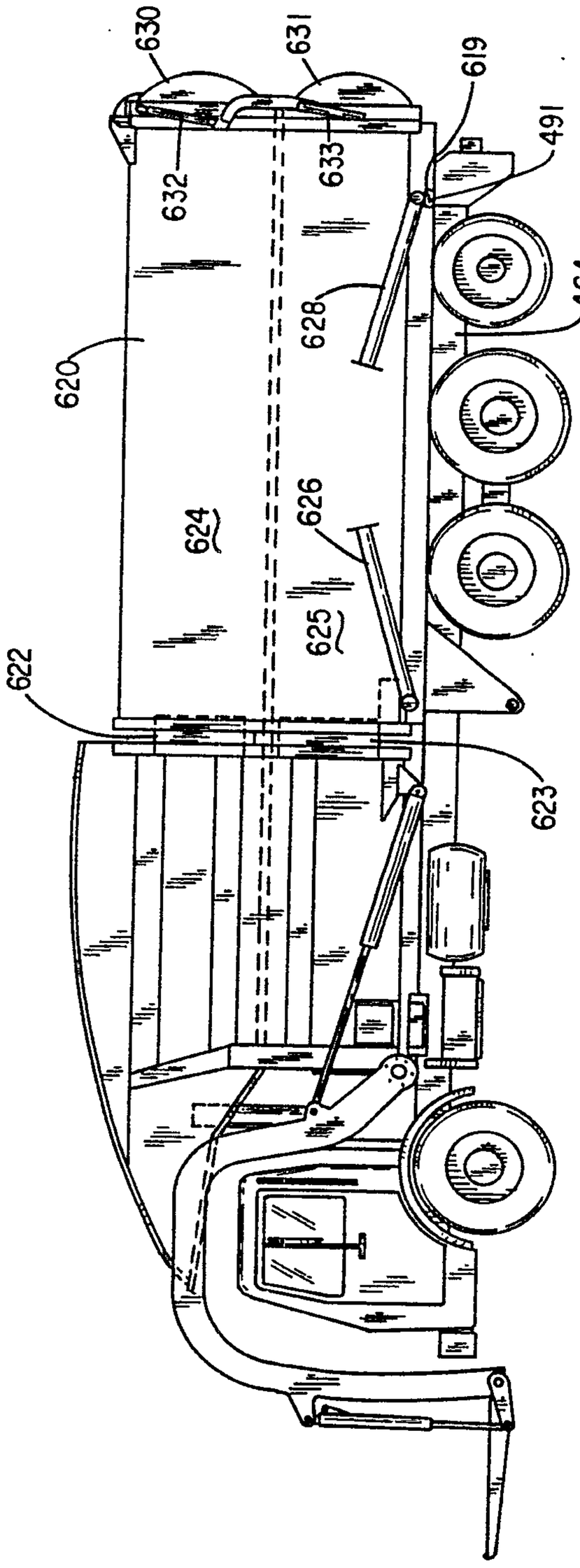


FIG. 6

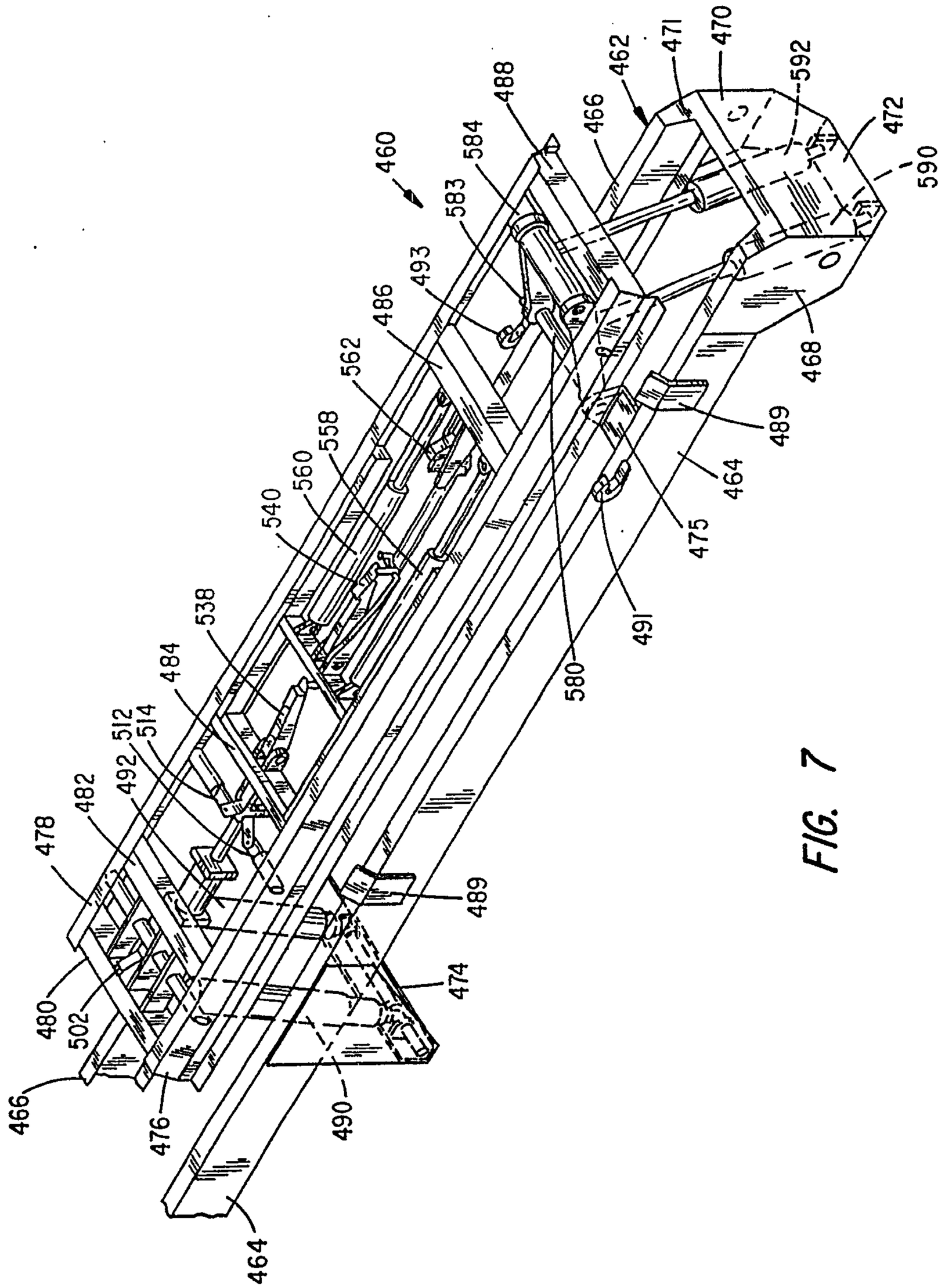

460
462
464
466
470
471
472
474
475
476
478
480
482
484
486
488
489
490
491
492
493
502
512
514
538
540
558
560
562
580
583
584
590
592
468

FIG. 7

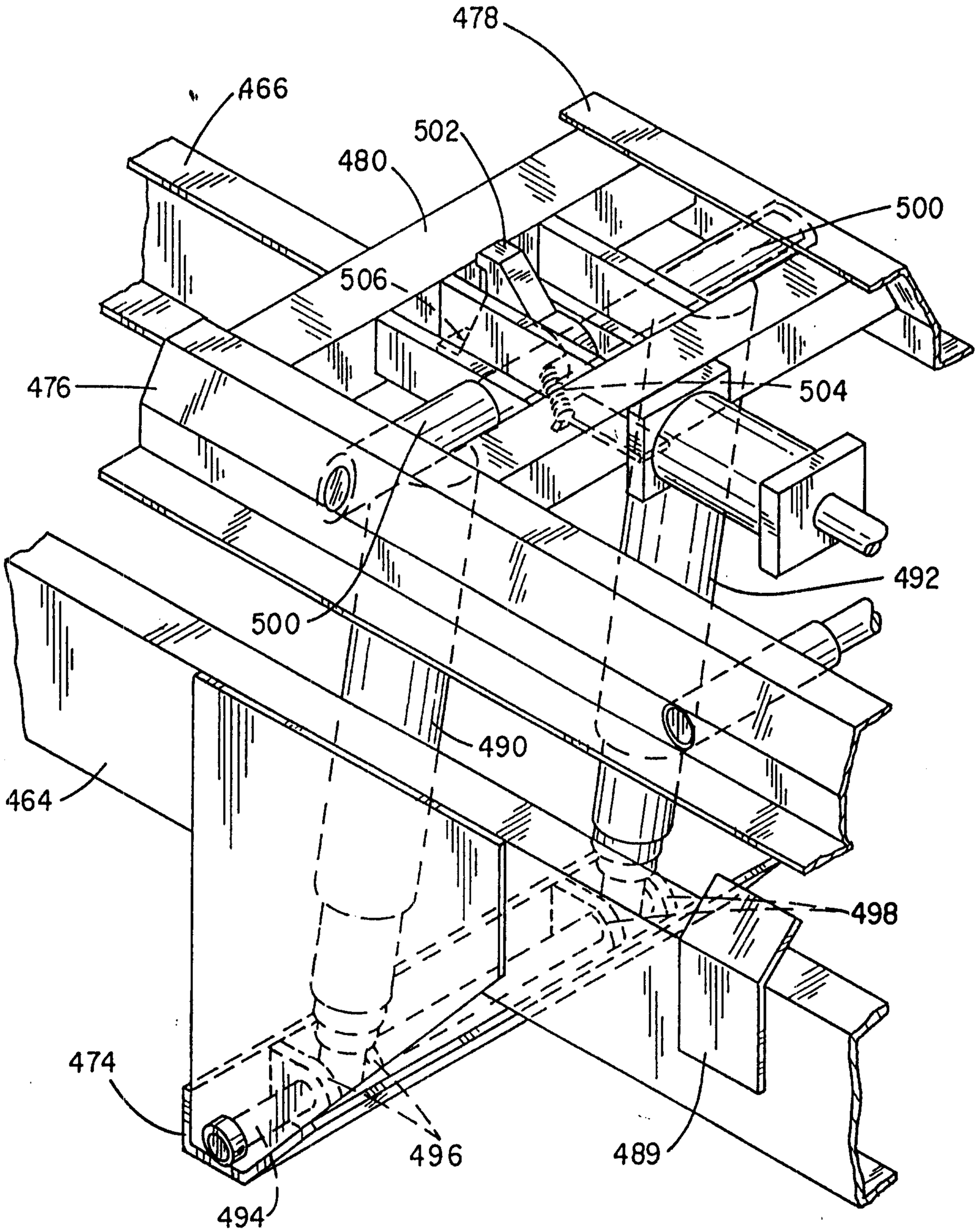

478
466
502
480
500
506
476
504
492
500
490
464
498
474
496
489
494

FIG. 8

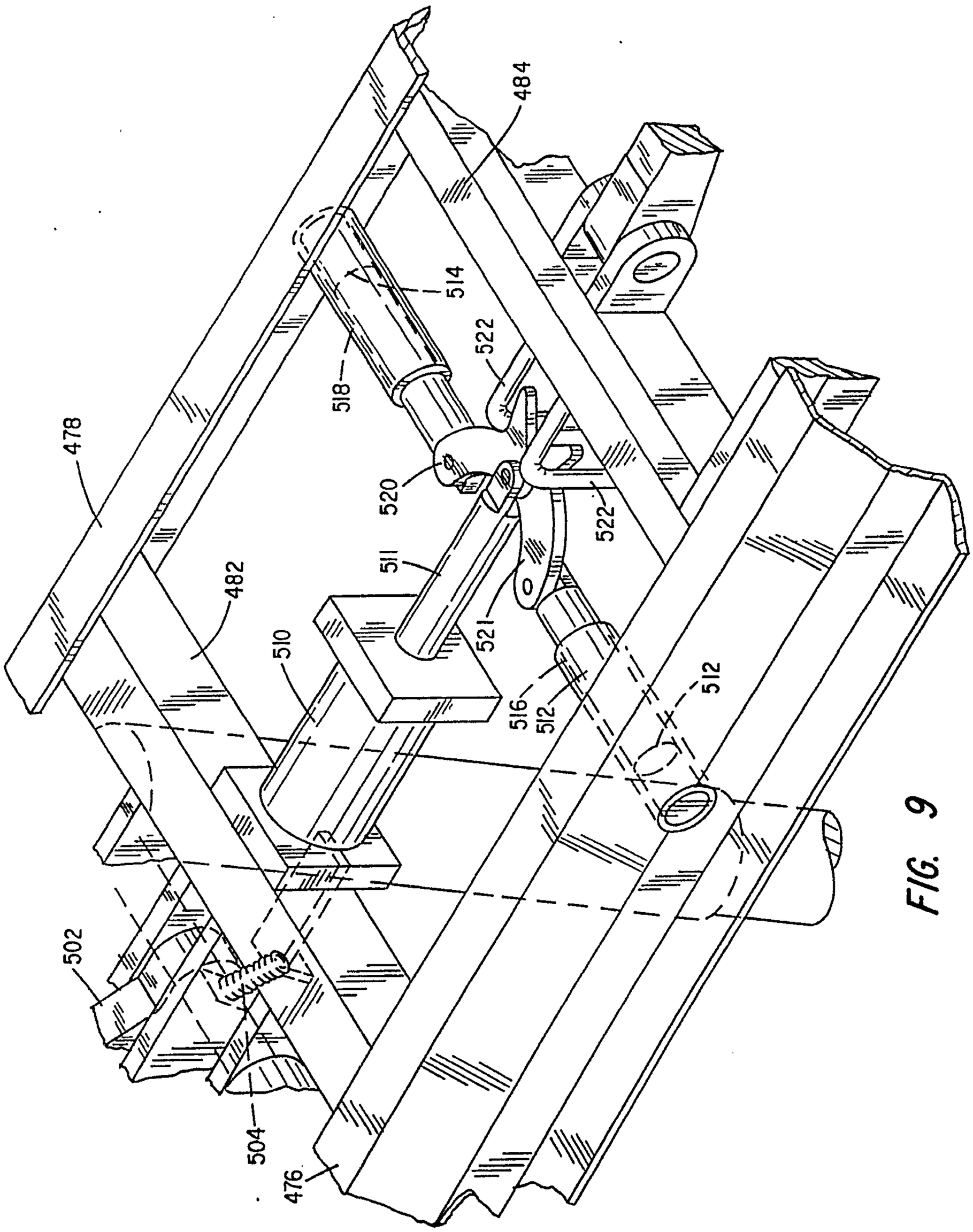

484
514
518
522
520
522
511
521
482
510
516
512
512
478
502
504
476

FIG. 9

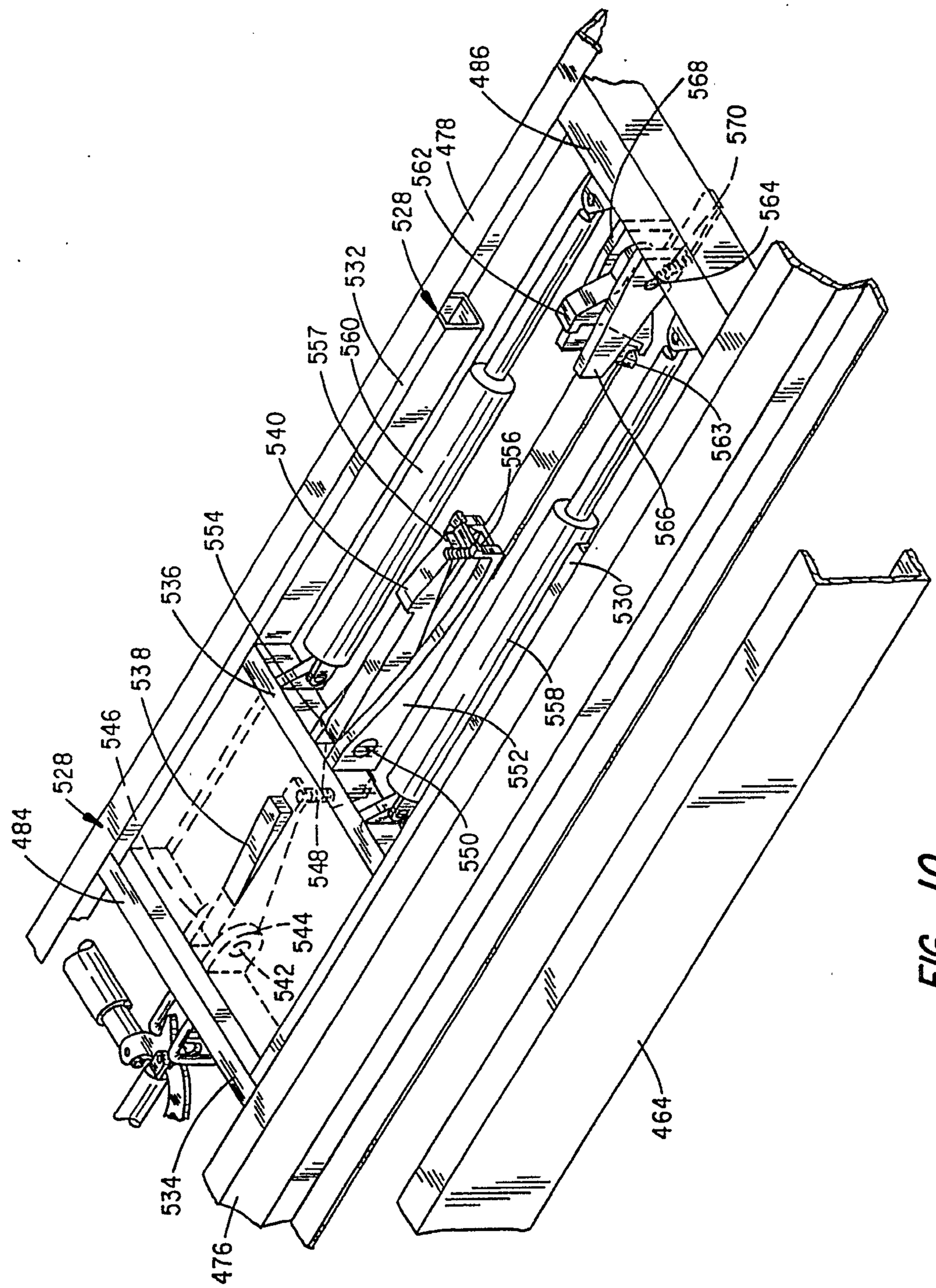

486
568
570
478
562
564
528
532
557
560
540
556
563
566
554
536
530
538
546
528
558
552
484
550
548
544
542
534
476
464

FIG. 10

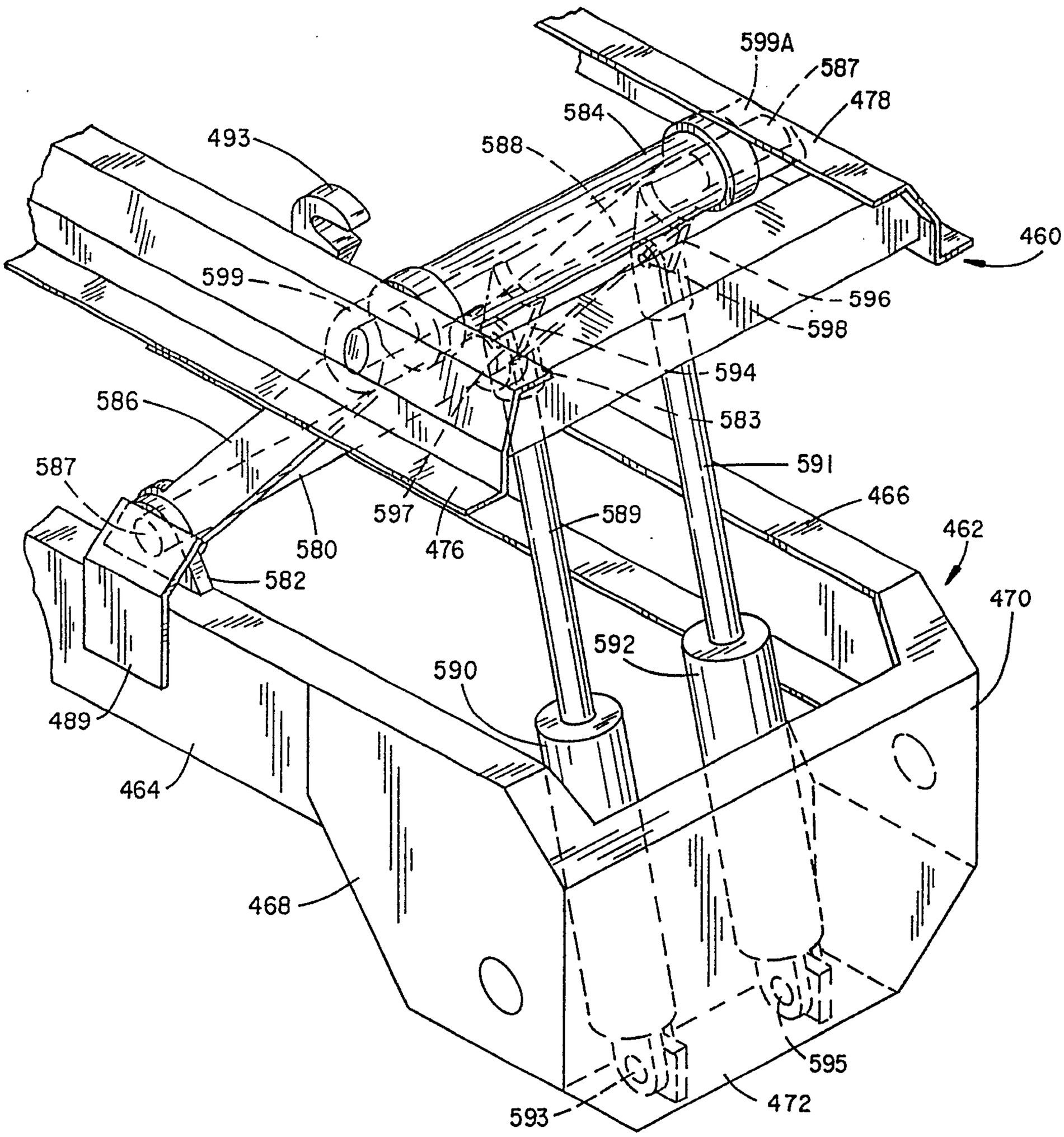

599A
587
478
584
588
493
460
599
596
598
594
586
583
591
587
597
589
466
462
580
476
582
470
592
590
489
464
468
595
472
593

FIG. 11

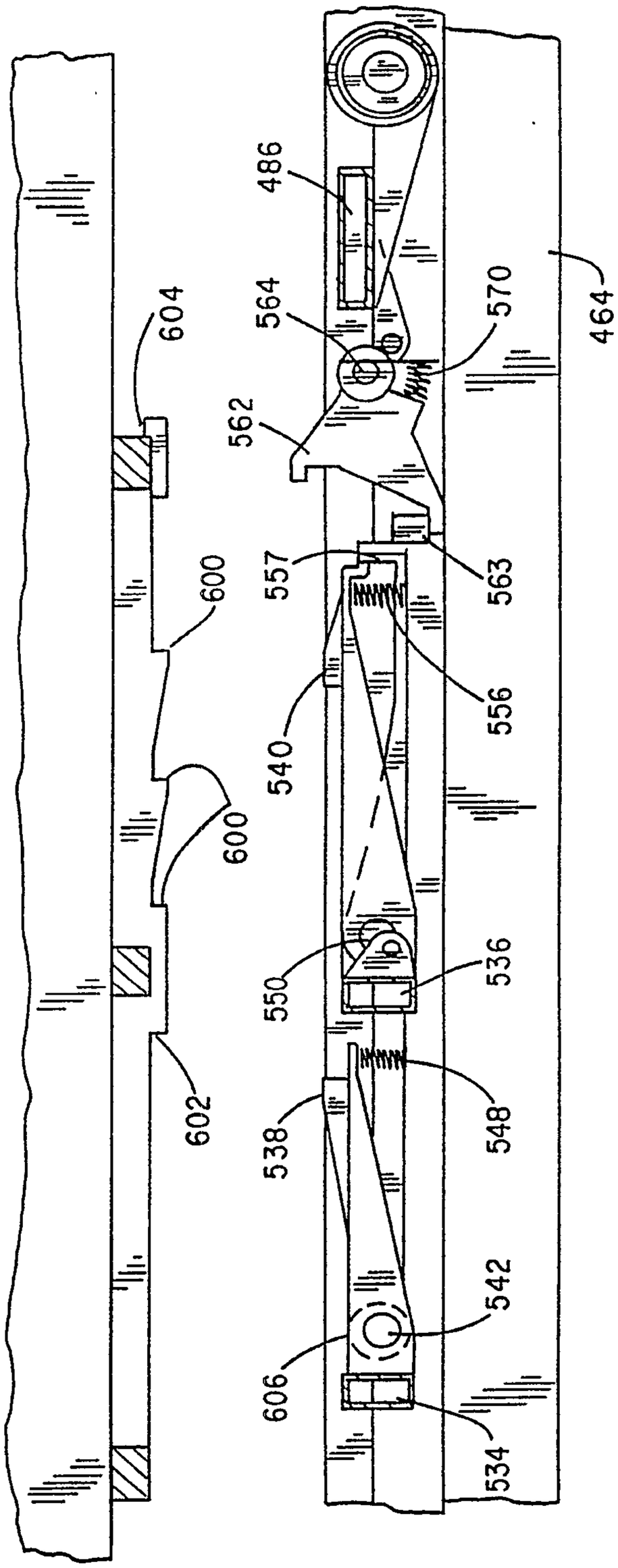

620
604
600
600
602
606
486
564
562
557
540
550
538
542
534
570
563
556
536
548
464

FIG. 12

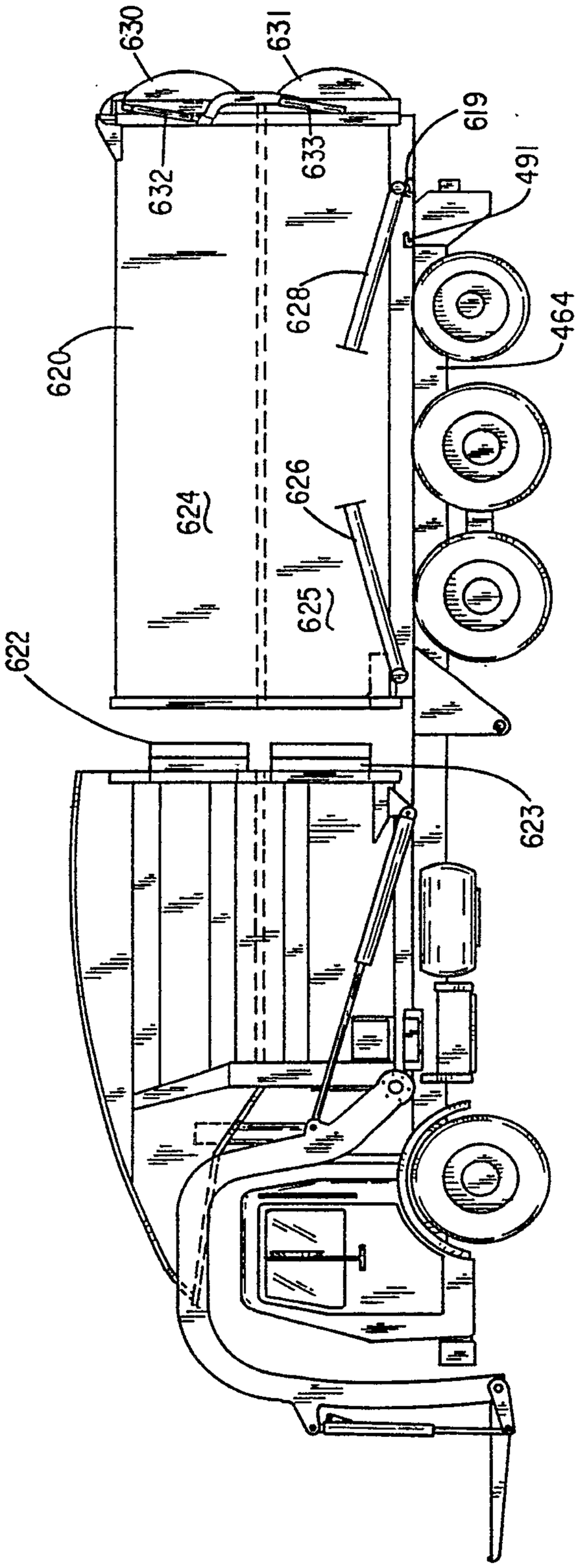


FIG. 13

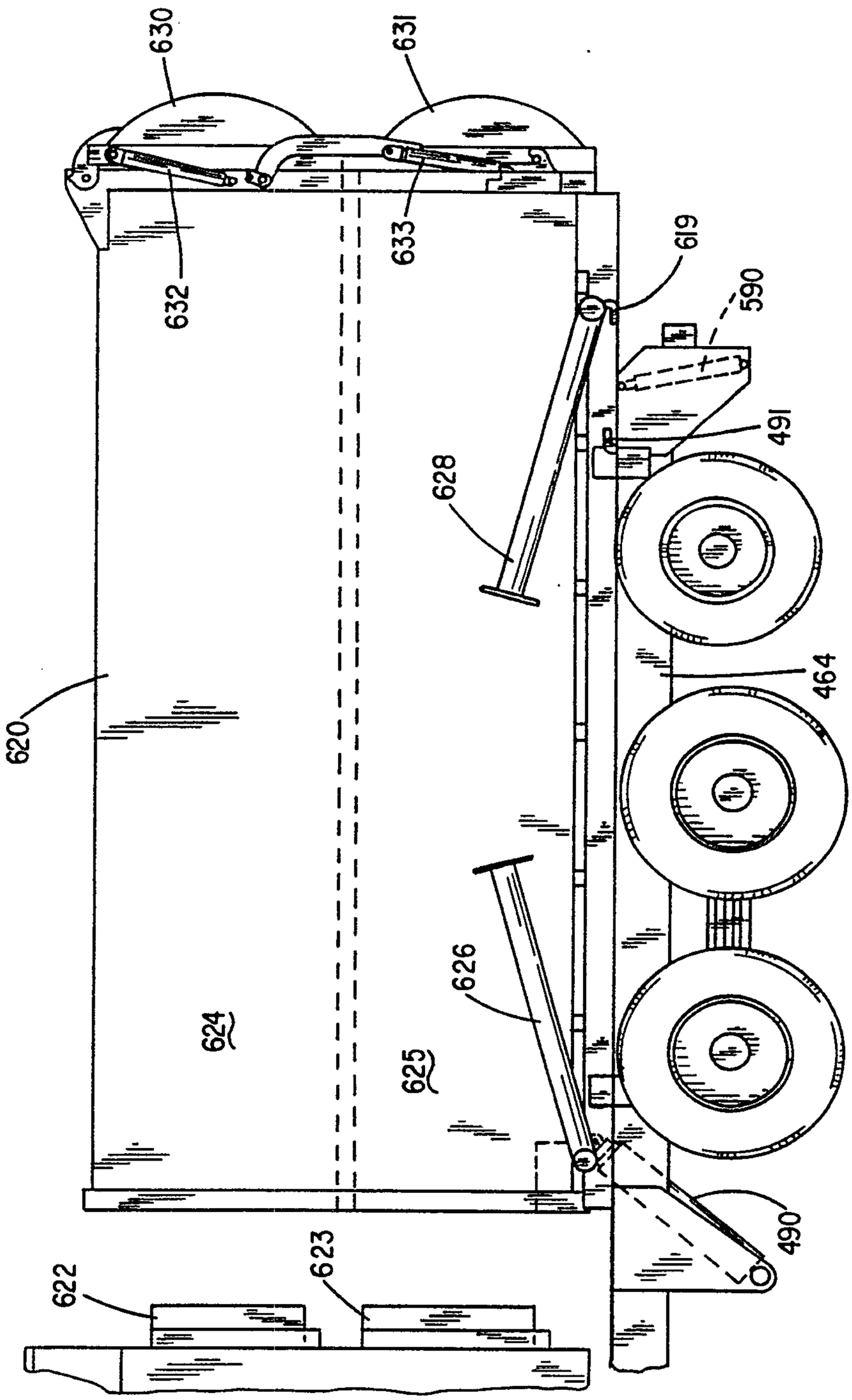


FIG. 14

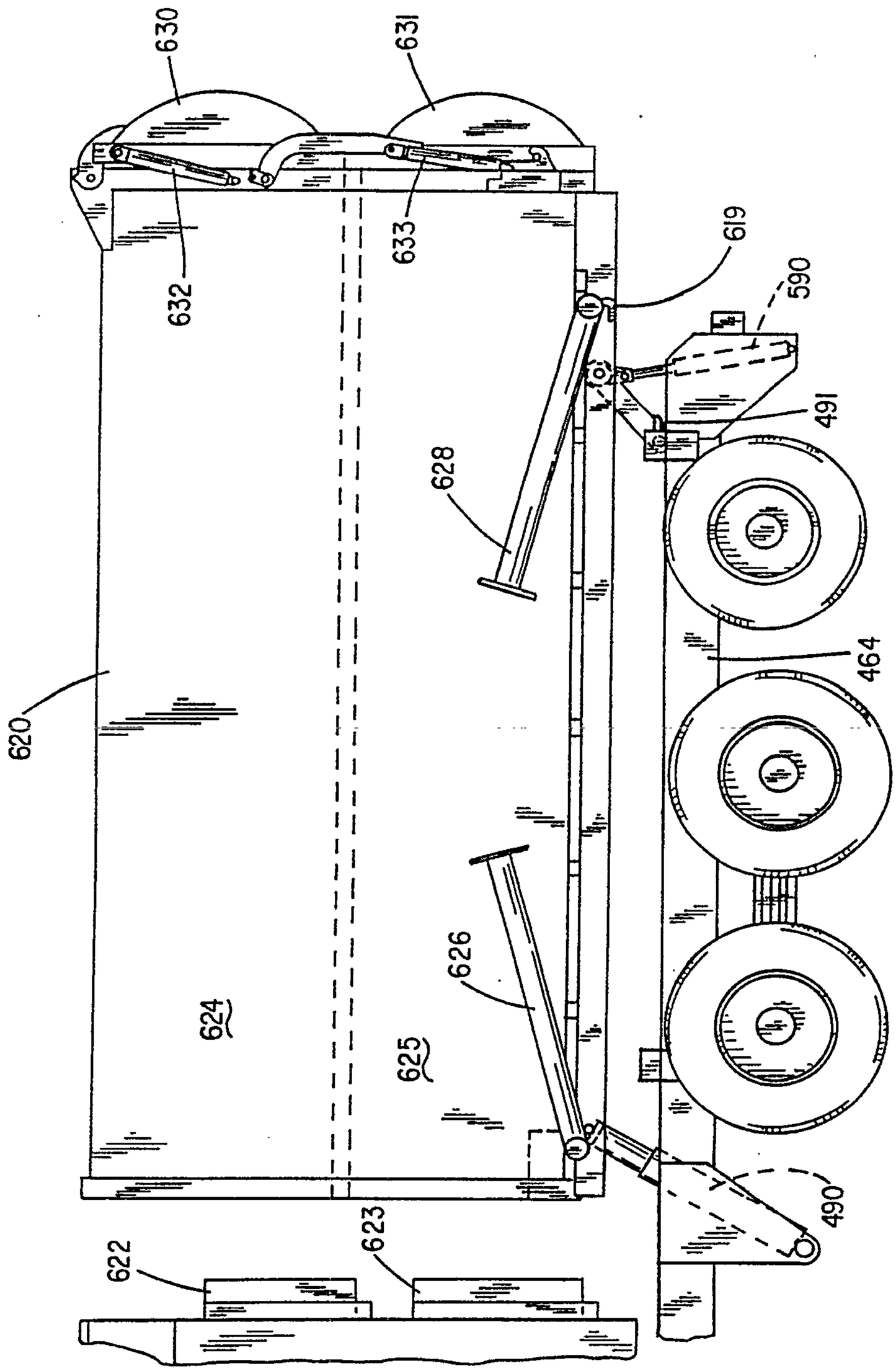


FIG. 15

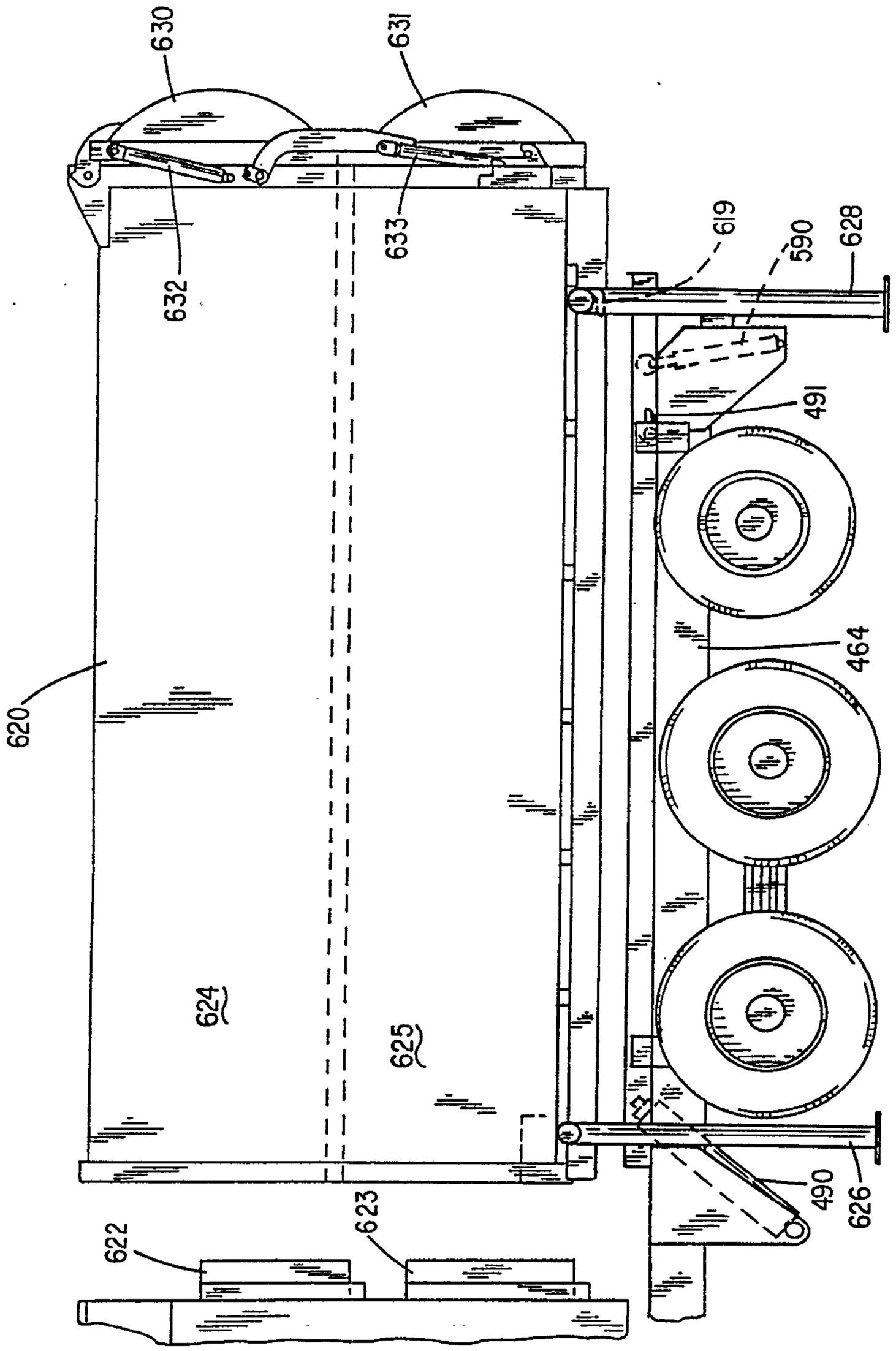


FIG. 16

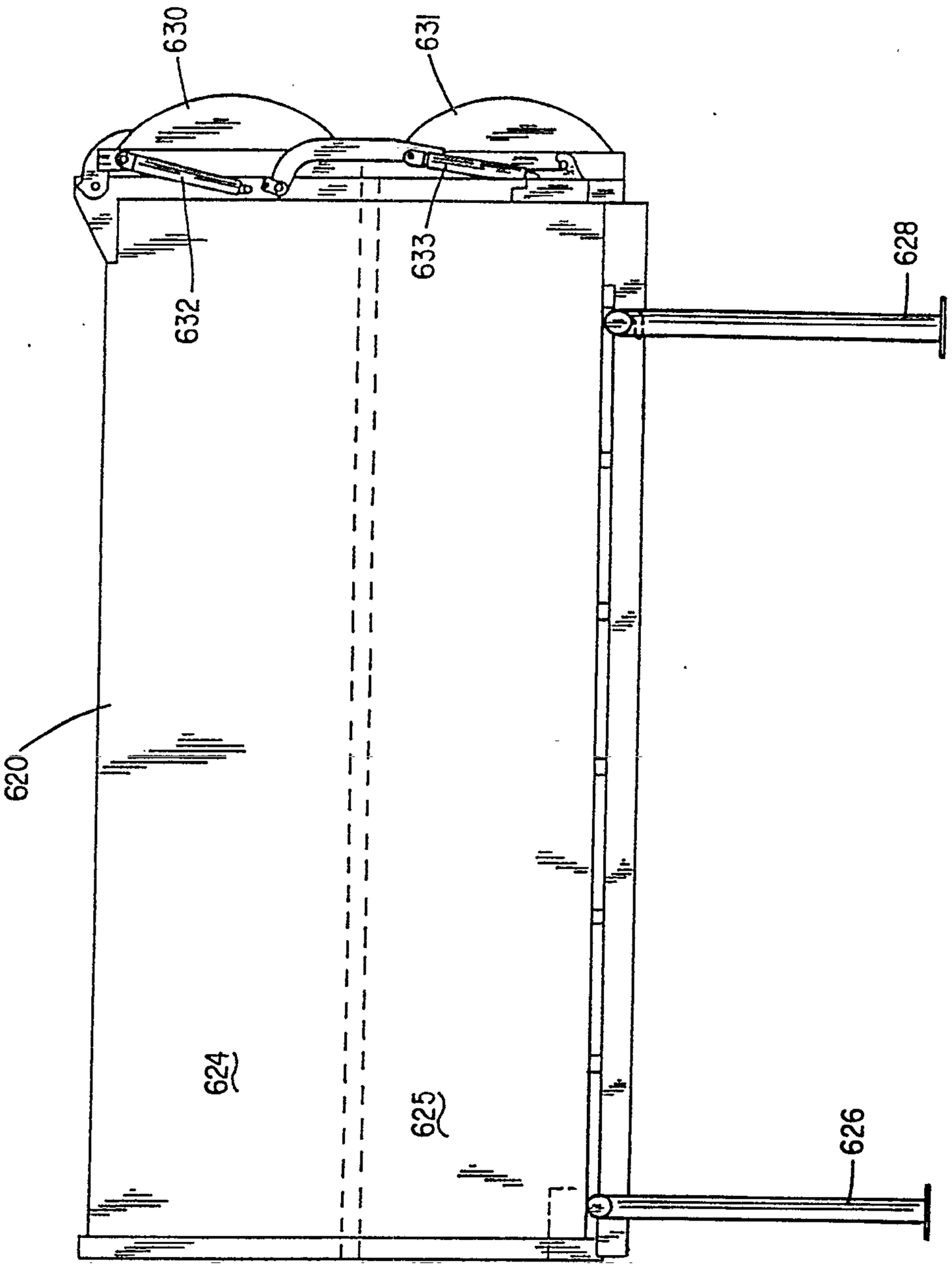


FIG. 17

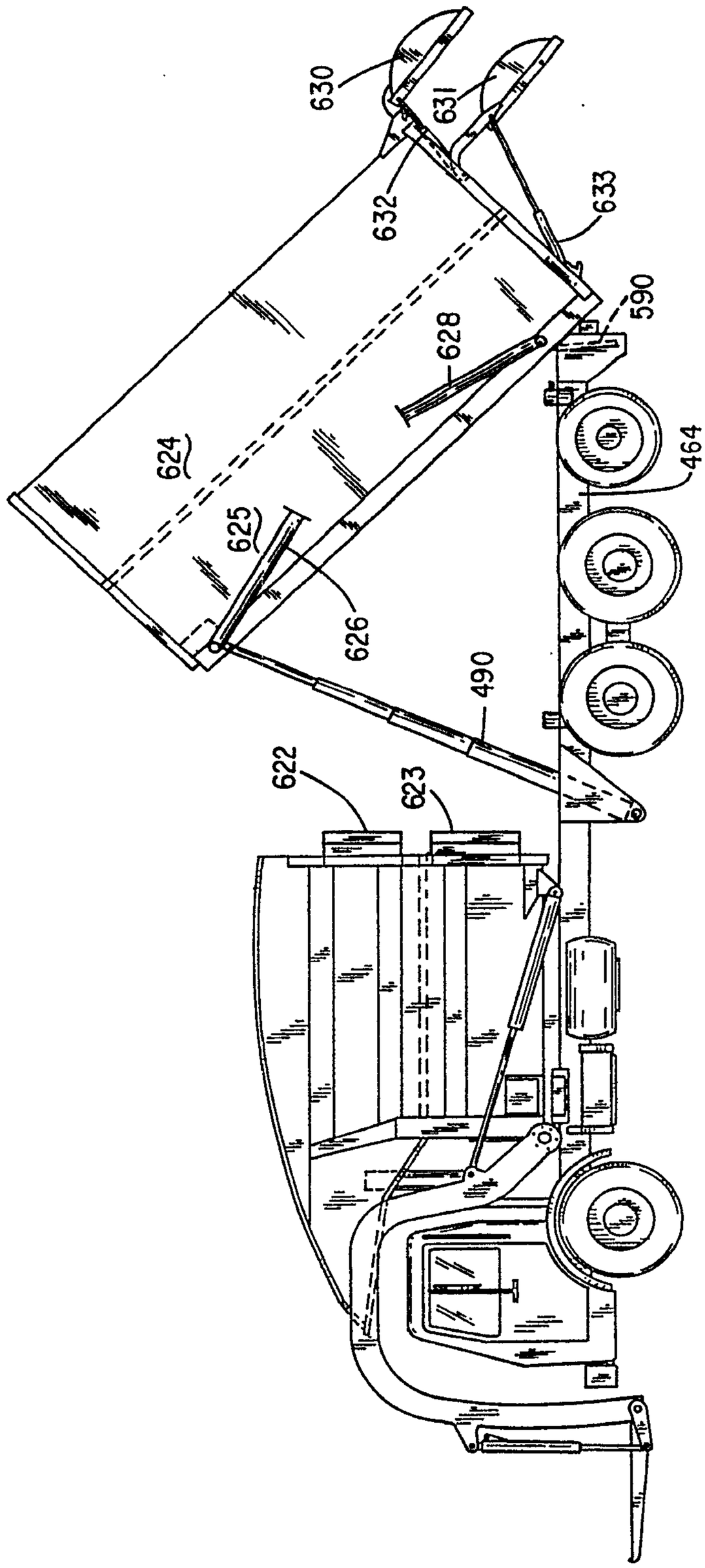


FIG. 18

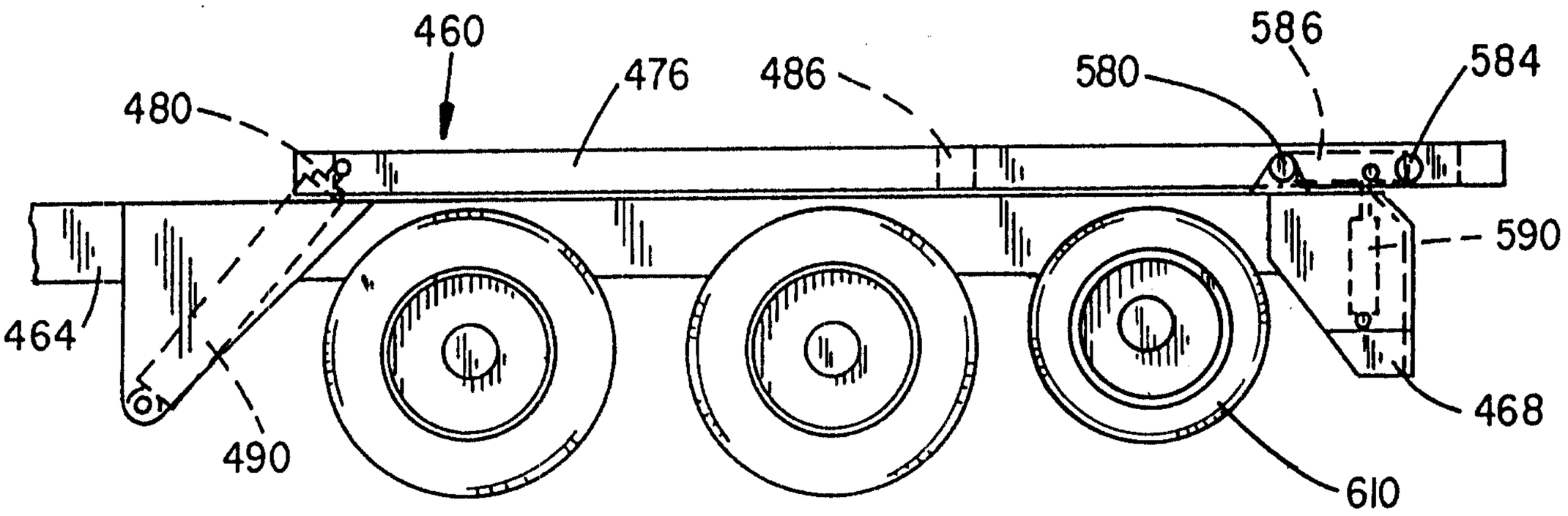


FIG. 19

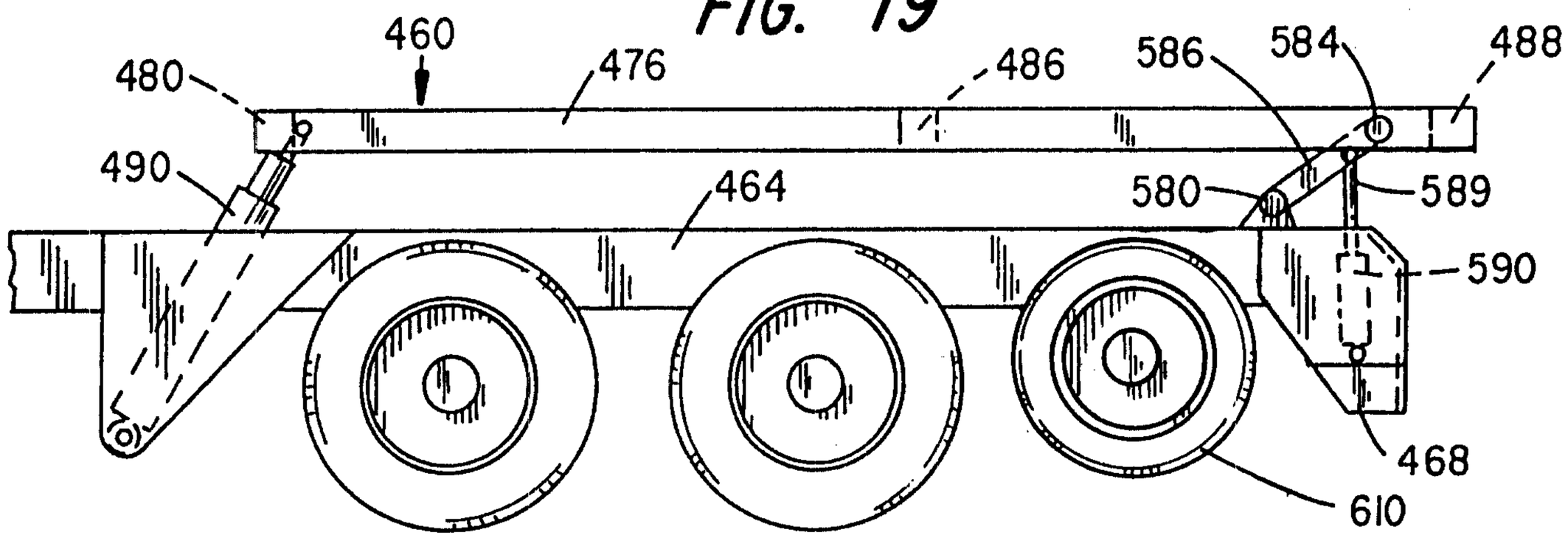


FIG. 20

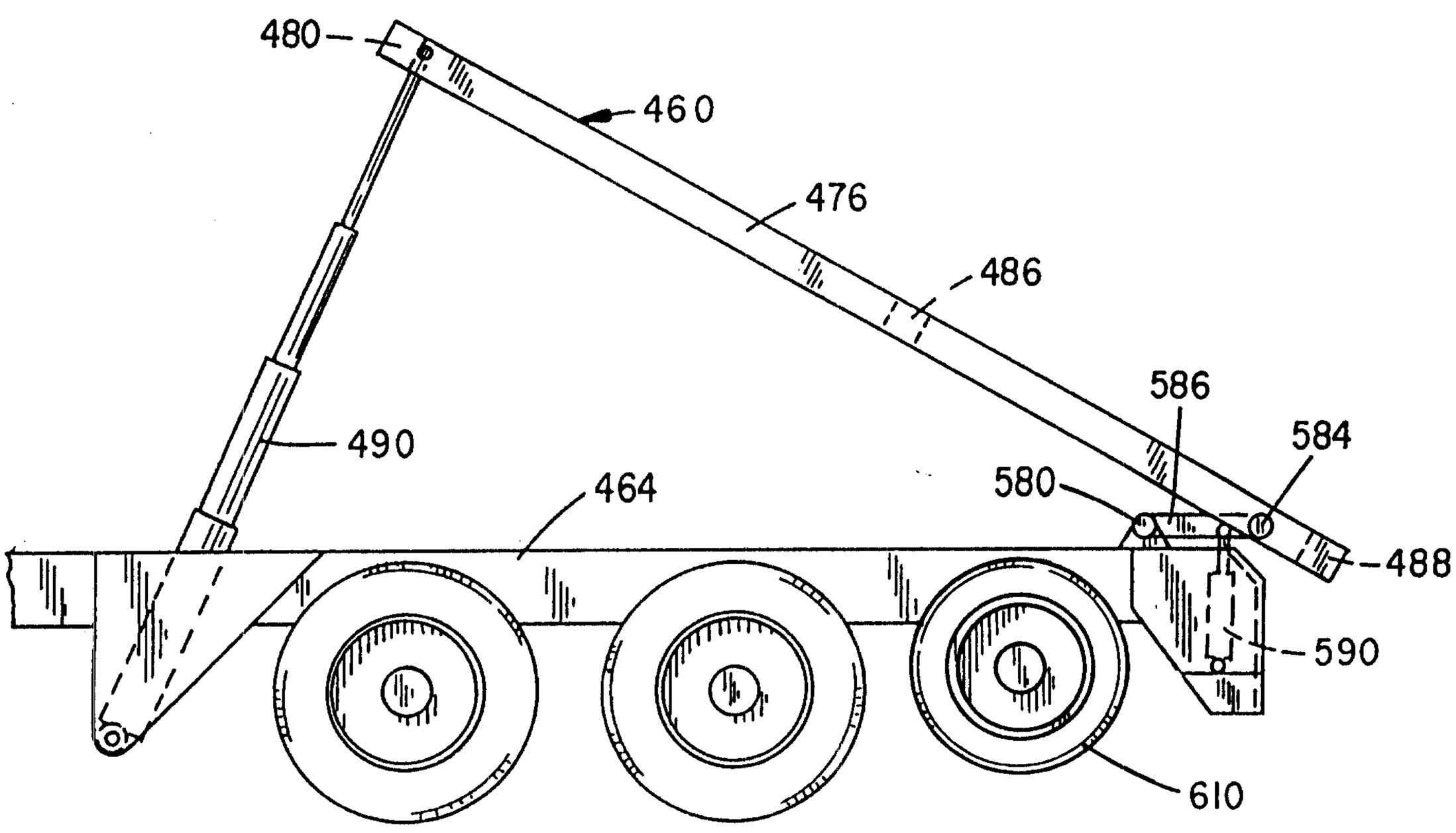


FIG. 21

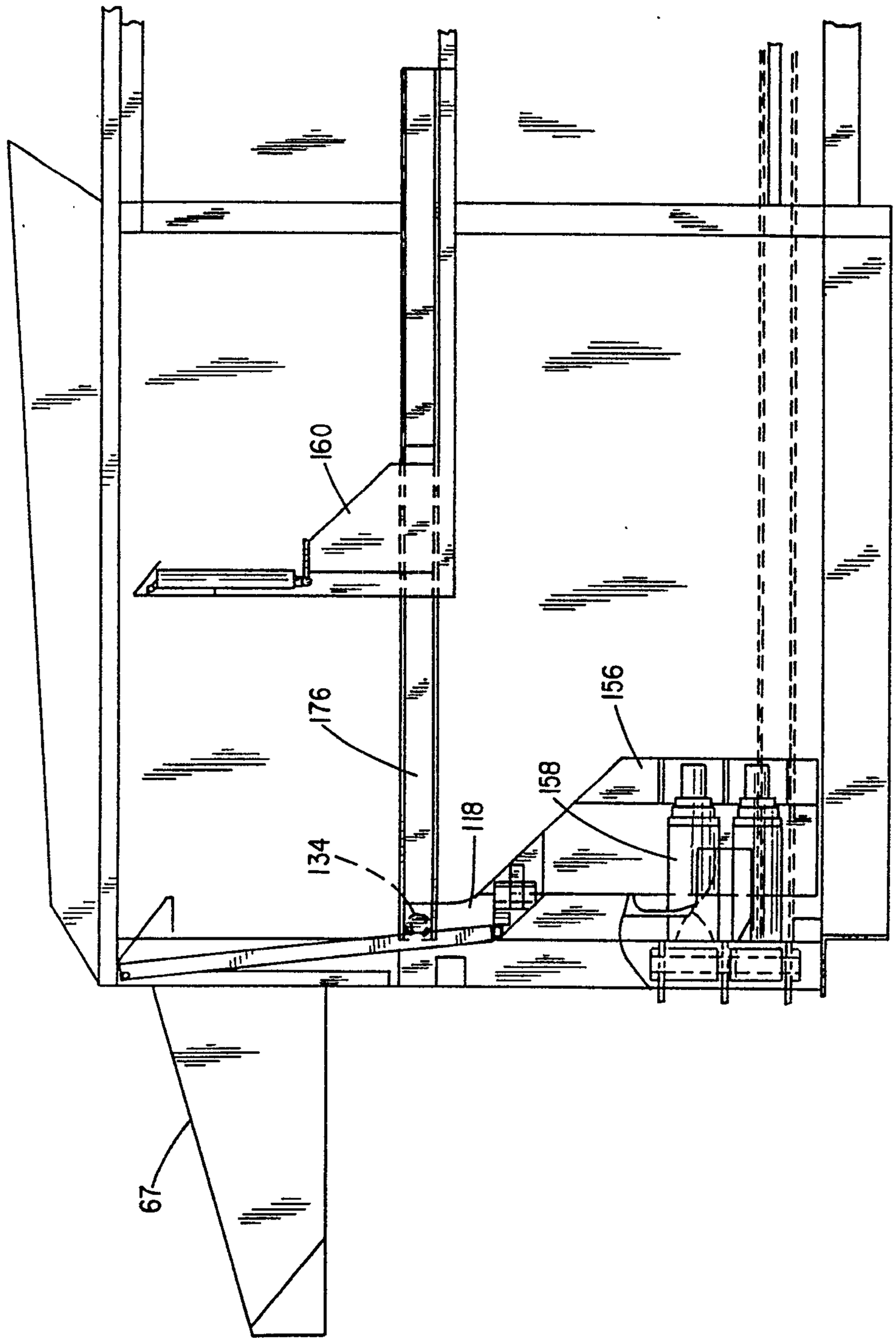


FIG. 22

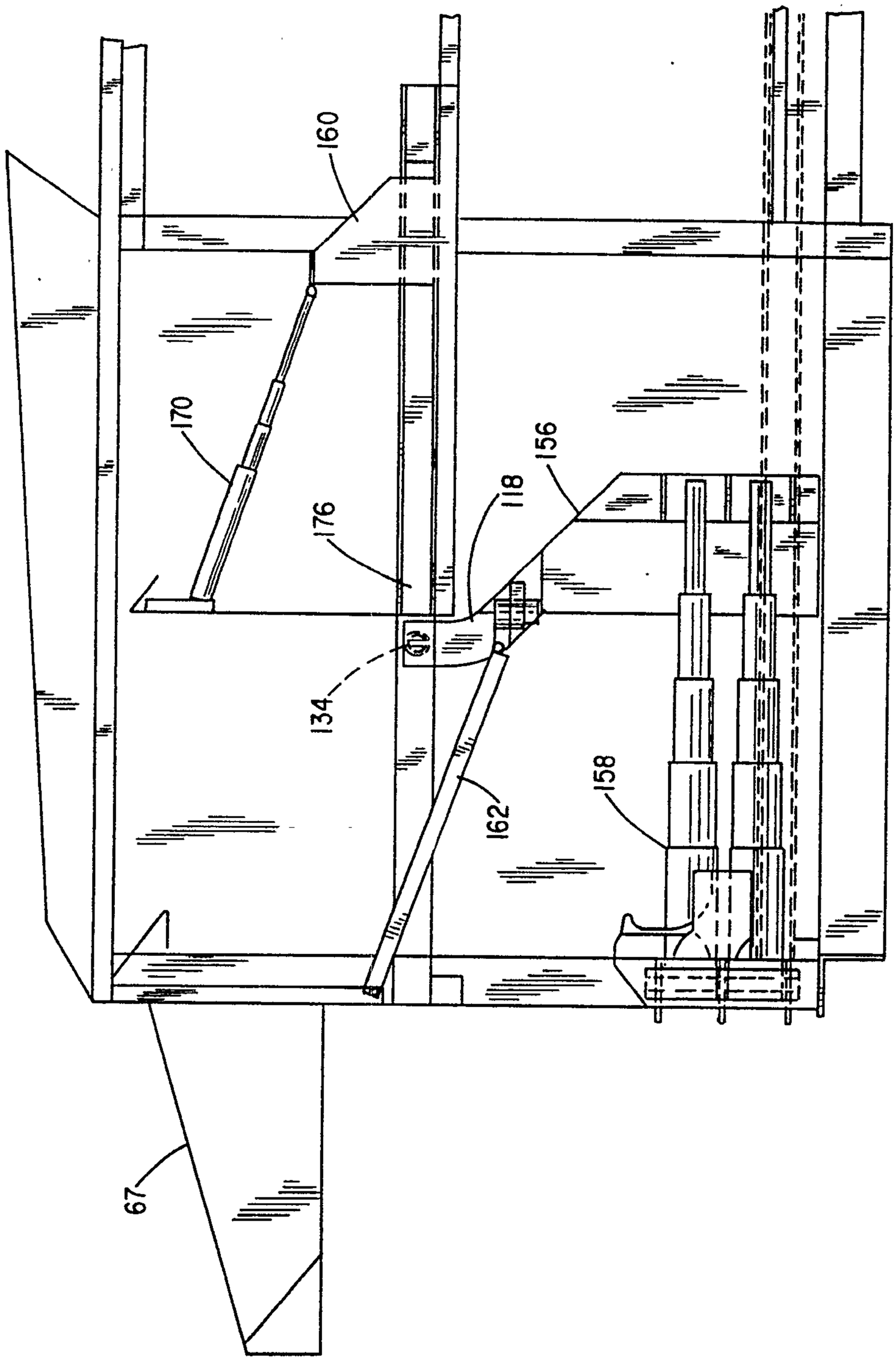


FIG. 23

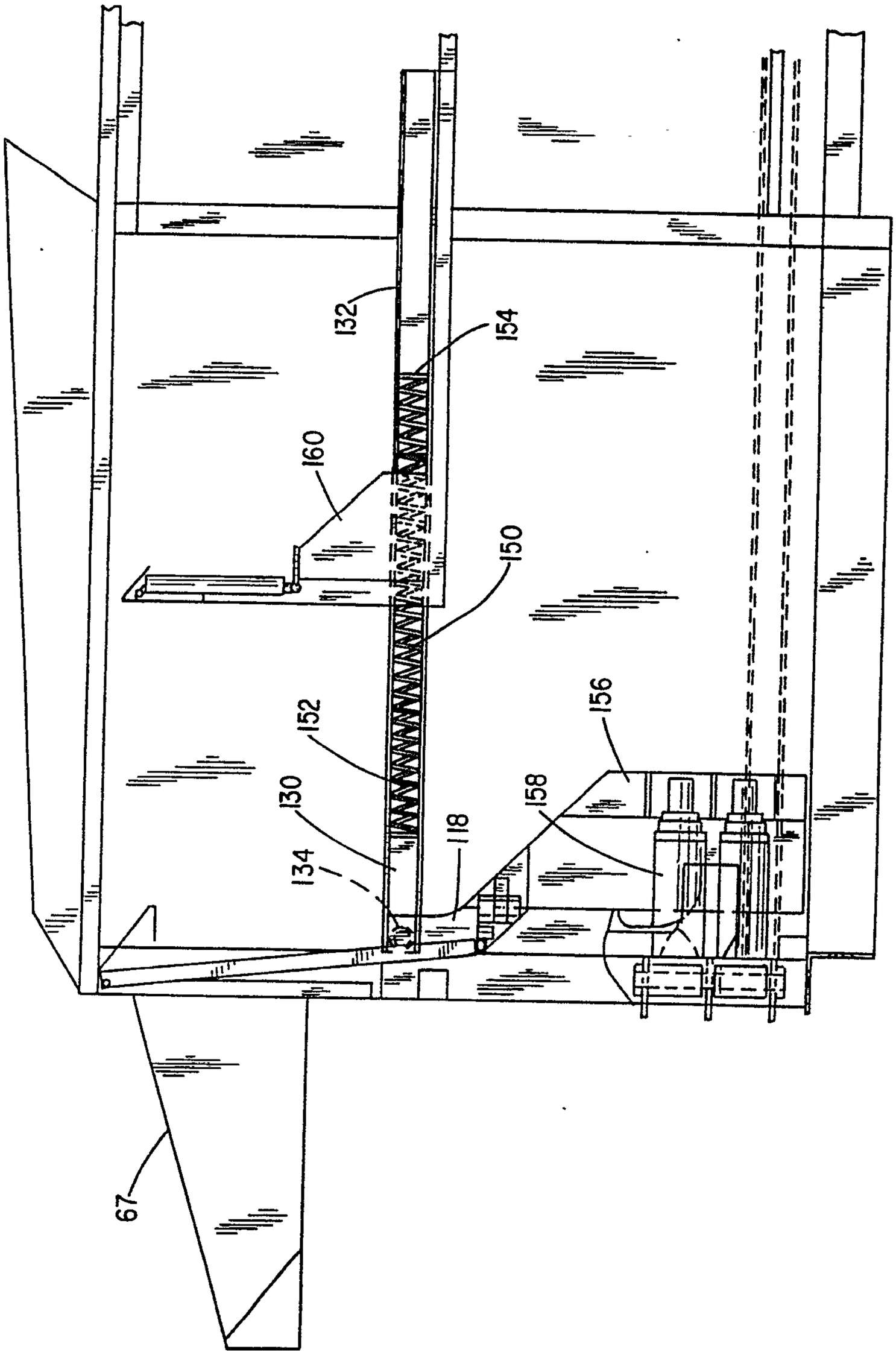


FIG. 24

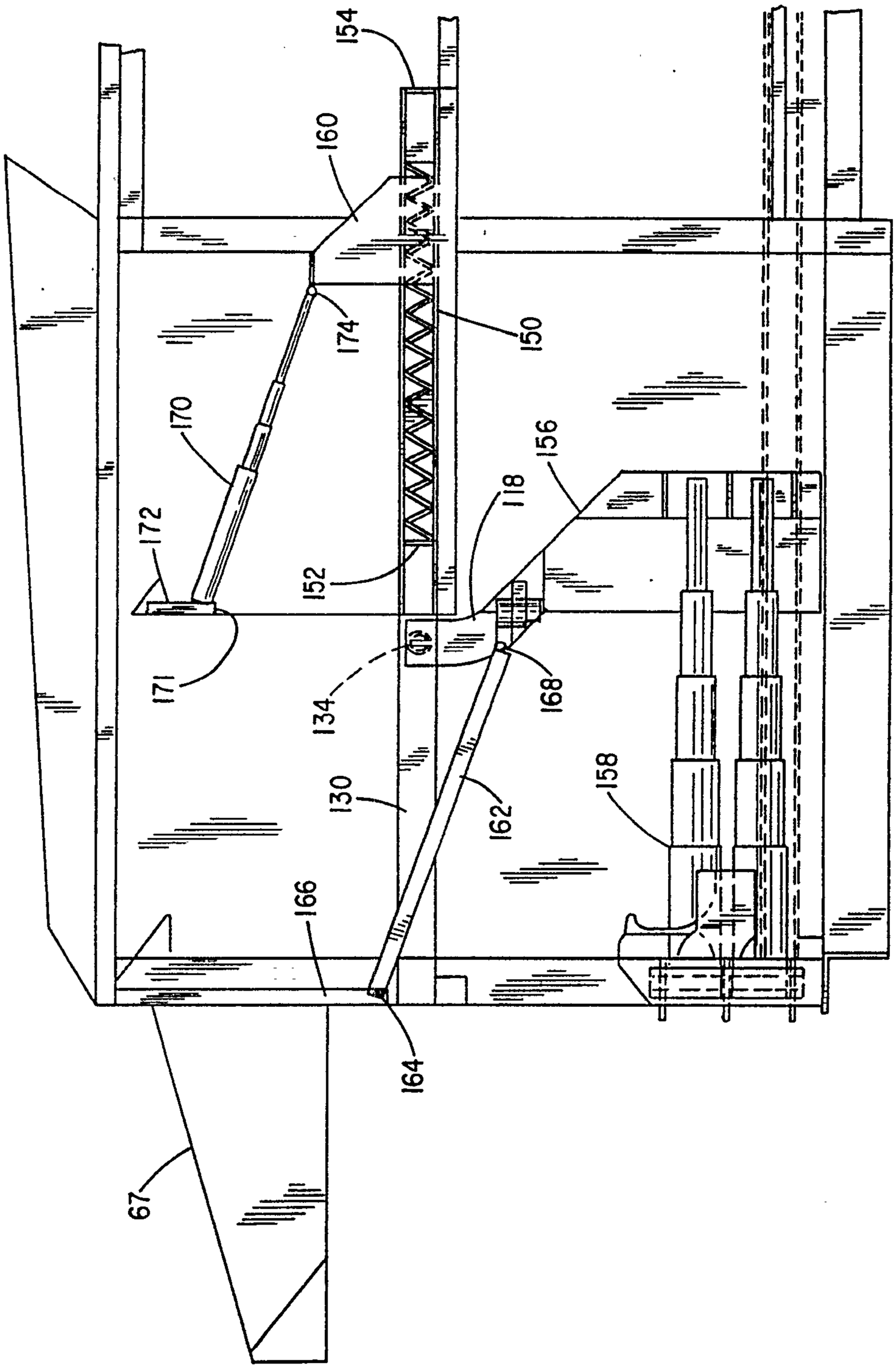

154
160
174
150
170
172
171
152
118
156
134
168
130
162
158
166
164
67

FIG. 25

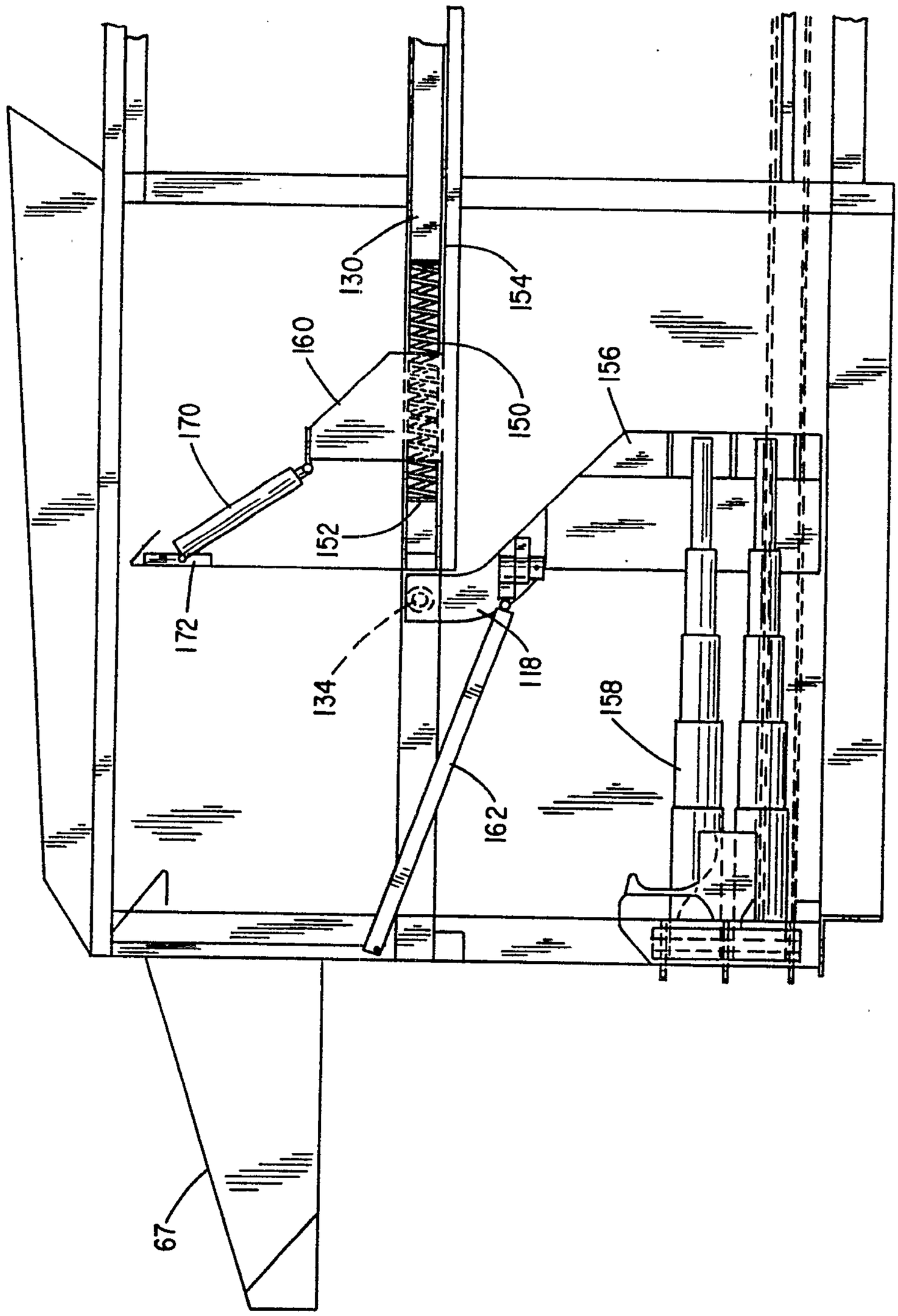


FIG. 26

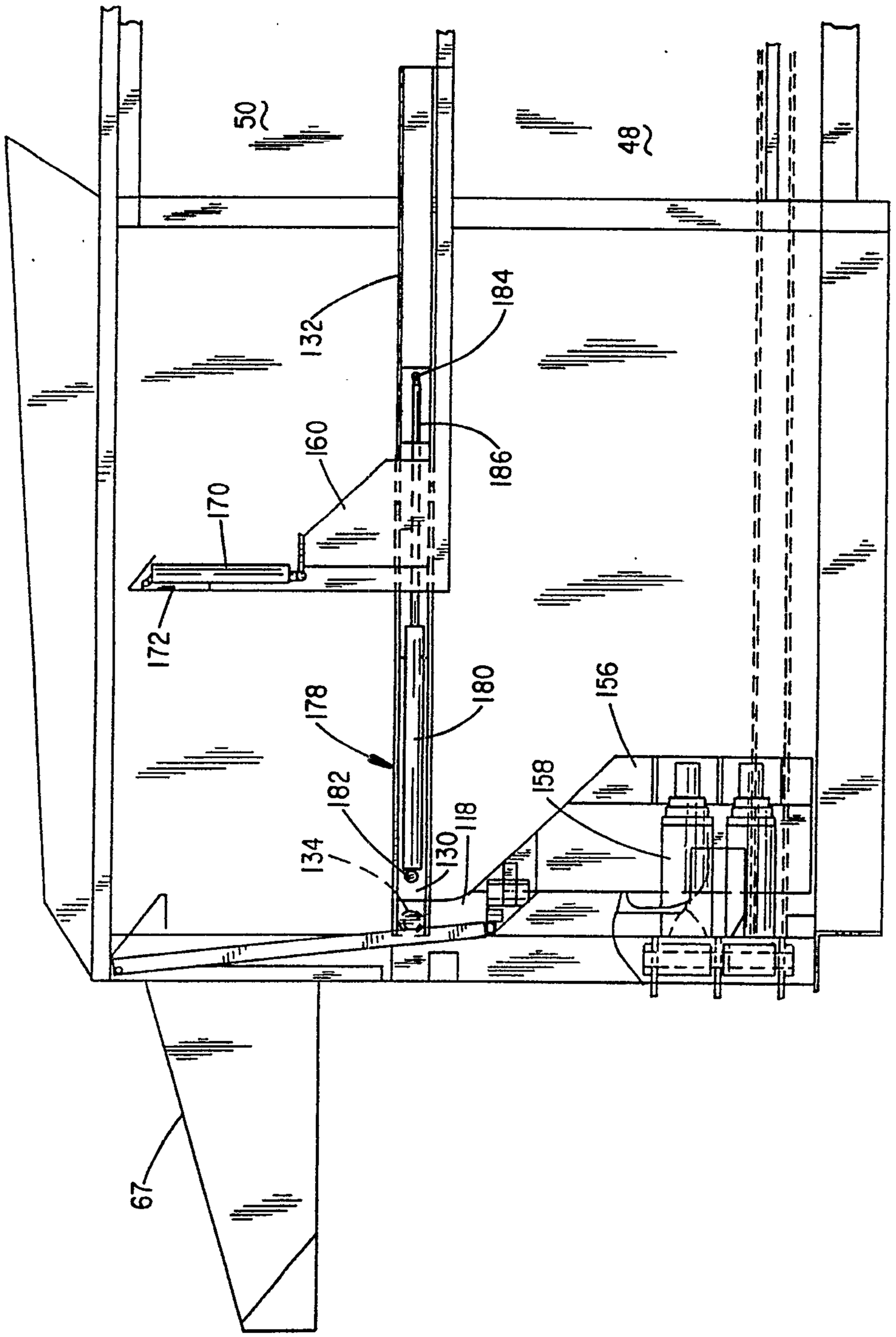


FIG. 27

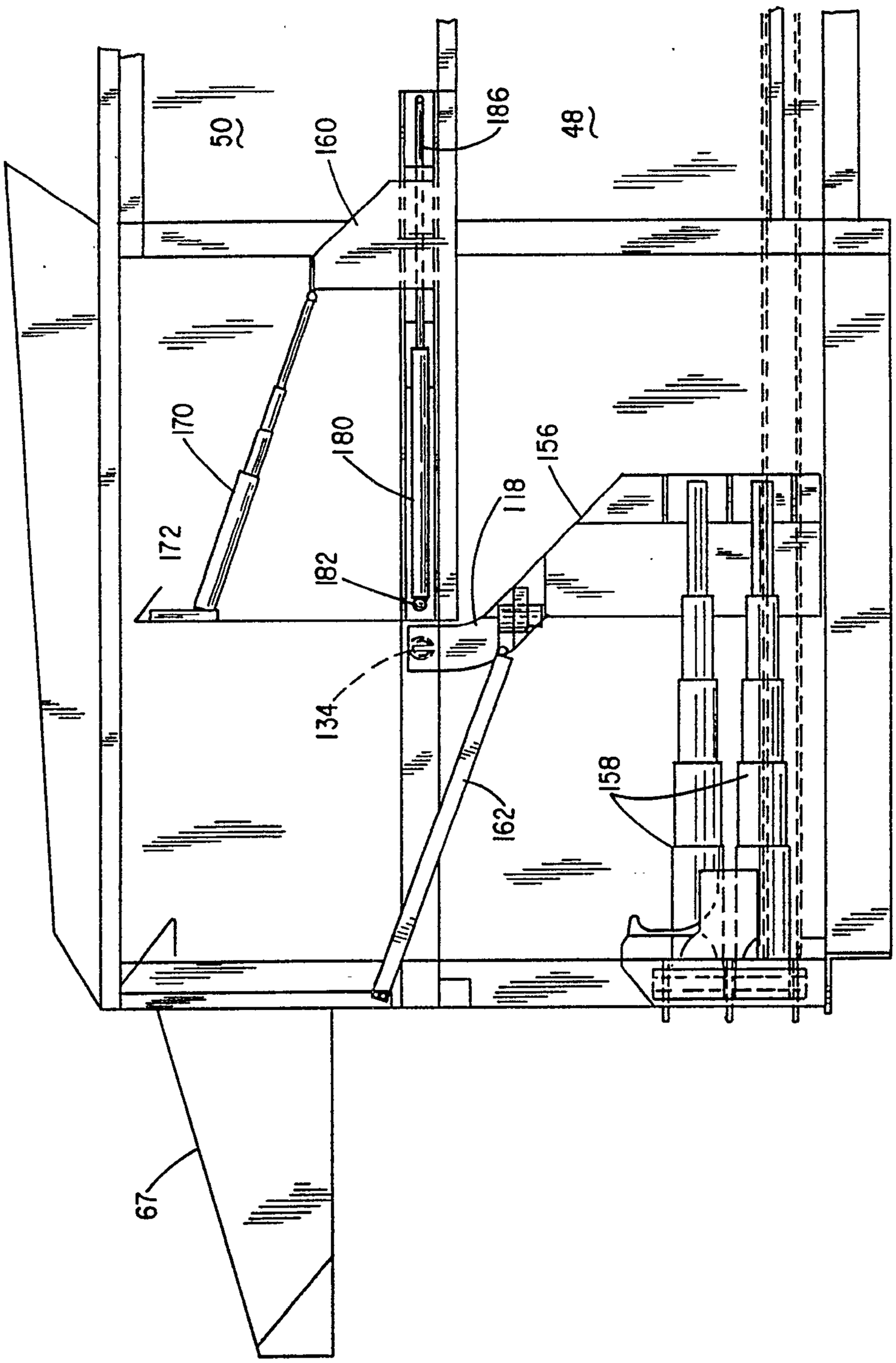


FIG. 28

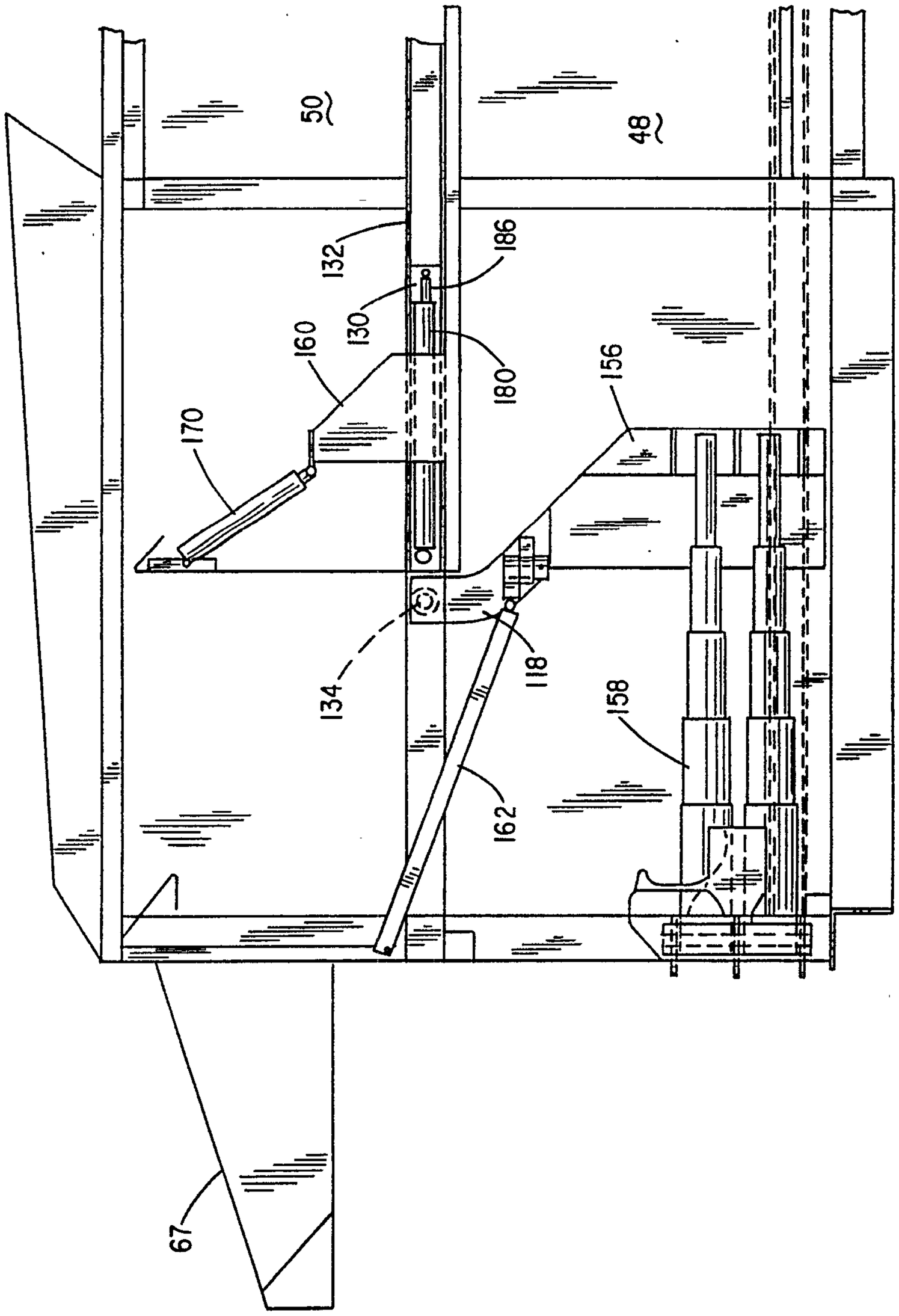


FIG. 29

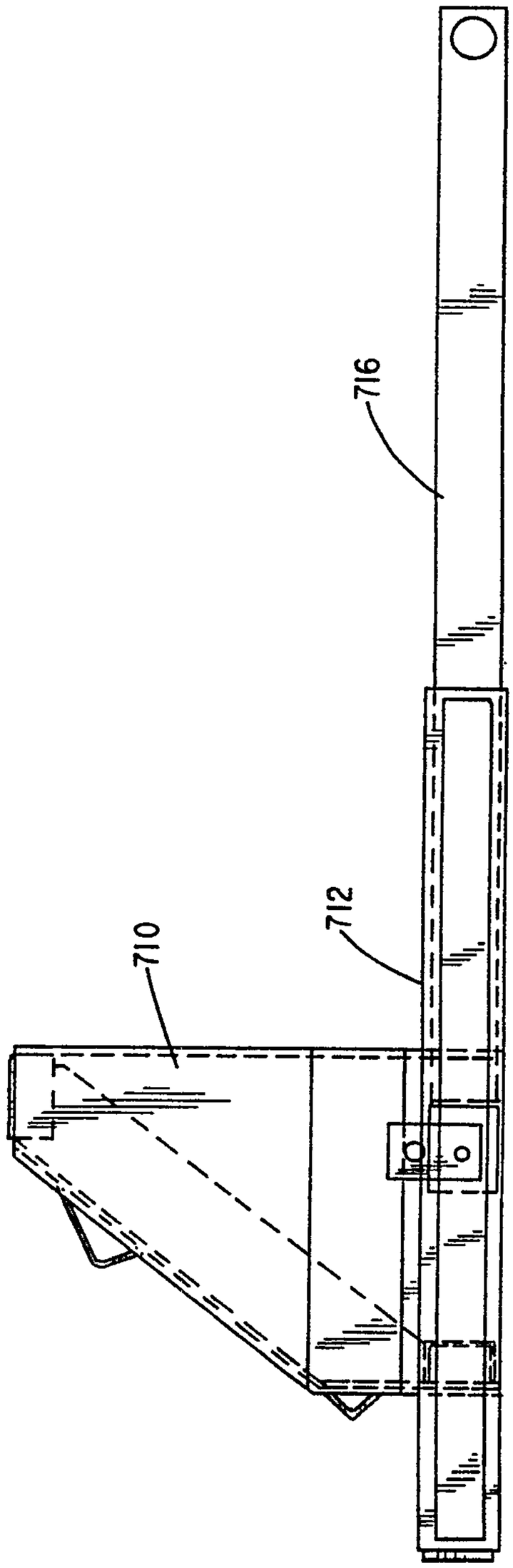


FIG. 30

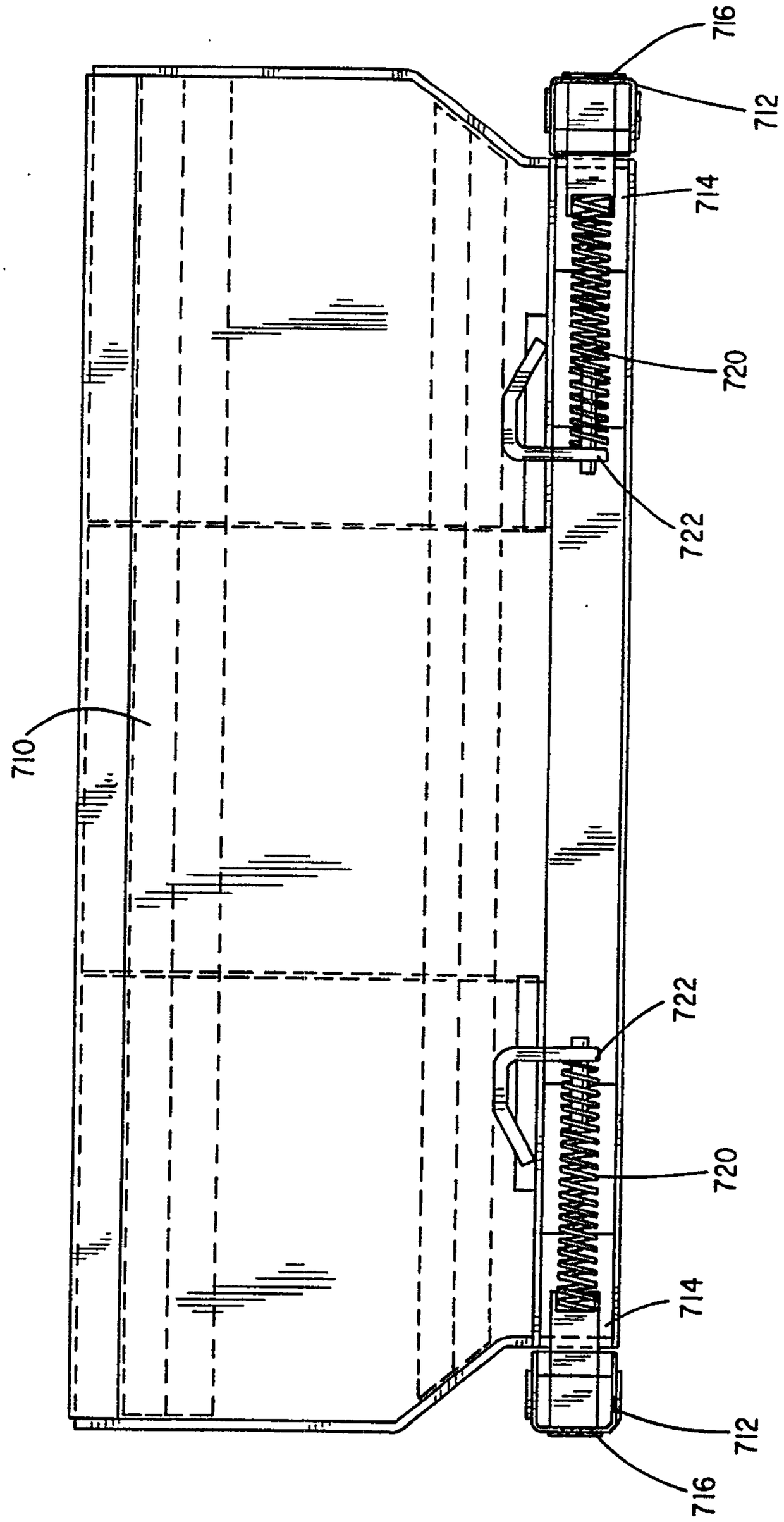


FIG. 31

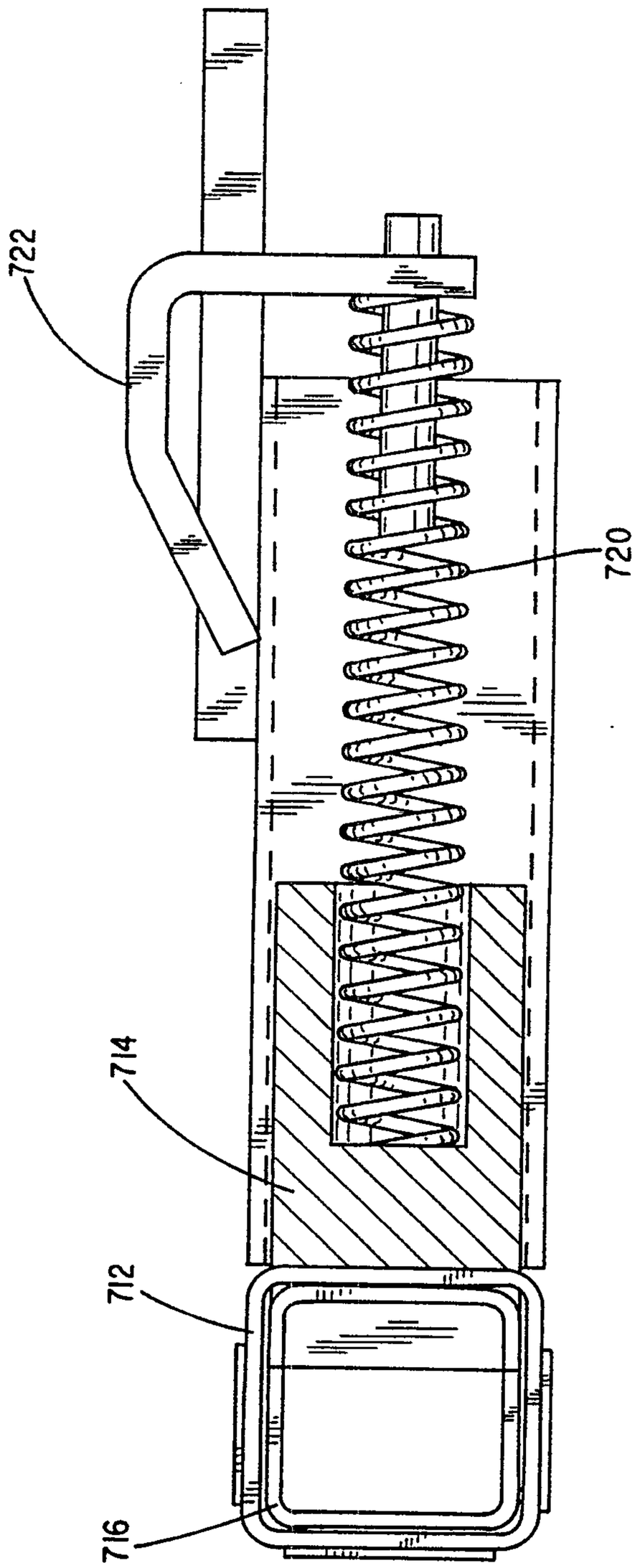


FIG. 32

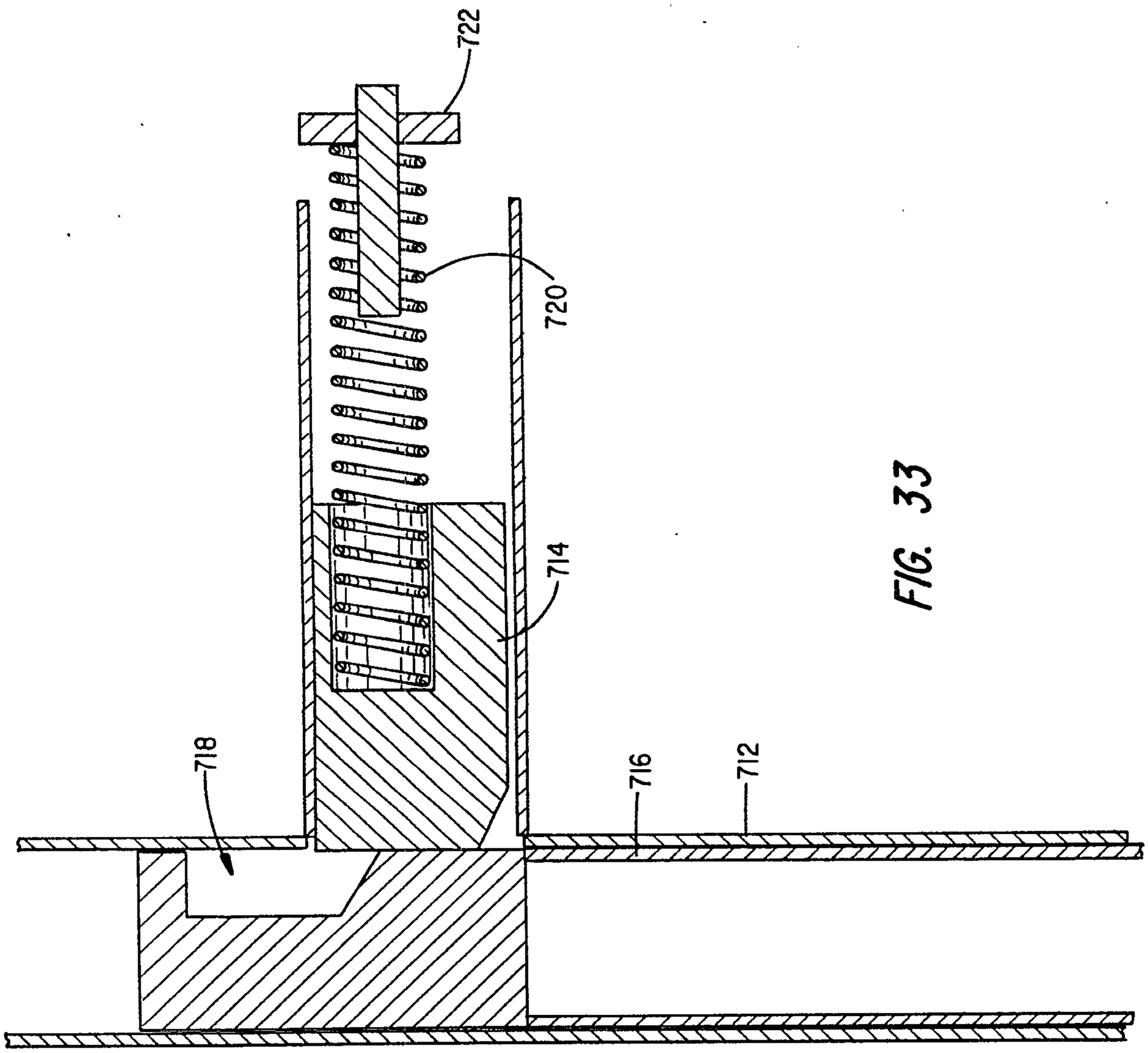


FIG. 33

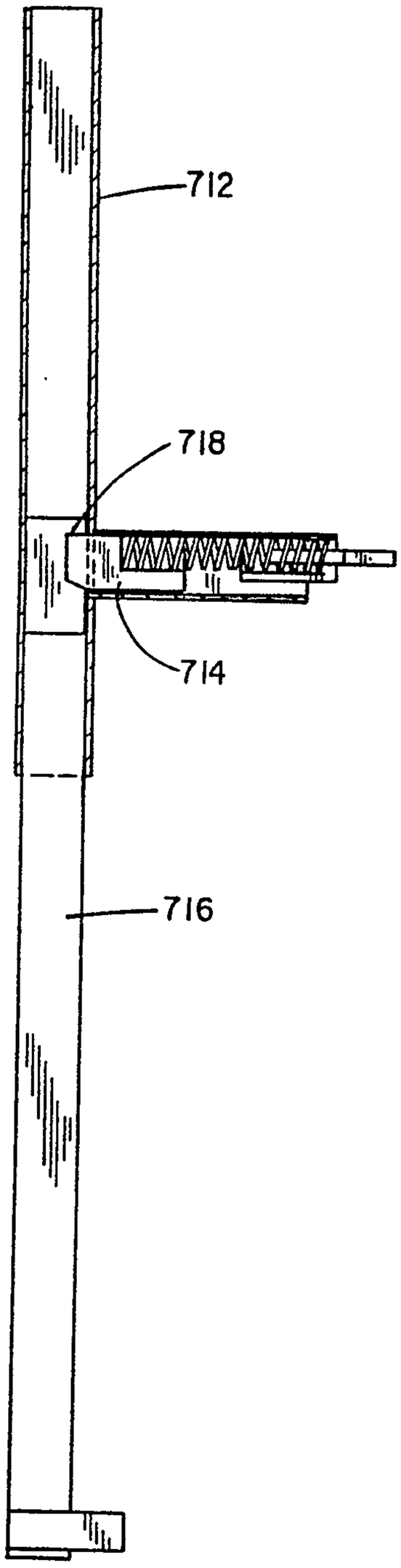


FIG. 34

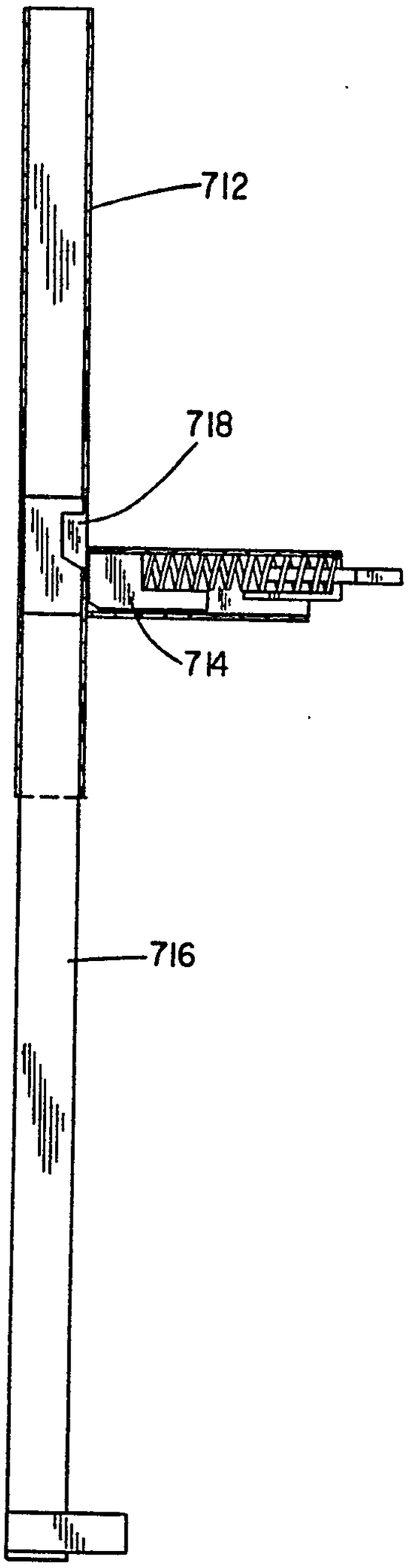


FIG. 35

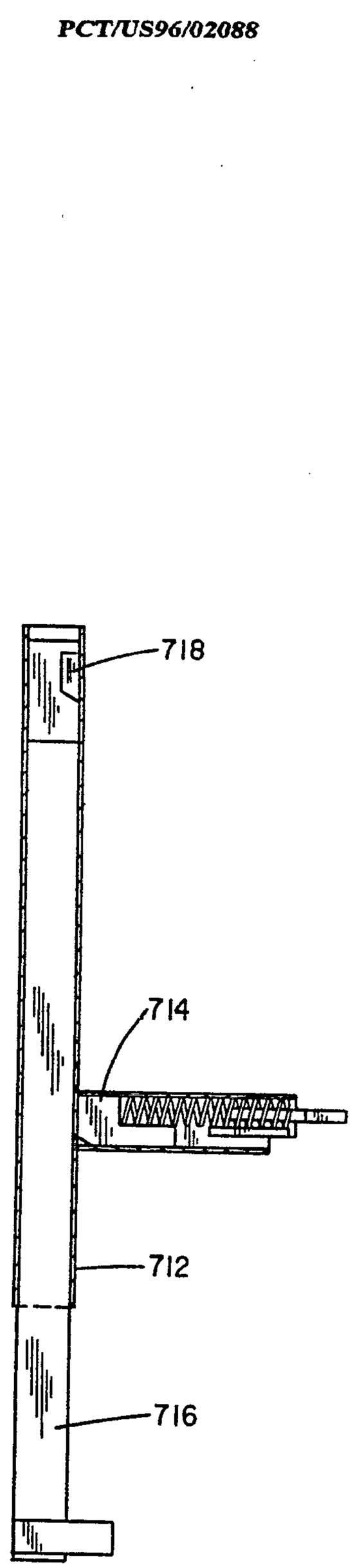


FIG. 36

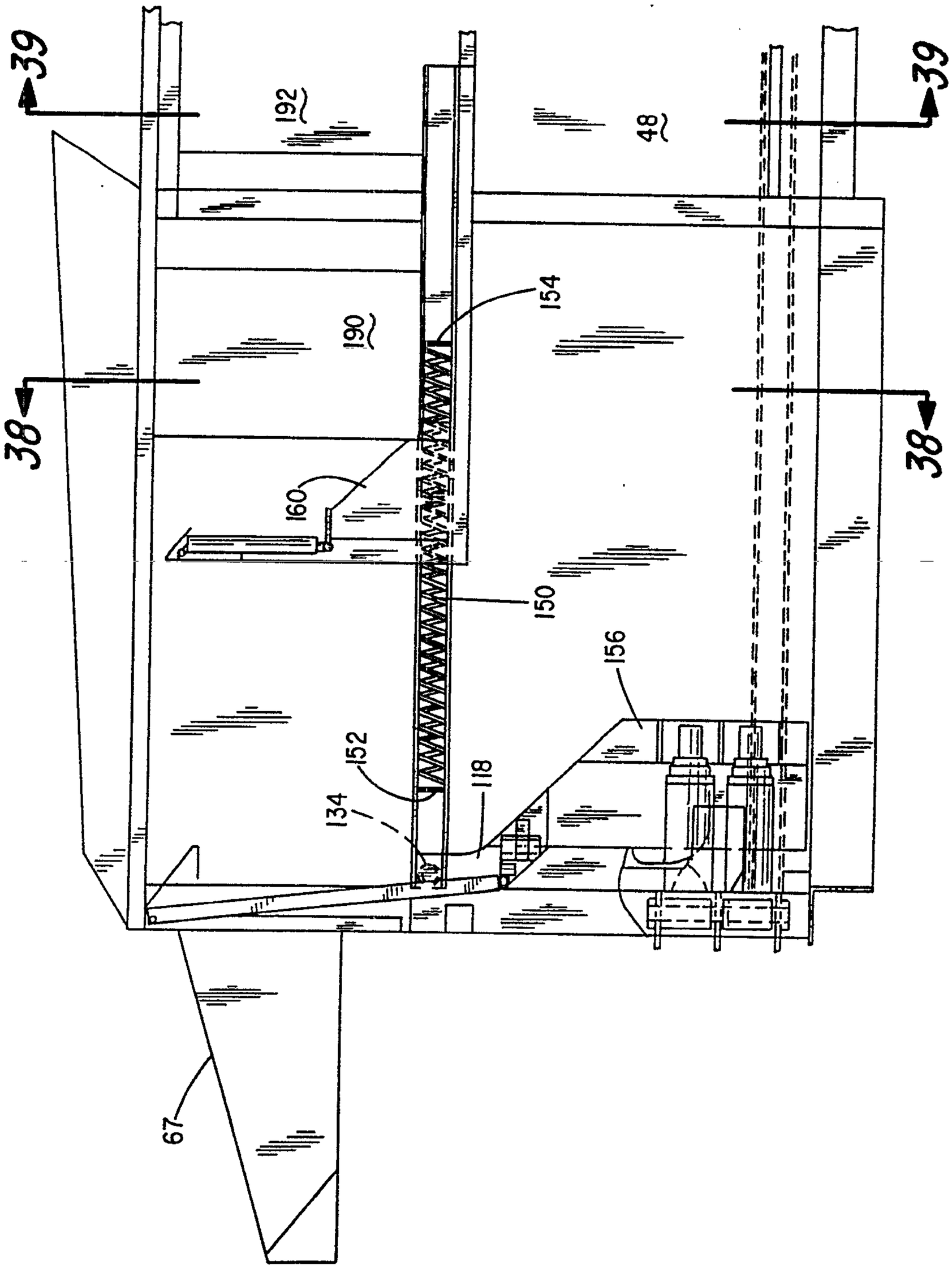


FIG. 37

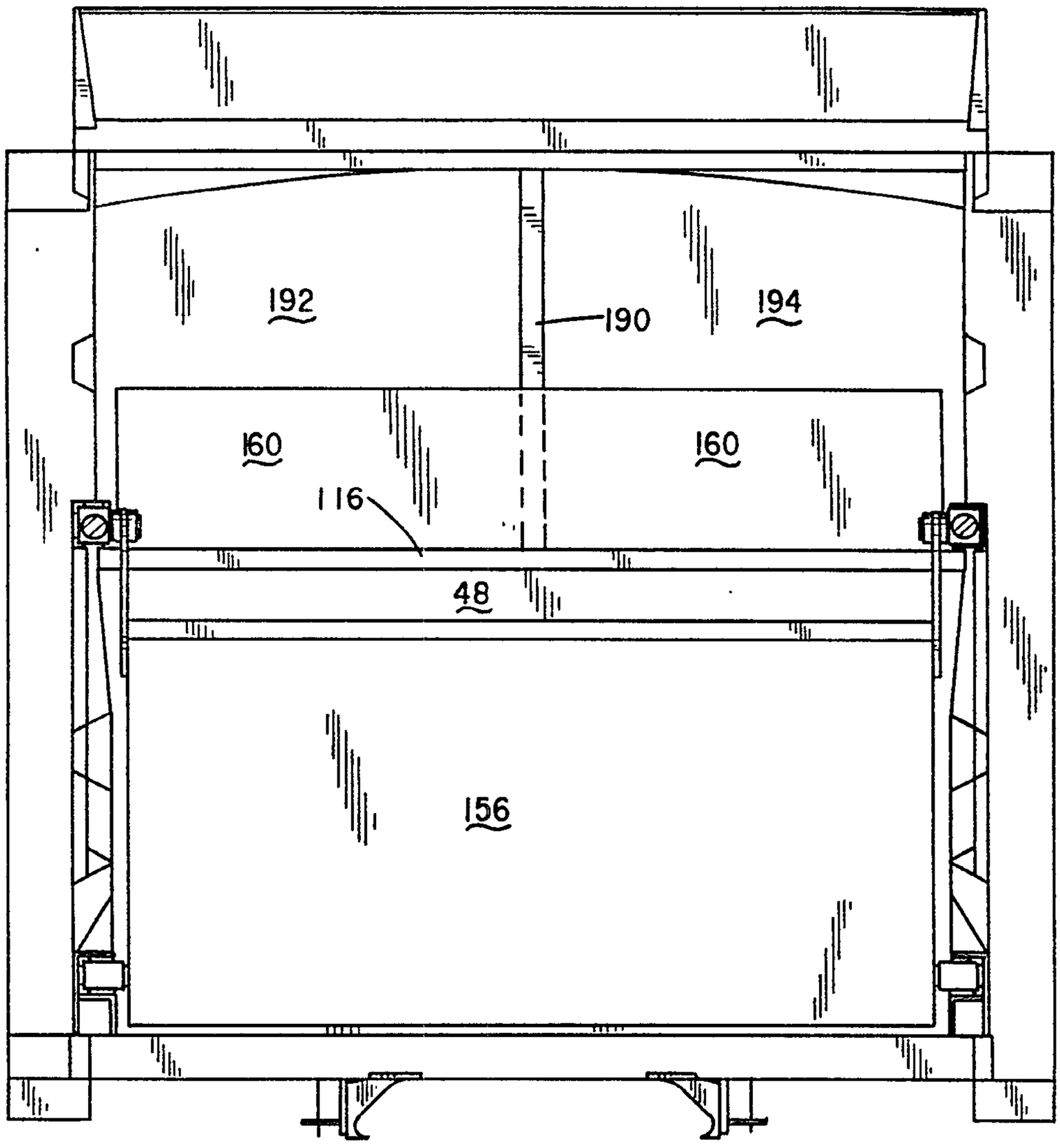


FIG. 38

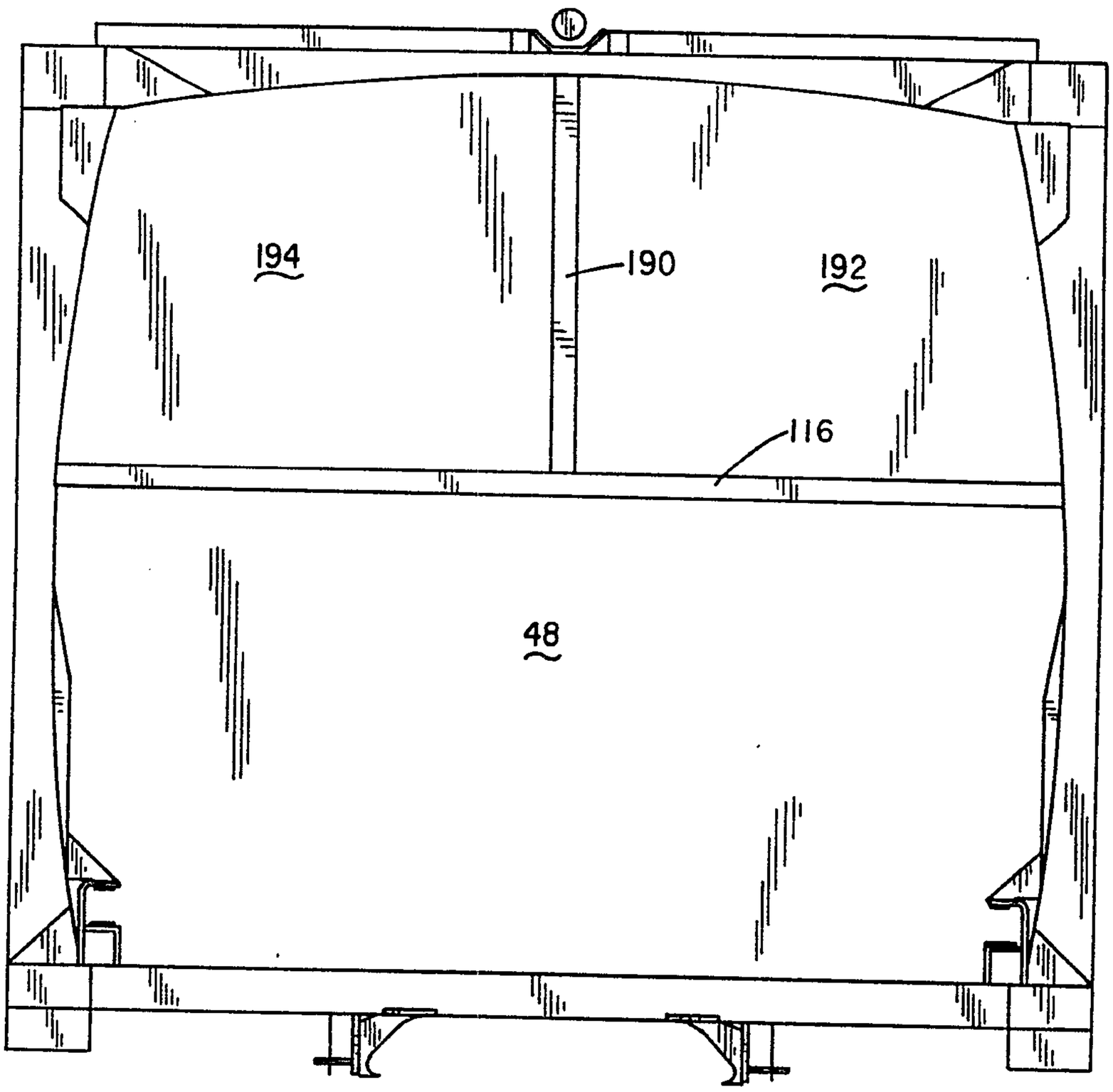


FIG. 39

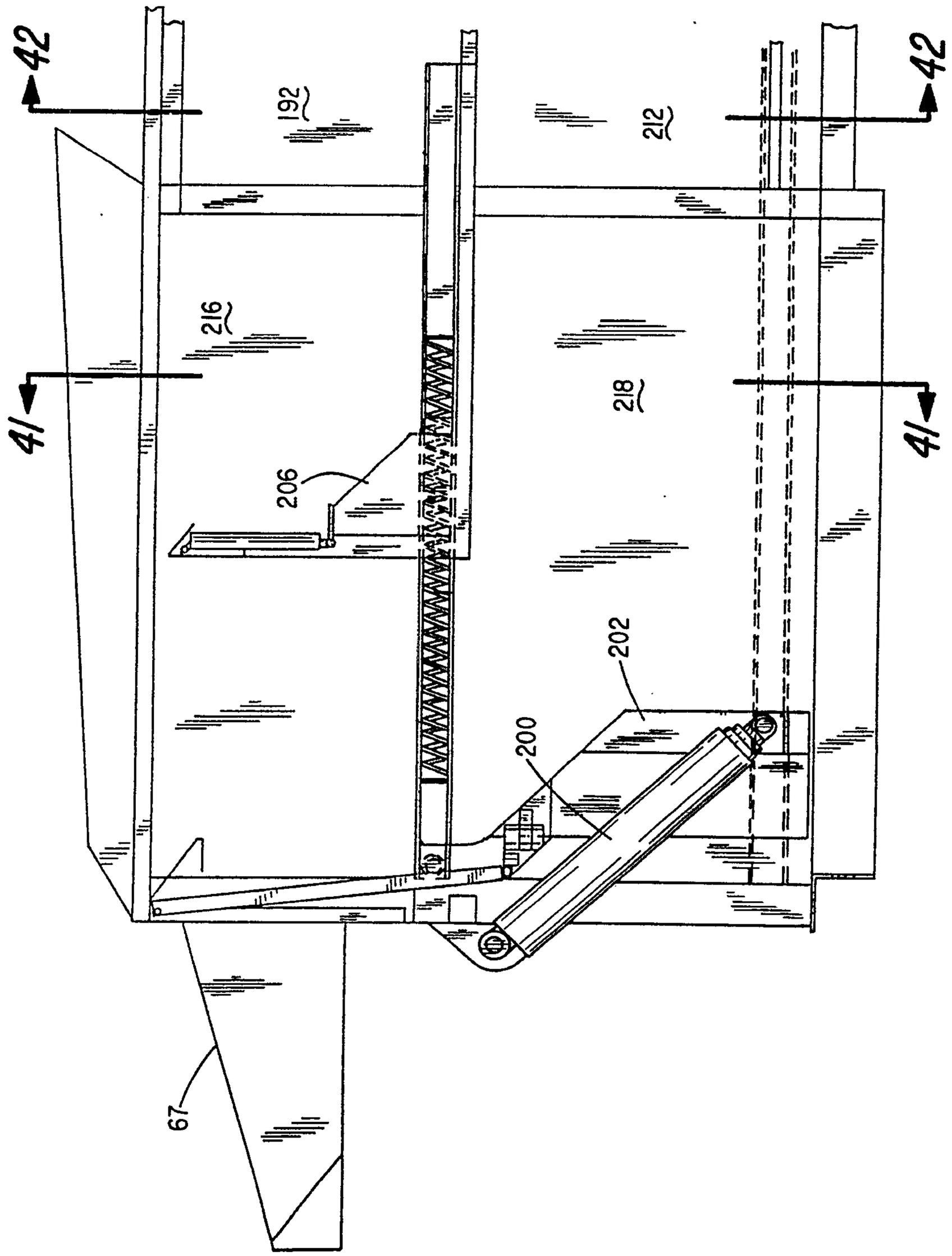


FIG. 40

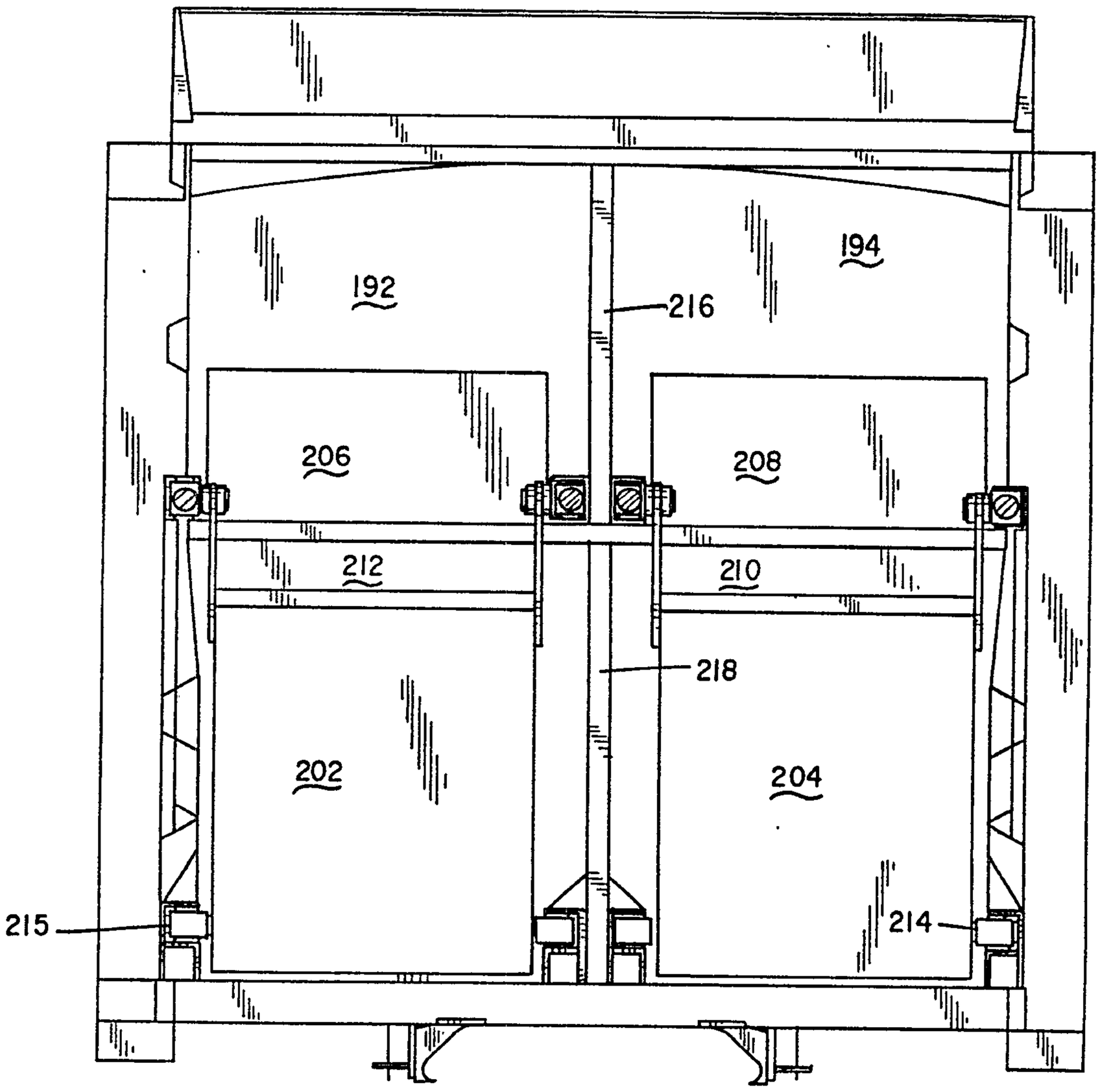


FIG. 41

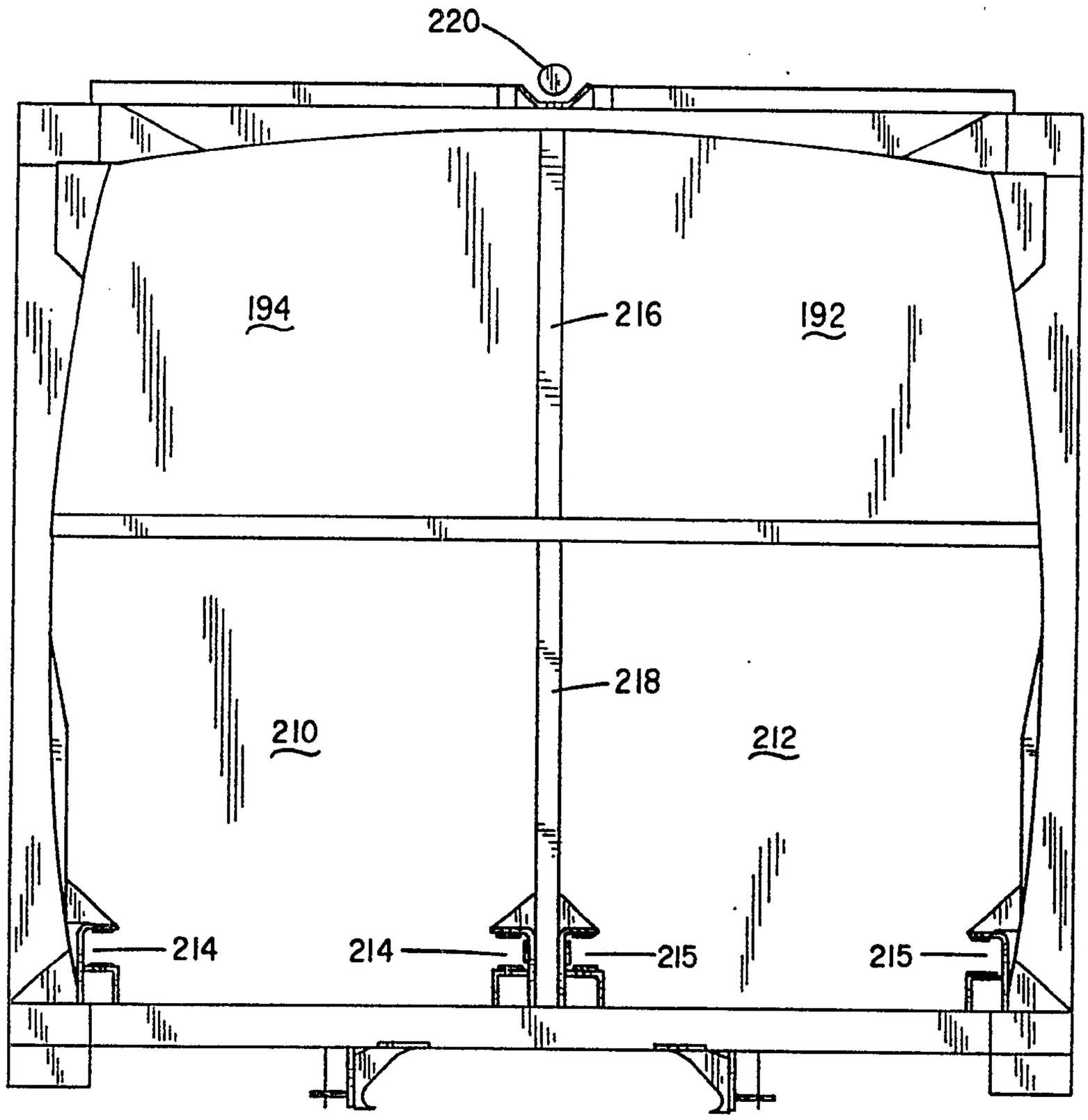


FIG. 42

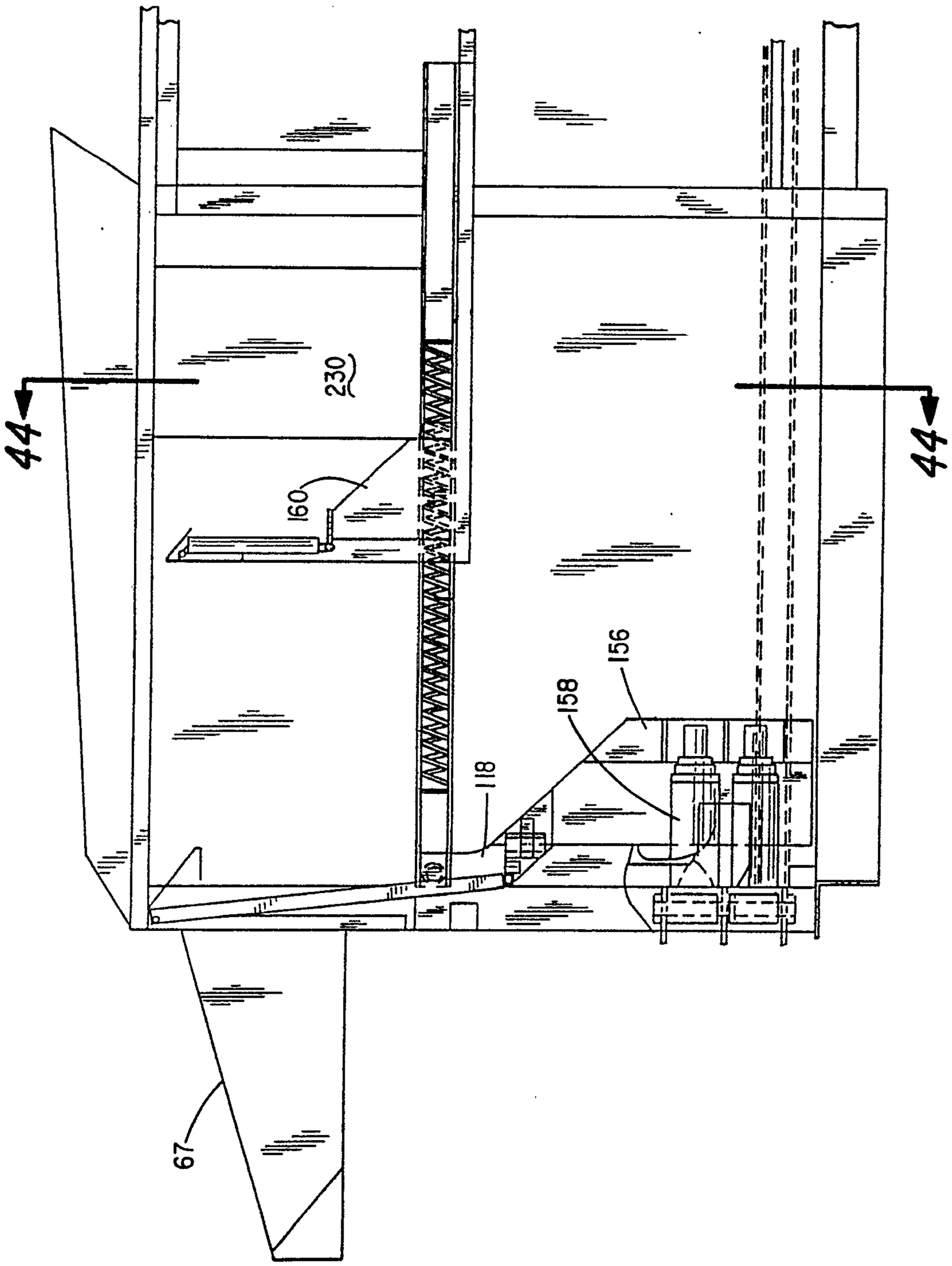


FIG. 43

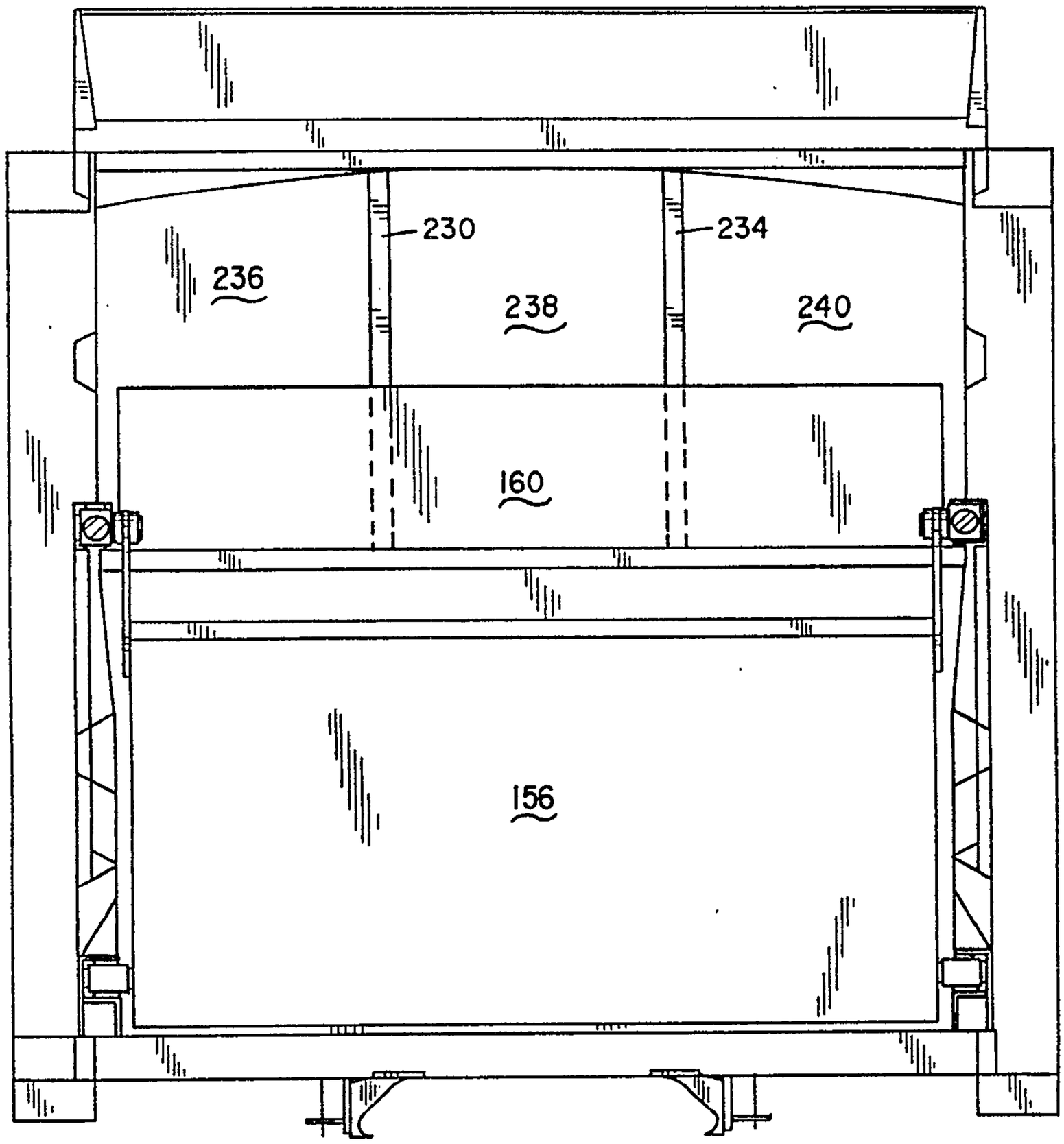


FIG. 44

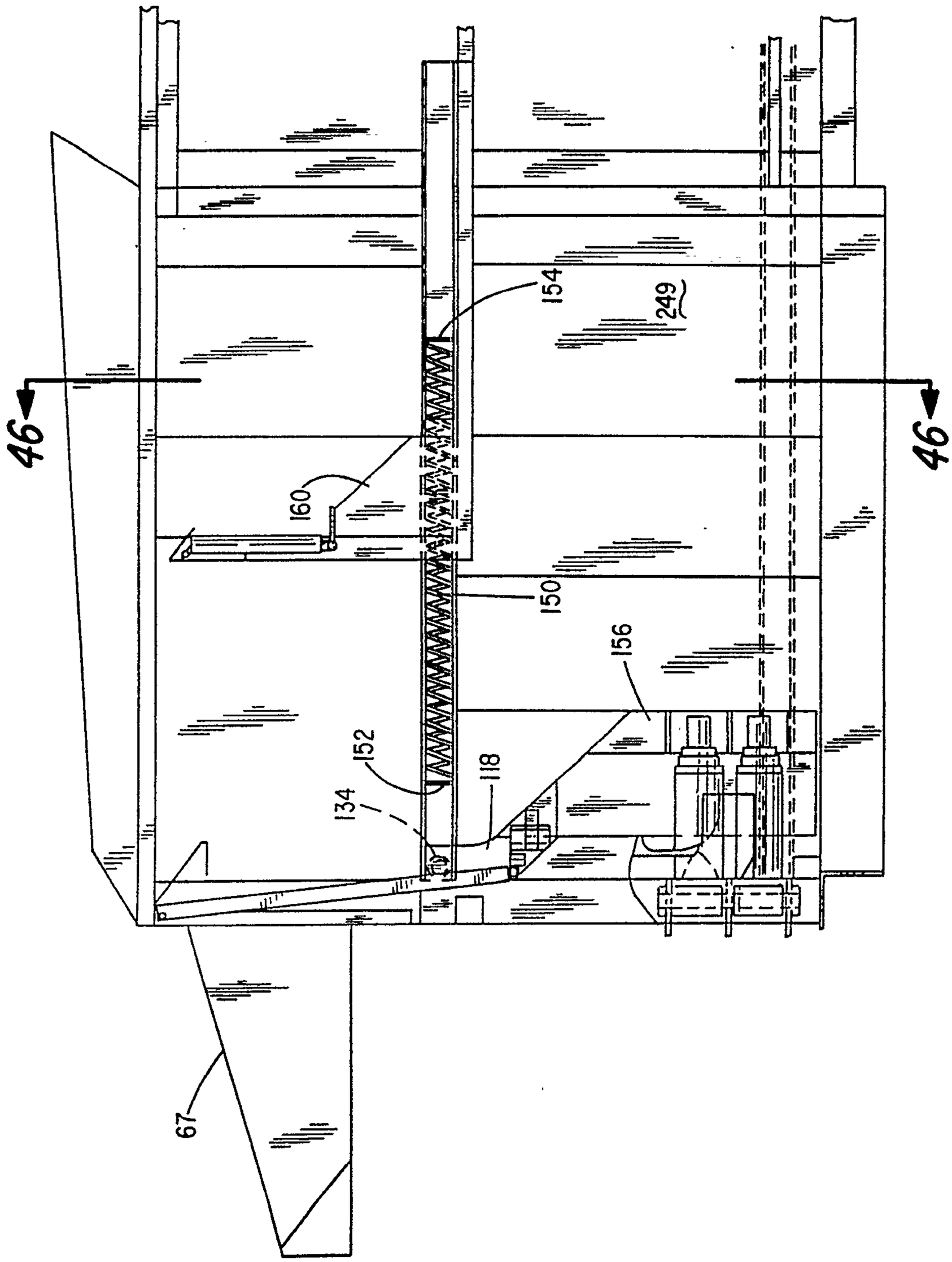


FIG. 45

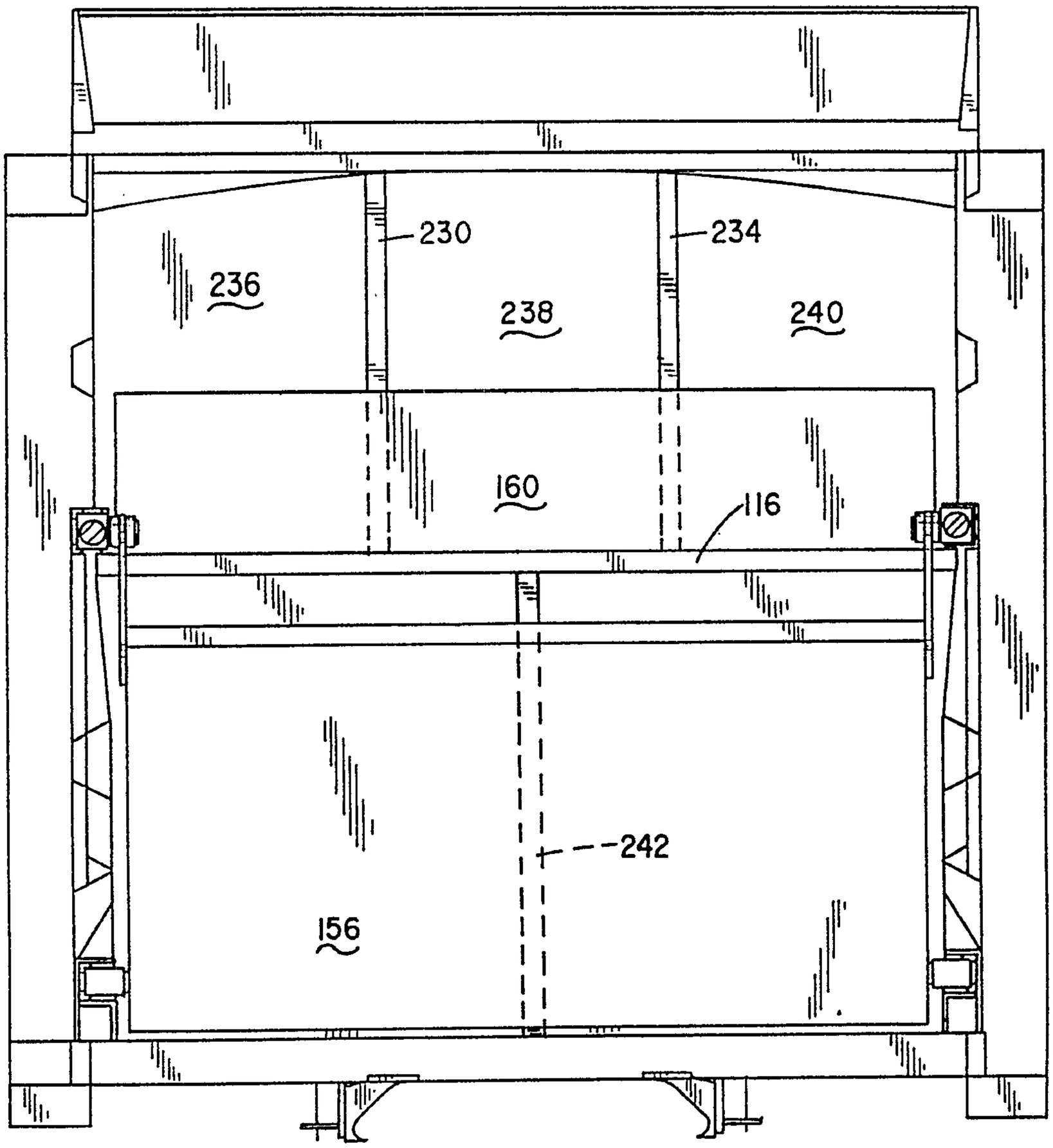


FIG. 46

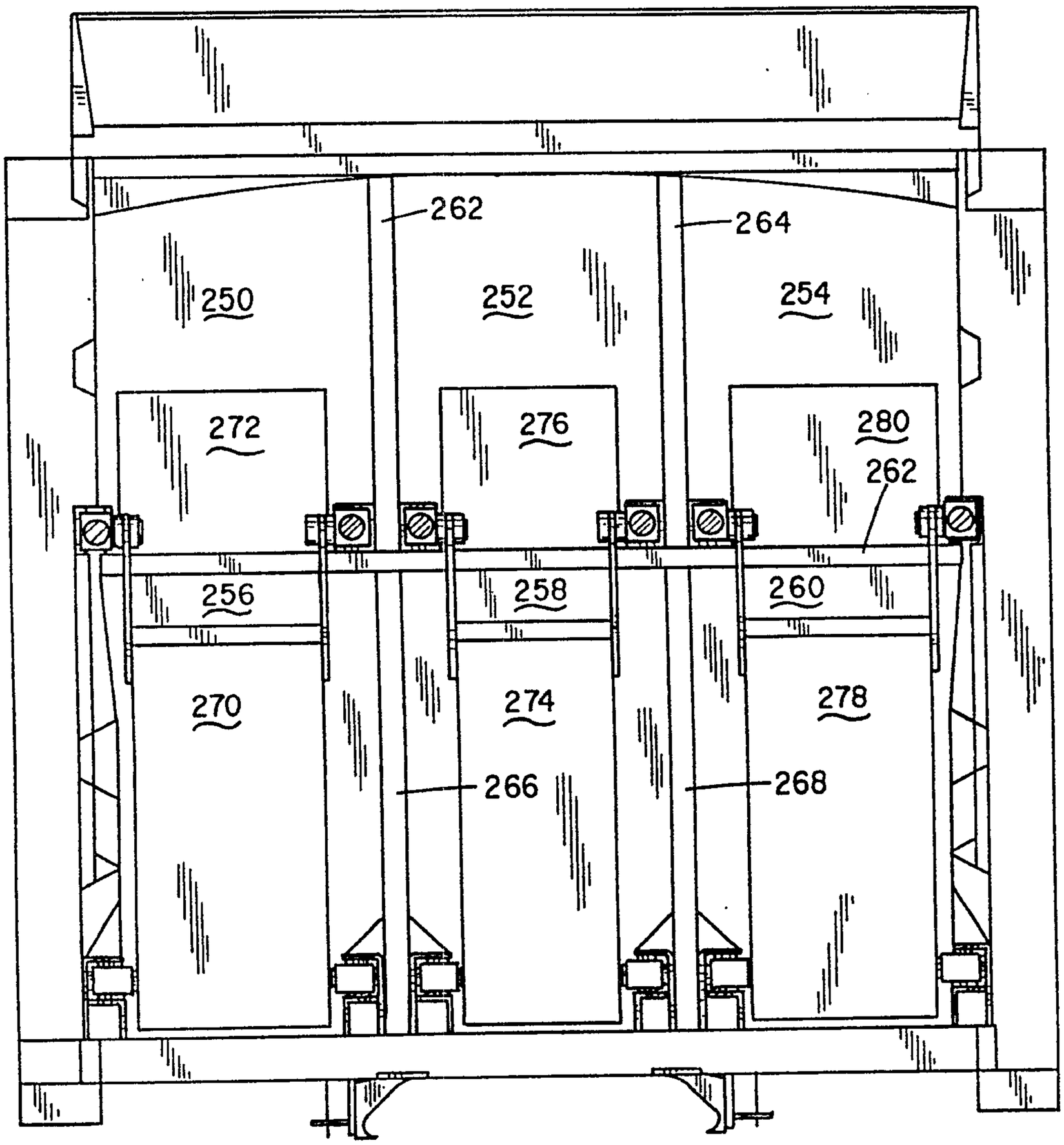

262
264
250
252
254
272
276
280
262
256
258
260
270
274
278
266
268

FIG. 47

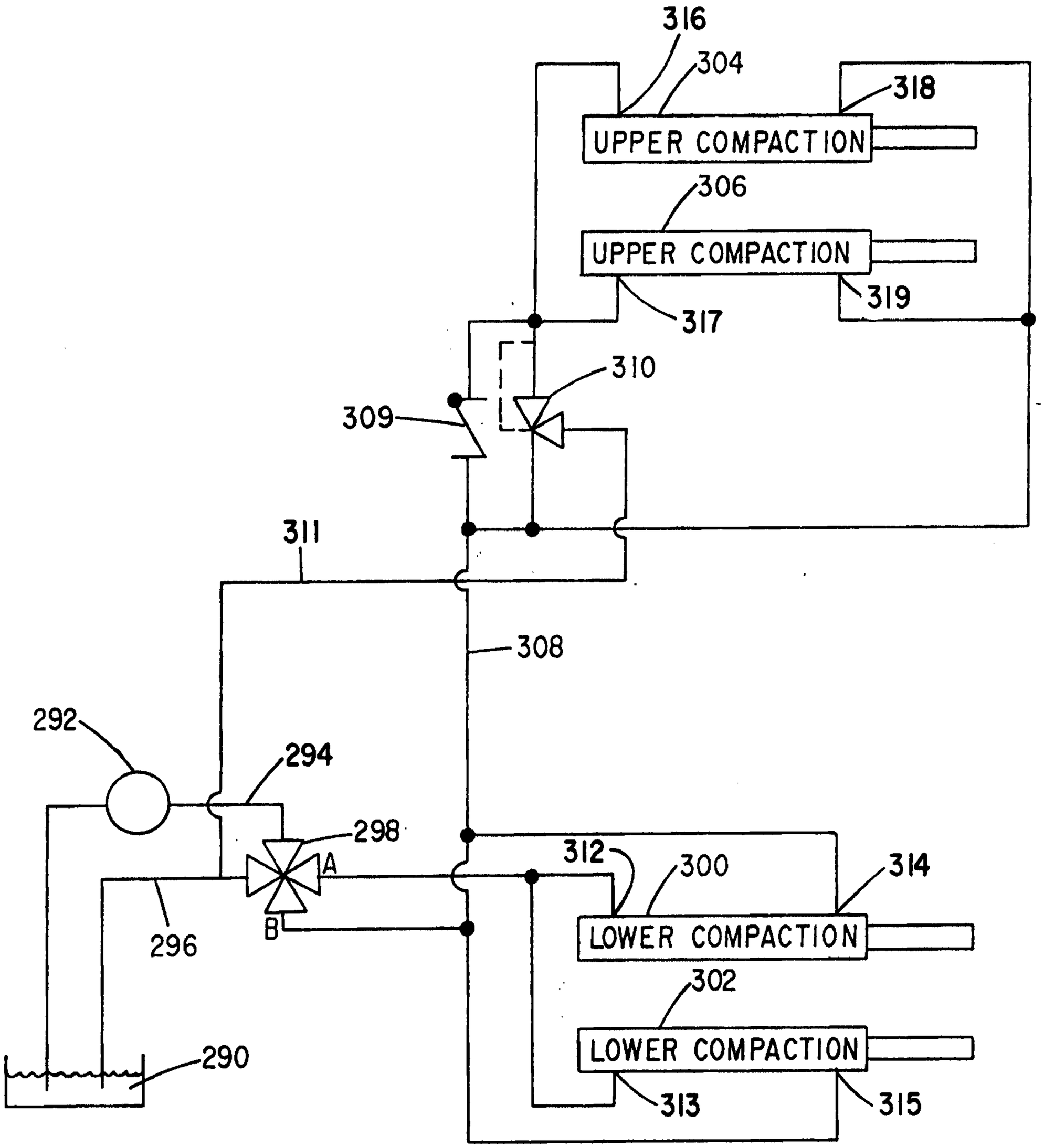

316
304
318
UPPER COMPACTION
306
UPPER COMPACTION
319
317
310
309
311
308
292
294
298
A
B
296
312
300
314
LOWER COMPACTION
302
LOWER COMPACTION
313
315
290

FIG. 48

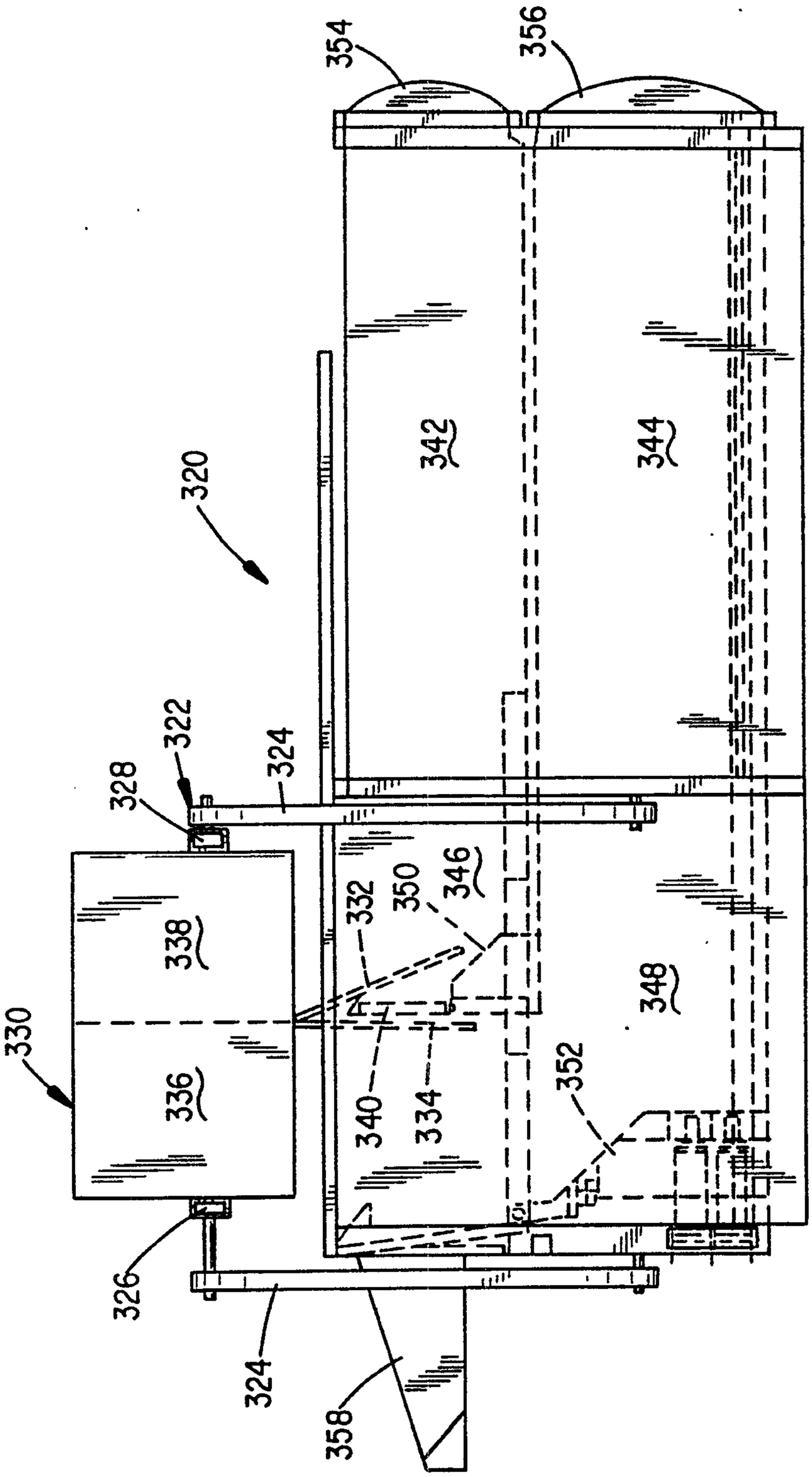
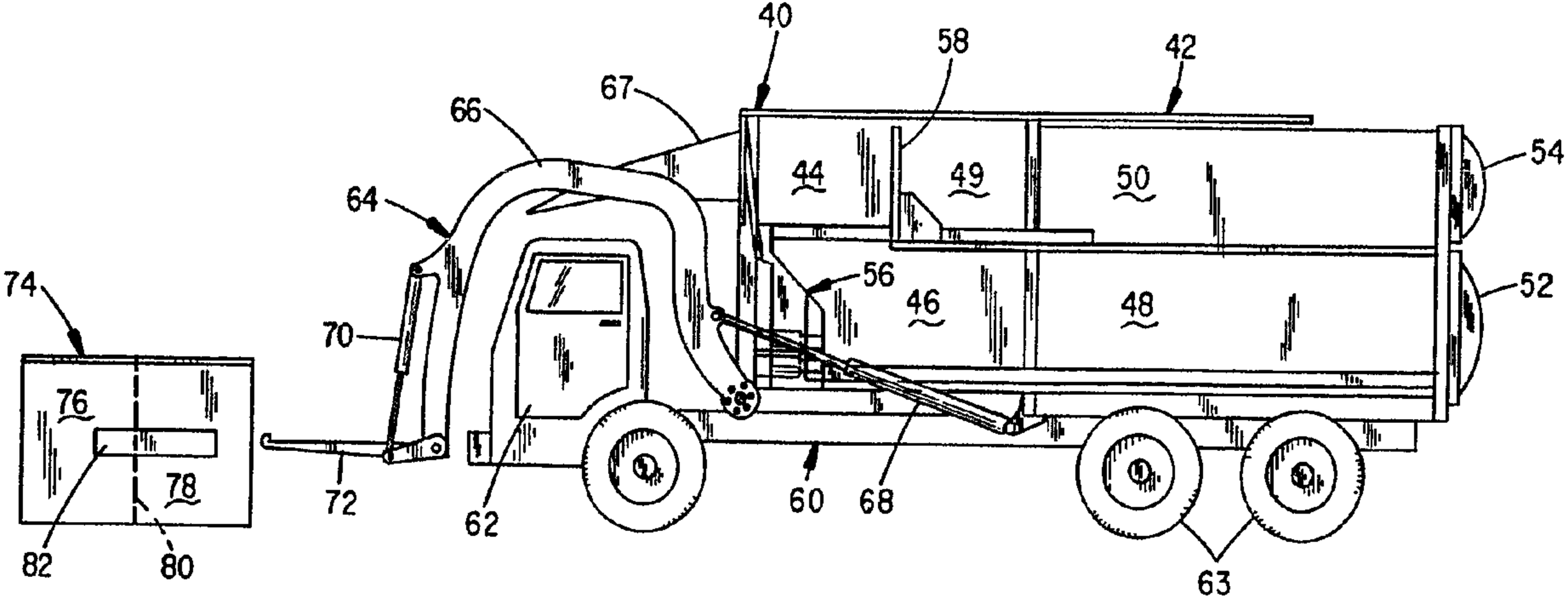

354
356
320
342
344
322
328
324
346
350
332
338
330
336
340
334
352
348
326
324
358

FIG. 49


40
58
42
67
66
64
74
44
49
50
54
56
46
48
52
70
76
78
72
62
60
68
82
80
63