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(54) **SYSTEME A CYCLE AUTOMATIQUE DE MANIPULATION DE  
POUBELLES AVEC MONTAGE SUR PIVOTS**

(54) **AUTO CYCLE SWIVEL MOUNTED CONTAINER HANDLING  
SYSTEM**

(57) Le véhicule de collecte d'ordures à plusieurs compartiments de la présente invention comporte un manipulateur automatique de poubelles capable de soulever et vider automatiquement une poubelle dans un bac de réception sélectionné du véhicule. Un microprocesseur commande le déploiement, la montée et la position latérale du manipulateur de poubelles. Ce microprocesseur analyse la tension de sortie de potentiomètres couplés au manipulateur de poubelles de façon à coordonner l'actionnement du manipulateur de poubelles, c'est-à-dire, prendre en douceur la poubelle sur le bord du trottoir, vider le contenu de la poubelle dans le bac de réception choisi, et replacer la poubelle au même endroit sur le bord du trottoir, mais à une distance établie au-dessus du sol.

(57) A multi-compartment refuse and/or collection vehicle having an automated container handling mechanism that may automatically lift and dump a container into a preselected corresponding charging hopper of the vehicle. A microprocessor controls the extension, lift and lateral position of the container handling mechanism and analyzes the output voltage of potentiometers coupled to the container handling mechanism to thereby coordinate actuation of the container handling mechanism and smoothly pick up the container from the curbside, dump the container into the preselected corresponding charging hopper, and return the container to the same position on the curbside but above the ground a predetermined distance.

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| <b>(54) Title:</b> AUTO CYCLE SWIVEL MOUNTED CONTAINER HANDLING SYSTEM  |   |   |
| <b>(57) Abstract</b>  |   |   |
| <p>A multi-compartment refuse and/or collection vehicle having an automated container handling mechanism that may automatically lift and dump a container into a preselected corresponding charging hopper of the vehicle. A microprocessor controls the extension, lift and lateral position of the container handling mechanism and analyzes the output voltage of potentiometers coupled to the container handling mechanism to thereby coordinate actuation of the container handling mechanism and smoothly pick up the container from the curbside, dump the container into the preselected corresponding charging hopper, and return the container to the same position on the curbside but above the ground a predetermined distance.</p> |   |   |

**AUTO CYCLE SWIVEL MOUNTED CONTAINER HANDLING SYSTEM**  
**BACKGROUND OF THE INVENTION**

**I. Field of the Invention**

This invention relates generally to lift and dump mechanisms for lifting and emptying  
5 containers, particularly refuse containers, into a multi-compartment refuse vehicle. More  
particularly, this invention relates to a device and method that automatically lifts, dumps into  
a selected hopper and returns a container to the same location on the curbside. Position  
sensitive potentiometers coupled to the container handling mechanism generate signals that  
allow coordination of the various members of the container handling mechanism for smooth  
10 operation and automatic return of the container handling mechanism to an initial position.

**II. Discussion of the Related Art**

Over the years, various devices have been used to transfer the contents of waste  
receptacles into the storage bodies of refuse vehicles. Refuse vehicles may load from the  
front, side or rear. Mechanized material handling devices often include a container holder or  
15 grasping device connected to an arm which is connected to a base, such as a vehicle. The  
arm and grasping device are operated to engage a container of interest, lift and dump the  
container into a receiving hopper in the vehicle.

A representative example of such a device appears in United States Patent No.  
5,391,039, issued to Holtom, which describes a refuse loader arm including a lift limb and a  
20 reach limb articulated to one another at a pivot point. The lift limb is vertically pivotally  
attached at one end to a refuse vehicle and the reach limb is articulated at its other end to a  
bin grasping assembly which is held at a constant angle to the lift limb by a parallelogram  
linkage. The lift limb and the reach limb pivot in a common plane to reach out and grasp the  
container of interest and lift and dump the container. Of course, the vehicle must be  
25 positioned directly alongside the container such that the container is aligned with the pivoting  
plane of the arm. United States Patent No. 5,330,308, issued to Armando et al., describes a  
refuse container loading device including a tubular support attached to a refuse vehicle,  
operable to pivot in a horizontal plane. A telescoping arm that pivots vertically is attached to  
the base and to a bin grasping device -that is able to pivot vertically and swivel horizontally.

30 Similarly, United States Patent No. 4,175,903, issued to Carson, describes an  
apparatus for picking up containers wherein a boom arm is attached to a platform which is

-2-

pivotaly attached to a refuse vehicle for rotating in a generally horizontal plane. The boom arm is pivotaly attached to the platform for pivoting vertically to raise and dump a container. A pick-up arm is provided to grasp the container and is attached to the boom arm with the ability to rotate in essentially a horizontal plane. The devices described in the '308 and '903 patents eliminate the need for precise positioning of the vehicle, but the lift and dump arms are quite complex.

In its simplest form, a fluid-operated actuator system includes a single linear actuator linked to operate on a single machine part. This actuator supplies the force needed to move the part. A jointed arm, for example, usually requires several actuators or a single actuator connected to operate a complex linkage in order to smoothly operate the jointed arm. The jointed arm may be designed using a plurality of actuators coupled in series, the actuation of which must be coordinated in order for the mechanized system to work smoothly. Otherwise, the device may not work as desired, for example, it may jam and even cause severe damage to the mechanical components and other parts of the machine. In this regard a need presently exists for a device and method to improve coordination of such a system. The present invention contemplates coordination of the actuation of fluid operated double acting cylinders coupled in series to a relatively simple lift and dump arm in a manner that avoids jamming and mechanical damage.

The operation of the conventional lift arms and grasping devices often requires that the operator joggle or shake the container above a preselected hopper opening while in the dump position to remove any contents jammed in the container. The operator must then manually control the positioning of the arm and grasping device in order to place the container on the ground. During this manual operation, it may be difficult for the operator to return the container to the exact position from which it was removed. Replacing a container between other objects in close proximity may prove difficult without incidental contact with the other objects or slamming of the container into the ground. Therefore, there is a need for a device and method to automatically and smoothly return a container to its original position after dumping into a multi-compartment vehicle. The present invention addresses these and other needs.

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### SUMMARY OF THE INVENTION

The purpose of the present invention is to provide a multi-compartment refuse and/or collection vehicle having a lift and dump mechanism that may automatically lift, dump into a preselected compartment and return a container of interest to the curbside. The vehicle includes a frame and container handling mechanism attached to the frame. The container handling mechanism generally includes an articulated arm having an actuated reach arm, lift arm and articulated grabber. The reach arm and the lift arm both have a fixed end and a free end. The fixed end of the reach arm is pivotally attached to an actuated swivel mount to allow fore and aft positioning of the grabber relative to the frame of the refuse vehicle. The free end of the reach arm is attached to the fixed end of the lift arm. The free end of the lift arm is attached to the articulated grabber.

A plurality of potentiometers are mechanically coupled to the reach arm, lift arm and swivel mount and are electrically coupled to an analog circuit. The analog circuit is electrically coupled to a programmable microprocessor based controller interface. Each potentiometer transmits an output voltage to the analog circuit which stores these values. The output voltages of the potentiometers are representative of the position of the reach arm, lift arm, and swivel mount with respect to the frame and hence each other. The analog circuit uses the output voltages transmitted by the potentiometers to transmit corresponding data to the programmable controller interface.

The microprocessor based controller includes software for processing data from the analog circuit and for providing output signals to control the activation of the actuators attached to the reach arm, lift arm, and swivel mount, to thereby coordinate the actuation of the double acting cylinders attached to the reach arm, lift arm and swivel mount. The controller is coupled to pneumatic and hydraulic circuits which control corresponding hydraulic double acting cylinders for lifting and extending the arms and for controlling the swivelling of the swivel mount. In this manner, a container of interest may be automatically lifted and dumped above the opening of a preselected charging hopper and returned to the same curbside position at a level slightly above the ground to avoid slamming the container into the ground.

## OBJECTS

It is accordingly a principal object of the present invention to provide a device for automatically controlling the lift and dump cycle of a container handling mechanism of a multi-compartment vehicle.

5 Another object of the present invention is to provide a device and method for automatically lifting a container from the curbside, dumping the container into an opening of a preselected charging hopper, and returning the container to the same position on the curbside.

10 A further object of the present invention is to provide a device and method that allows the user to manually or automatically lift and dump a container of interest into a preselected charging hopper with the container handling mechanism.

15 These and other objects, as well as these and other features and advantages of the present invention will become readily apparent to those skilled in the art from a review of the following detailed description of the preferred embodiment in conjunction with the accompanying drawings and claims and in which like numerals in the several views refer to corresponding parts.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a side elevational view of a refuse collection vehicle suitable for use with a container handling system having a lift arm and extension arm;

20 Figure 2 is a fragmentary perspective view from the embodiment of Figure 1, showing the container handling system in the stowed position;

Figure 3 is a fragmentary perspective view similar to that of Figure 2 showing a container (in phantom) as having been seized by the container handling system and with the upper packer panel assembly removed;

25 Figure 4 is a fragmentary perspective view similar to that of Figure 3 illustrating both the seized container in the raised, inverted or tipped position and the relative alignment of potentiometers associated with the lift arm and extension arm;

Figure 5 is an enlarged fragmentary perspective view illustrating details of the container handling mechanism;

30 Figure 6 is a partial sectional enlarged side elevational view of one type of hydraulically operated swivel mount and a potentiometer attached thereto;

-5-

Figure 7 is a fragmented side elevational schematic view of the joystick and pad, showing the associated pneumatic lines extending from the joystick;

Figure 8 is a partial schematic diagram of an electric circuit electrically coupled to the pad shown in Figure 7;

5 Figure 9 is a schematic diagram of the electrical, pneumatic and hydraulic circuits used to control the lift, extension, swivel and grabbing of the container handling mechanism of the present invention; and

Figures 10 is a software flow diagram of the automatic dump cycle in accordance with the present invention.

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### DETAILED DESCRIPTION

The present invention represents broadly applicable improvements in a class of loading devices which can take form in any of a variety of embodiments. The embodiments detailed herein are intended to be taken as representative or exemplary of those in which the improvements of the invention may be incorporated and are not presented as being limiting in any manner.

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Referring first to Figures 1 and 2, the container handling mechanism 10 of the present invention is shown mounted to a side loading refuse vehicle 12. The handling mechanism 10 includes a swivel mount, generally at 14, which is attached to one of two spaced main frame or chassis members 16-18 (see Figure 2) of the refuse vehicle 12. The swivel mount 14 is attached to the frame member 16 underneath upper and lower refuse receiving or charging hoppers 20 and 21 respectively, which includes a top opening as at 22, for receiving refuse. Details of the swivel mount 14 will be described below in greater detail. A hinged or pivoting lift arm, generally at 26, has a fixed end pivotally connected to the swivel mount 14 and a free end pivotally connected to a refuse container holder or grabber, generally at 28.

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25 As will be described below, the swivel mount 14 enables the position of the extension arm 24, lift arm 26 and container holder 28 to be adjusted back and forth along the length of the refuse vehicle 12 to accommodate a container 30 of interest in a variety of locations and later dump the container into the upper charging hopper 20 or lower charging hopper 21. The grabber 28, extension arm 24, and lift arm 26 cooperate to empty refuse containers into the

30 charging hopper 20 or 21 through opening 22.

-6-

The refuse vehicle 12 includes a cab 32 and a multi-compartment storage body 34 connected to receive material from corresponding charging hopper 20 or charging hopper 21. The storage body 34 and charging hoppers 20 and 21 are carried on a common sub-frame 36 which, in turn, may be pivotally attached to heavy chassis frame members 16-18 as at 38. The charging hoppers 20 and 21 are aligned to corresponding compartments 33 and 35 within the storage body 34 for compacting refuse into the storage body 34 (see Figures 2 and 3). The storage body 34 includes a tailgate 40 which is pivotally carried by a pair of hinges, one of which appears at 42, mounted at the top of the storage body 34. The tailgate 42 is operated between an open and a closed position by a pair of hydraulic cylinders, one of which is shown at 44, which are pivotally attached to the tailgate 40, as at 46, and to the storage body 34, as at 48. Side latches, as at 50, are provided for latching tailgate 40 to the storage body 34 in a well-known manner. Those skilled in the art will appreciate that the tailgate 40 may be replaced with an upper and lower tailgate of similar construction, such that each compartment 33 and 35 may be enclosed independent of the other.

The tailgate 40 is designed to open in conjunction with the tilting of the storage body 34 to discharge refuse. Tilting is accomplished by a pair of spaced side mounted hydraulic lift cylinders, one of which appears at 52, that are pivotally attached between the frame by a heavy lug or gusset member 54 at 56 and to the storage body 34 sub-frame 36 at 58. A cab protector is shown at 60 and the entire system is supported by a plurality of wheels.

Figures 2-4 shows the position of the container handling mechanism 10 and associated extension 24 and lift 26 arms during a dump cycle. As will be described in greater detail below, the extendable arm 24 and swivel mount 14 combination enables the position of the lift arm 26 and container holder 28 to be adjusted laterally and back and forth along the length of the refuse vehicle 12 to accommodate handling a container of interest anywhere within a relatively extensive range. The grabber system 28, lift arm 26 and extension arm 24 cooperate to approach, seize, lift, empty, and return the refuse containers. Figure 2 shows the container handling mechanism in a stowed position and aligned with a container 30 and with the grabber fully opened to minimize lateral protrusion with respect to the vehicle. Figure 3 shows the container handling mechanism 10 extended and grabbing a container 30 of interest. Figure 4 shows the container handling mechanism 10 in a dump position with the lid 62 of container 30 pivoted open. Those skilled in the art will appreciate that curbside



-7-

refuse containers 30 need not be aligned at a particular spot or be particularly close to the truck 12 so long as they are in the range of the extendable arm 24. Once the container is seized by grabber 28, the operator may initiate an automatic dump cycle which lifts, empties into a preselected charging hopper 20 or 21, and returns the container near its original position above the ground a predetermined amount. The details of the auto dump cycle will be described below in greater detail in conjunction with the description of Figures 7-10.

Figure 5 shows in greater detail the preferred embodiment of the container handling mechanism 10, depicting the articulated extendable lift-and-dump arms 24-26 of the invention in greater detail. The extension arm 24 and lift arm 26 are pivotally connected at a central joint 64. Extension arm 24 is pivotally attached between the swivel mount 14 as at 70 and central joint 64 as at 72. Lift arm 26 is pivotally attached between central joint 64 as at 74 and grabber system 28 as at 76. The joints of the system, particularly those of the articulated extension and lift arms 24-26, may be provided with conventional resilient bushings to cushion the operation of the system and increase the life of the mechanical joints. These may be of a rubber compound or other durable resilient material of a durometer to reduce shock yet not affect mechanical joint performance. Alternatively, the pivot joints may be maintenance free greaseless connections as shown in co-pending U.S. patent application serial number 08/752,220 filed November 19, 1996 and assigned to the same assignees as the present invention, the entire disclosure of which is incorporated herein by reference.

The extension arm 24 and lift arm 26 are operated by a pair of linear actuators, preferably double acting hydraulic cylinders. The extension arm 24 has an upper or reach controlling cylinder 66 and the lift arm 26 has a lift, lift/tipping, or dumping cylinder 68, each being mounted with a rod end and a pivotally connected cylinder end. The cylinder end of reach cylinder 66 is pivotally connected to wrist pin pivot joint 78 and the rod end is pivotally connected to a second wrist pin type pivot joint 80 connected between spaced lugs 82 and 84 fixed at central joint 64. The cylinder end of the lift cylinder or actuator 68 is connected pivotally at joint 86 and the rod end is pivotally connected to a common pin member 88. The pin member 88 joins the common joint of spaced pairs of arcuate linkage elements 90 and associated linking rods as at 92. A grabber mounting and pivot segment 94 pivotally connects the grabber system 28 to the lift arm 26 as at 74. The pair of spaced operating following rods or linkage bars, one of which is shown at 92, are attached to pivot

segment 94. These rods flank the lift arm 26, and pivot the grabber 28 for dumping as the lift cylinder 68 is extended.

The grabber 28 includes opposed digits or compound jaw elements having inner segments 100 and 102 flanked by outer segments 104 and 106. The inner segments 100 and 102 are pivotally connected to a base element 108 at 110 and 112, respectively, and outer segments 104 and 106 likewise are pivotally connected to the respective inner elements at 114 and 116. The opposed segments are operated to close or open to seize or release a rigid container 30 by pivotally connected, oppositely disposed pairs of linear actuators, including inner and outer actuators 118 and 120 operating outer segments 104 and 106, respectively, and inner and outer actuators 122 and 124 (see also Figure 3), in a like and symmetric manner, operating inner segments 100 and 102. Roller members 126 and 128 mounted in the outer segments 104 and 106 guide the outer segments in following the periphery of a container of interest to be seized. Each roller member 126-128 may be made from a rubber material or plastic material such as high density polyethylene. Details of additional suitable grasping or grabber devices may be had by consulting U.S. Patent application Serial No. 08/342,752, entitled CONTAINER HOLDING AND LIFTING DEVICE, filed November 21, 1994 and U.S. Patent application Serial No. 08/716,999, entitled CONTAINER GRABBING DEVICE, filed September 20, 1996, both of which have been assigned to the same assignee as the present application, the disclosures of which are hereby incorporated by referenced herein for any necessary purpose.

Figure 6 shows a portion of the swivel mount 14, the details of which will next be presented. The swivel mount 14 includes heavy base plate 130 affixed to frame member 16 underneath the side of recessed or offset refuse receiving or charging hopper 20. A base pivot member 132 is aligned between upper and lower flanges 134 and 136 through which a pivot shaft 138 is journaled for rotation on spaced bearings 140. An operable swivel arm 142 and connecting link 144 are keyed to the pivot member or shaft 132. The rod end of a base pivot cylinder 146 is connected to the swivel arm 142. The extension arm 24 is pivotally mounted to a dual plate mounted to flanges 134-136 (see Figure 4). The extension or reach cylinder 66 mounts to member 148 extending from the pivot member 132 between the dual plates. Extension and retraction of the base pivot cylinder 146 rotates or swivels the pivot member 132, thereby pivoting the dual plate and extension arm 24 forward and aft in

relationship to the vehicle chassis and charging compartments 20 and 21. The fluid lines to cylinders 66-68, 118-124 and swivel cylinder 146 are coupled to means for controlling the cylinders, as discussed below in further detail.

The control system of the present invention employs potentiometric devices to  
5 determine the relative position of certain parts. Referring to Figures 4 and 6, potentiometers 150-154 of known suitable construction are shown coupled to the respective extension arm 24, lift arm 26 and swivel mount 14. Each potentiometer includes a shaft that rotates within the potentiometer as the position of the corresponding extension arm 24, lift arm 26, or  
10 swivel mount 14 changes. As the shaft rotates the resistance within the potentiometer changes, thereby changing an output voltage relative to an input voltage. The amount of the measured output voltage is used to correlate the position of the shaft with the position of the corresponding extension arm 24, lift arm 26, or swivel mount 14. As shown in the drawings, bars 156-160 are attached to the shaft of the respective potentiometers 150-154. Bars 156-158 travel in a groove formed in ramp 162 attached to respectively to the extension arm 24  
15 and lift arm 26. A spring (not shown) applies a constant pressures against the bar, thereby engaging the bar against ramp 162. As the bar moves up and down the ramp, the shaft of the potentiometer rotates, changing the measured output voltage of the potentiometer. The ramp 160 tends to accentuate the rotation of the shaft as the corresponding cylinders of the extension arm 24 and lift arm 26 are extended and retracted. Potentiometer 154 has a  
20 jointed bar 160 attached to the shaft thereto. The free end of the jointed bar is fixed to pivot member 132. As the pivot member 132 rotates, the bar 160 in turn rotates the shaft of potentiometer 154. The bar is jointed to allow movement through approximately 180°. A potentiometer of suitable known construction is available from Duncan, Inc., part number 9810-661-2 RE 56155 96-07 having a resistance between 0-5k ohms.

25 Figures 7-9 depict a system for controlling the extension, lift and swivel of the means for carrying a container, and taken together show the electrical and fluid coupling of the microprocessor based controller and the hydraulic cylinders or actuators. Figures 7 and 8 show a joystick 170 and pad 172 used for controlling auto cycle and manual actuation of extension cylinder 66, lift cylinder 68, swivel cylinder 146, and grabber cylinders 118-124. A  
30 main pneumatic line 176 enters the joystick control console 174, wherein fore and aft movement (movement in the y-plane) or lateral movement (movement in the x-plane) of the

joystick 170 controls the flow of fluid through the pneumatic lines 178-184 to corresponding pneumatic solenoids 186-192. Vector arrows indicate the direction that the joystick is moved to control the flow of fluid through one of pneumatic lines 178-184.

The pad 172 includes switches and associated electrical conductors 206-217 (see Figure 8) that are electrically coupled to a corresponding programmable interface controller 202 (see Figure 9) which is electrically coupled to pneumatic solenoids 194-200 and corresponding analog circuit 204 for automatic control of solenoids 186-190. Pneumatic solenoids 186-200 are electrically coupled to hydraulic solenoids 220-232 which control the actuation of double acting hydraulic cylinders 66, 68, 146, and 118-124 respectively. Potentiometers 150-154 are electrically coupled to analog circuit 204 as at 234-238 and send a signal representative of the actuation of the corresponding cylinders 66, 68, and 146 and relative position of the associated reach arm 24, lift arm 26, and swivel mount 14.

Having described the essential constructional features of a representative embodiment of the present invention, the mode of operation will next be presented in conjunction with the flow chart of Figure 10. At the beginning of a cycle, the operator positions the vehicle such that the container 30 is in range somewhere in front of the container handling mechanism 10 (see block 250). The operator then manipulates joystick 170 to manually control the coordinated actuation of reach 66 and lift 68 cylinders, to thereby align the grabber 28 with the container 30. The operator then closes switch 212 to actuate cylinders 118-124 and engage grabber 28 with container 30 (see block 252).

The operator then selects which charging hopper 20 or 21 the container will be emptied, wherein closing switch 217 will empty the container into upper charging hopper 20 and closing switch 215 will empty the container into lower charging hopper 21. The operator then depresses or closes switch 214 to activate the auto dump cycle (see block 254) and either closes switch 215 or 217 depending upon the charging hopper selected for receiving the container's contents. The analog circuit stores in memory the output voltage signals received from potentiometers 150-154 which correlates with the position of the extension arm 24, lift arm 26, and swivel mount 14 and corresponding extension cylinder 66 (E), lift cylinder 68 (L), and swivel cylinder 146 (S) at the container pick-up position (see block 256). The initial output voltages are stored in memory as  $e_i$ ,  $l_i$ , and  $s_i$  (see block 258). A first output voltage of potentiometer 154 corresponds with a position for dumping into the

-11-

upper charging hopper 20 and a second output voltage of potentiometer 154 corresponds with a position for dumping into the lower charging hopper 21. The first and second output voltages are predetermined and stored within the programmable interface 202. The analog circuit 204 then controls and coordinates the actuation of extension cylinder 66, lift cylinder 68 and swivel cylinder 146, thereby actuating the swivel cylinder 146 and raising and tipping the container above the selected charging hopper 20 or 21, such that the output voltage of potentiometer 154 corresponds with either the first output voltage (switch 217 closed) or the second output voltage (switch 215 closed; see block 260).

Once the container 30 is in the dump position, the operator has the option of releasing the auto cycle switch 214 and using the joystick 170 to joggle the container 30 to jar loose any material remaining in the container 30. The operator then depresses the auto cycle switch 214 to continue the auto dump cycle (see block 264). The analog circuit and programmable interface 202 together control the actuation of cylinders 66, 68 and 146 such that the output voltages received from potentiometers 150-154 are equal to  $e_i$ ,  $l_{i,k}$ , and  $s_i$  (see block 266), wherein  $k$  is a preprogrammed constant determined to elevate the container slightly above the ground to avoid slamming the container on the ground during the auto cycle. In this manner the container is returned to the initial position on the curbside, but above the ground a predetermined distance. The operator then disengages the container 30 (see block 268) and then repeats the auto dump cycle for other containers (see loop 270).

During the auto dump cycle, if the auto dump cycle switch 214 is released a timer is initiated (see decision block 262 and block 272) tracking time ( $T$ ). If the auto cycle switch 214 is again depressed before a preprogrammed maximum time ( $M$ ) the auto dump cycle continues (see decision blocks 274 and 276, and block 264). If the tracked time  $T$  is greater than the preprogrammed maximum time  $M$ , the reset switch 216 must be closed (see block 278), the extension arm 24, lift arm 26, and swivel mount 14 repositioned, and the auto cycle switch 214 depressed which re-initiates the auto dump cycle (see loop 280).

This invention has been described herein in considerable detail in order to comply with the patent statutes and to provide those skilled in the art with the information needed to apply the novel principles and to construct and use such specialized components as are required. However, it is to be understood that the invention can be carried out by specifically different devices, and that various modifications, both as to the equipment details

WO 99/15439

PCT/US98/08990

-12-

and operating procedures, can be accomplished without departing from the scope of the invention itself.

What is claimed is:

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-13-

## CLAIMS

1. A lift and dump mechanism to automatically lift, dump and return a container of interest to an original location comprising:

- a) a frame;
- b) carrying mechanism for carrying the container among pick-up, dump and release locations;
- c) swivel mount mechanism attached between said frame and said carrying mechanism for swiveling said carrying mechanism fore and aft relative to said frame, said swivel mount mechanism having a first position sensor coupled thereto for generating a signal representative of a rotational position of said swivel mount mechanism relative to the frame;
- d) reach mechanism pivotally attached to said swivel mount mechanism for extending the carrying mechanism towards and away from the frame, said reach mechanism having a second position sensor coupled thereto for generating a signal representative of a position of said reach mechanism relative to the frame;
- e) lift mechanism pivotally attached between said reach mechanism and said carrying mechanism for lifting the container between the pick-up, dump and release locations, said lift mechanism having a third position sensor coupled thereto for generating a signal representative of a position of said lift mechanism relative to the reach mechanism;
- f) a control system for controlling the position of said swivel system, said reach mechanism, said carrying mechanism and said lift mechanism, said control system being electrically coupled to said first, second and third position sensors, said swivel mount mechanism, said reach mechanism, said carrying mechanism, and said lift mechanism;

-14-

and

g) wherein said control system includes:

- (1) a memory programmed to store values related to signals from said position sensors indicative of at least one coincident position of said swivel mount mechanism, said reach mechanism and said lift mechanism at said pickup location;
- (2) reposition control device to reposition said swivel mount mechanism, said reach mechanism and said lift mechanism at said release location, said release location being a function of said pickup location.

2. The lift and dump mechanism of claim 1 wherein said memory is further programmed to store values related to signals from said position sensors identifying selected positions addressing at least one fore and one aft dumping location for said swivel mount mechanism and a dumping control device to control the dumping location used.

3. The lift and dump mechanism of claim 1 wherein said release location differs from said pickup location by a constant amount related to a height of said lift mechanism.

4. The lift and dump mechanism of claim 2 wherein said release location differs from said pickup location by a constant amount related to a height of said lift mechanism.

5. The lift and dump mechanism of claim 1 wherein said frame is attached to a refuse collection vehicle of the side loading type.

6. The lift and dump mechanism of claim 1 wherein said control means includes a microprocessor-based controller electrically coupled to said first, second and third position sensors and said swivel means, reach means, carrying means and said lift means.

7. The lift and dump mechanism of claim 1 wherein



-15-

said first position sensor includes a potentiometer mechanically coupled to a swivel mount of said swivel means.

8. The lift and dump mechanism of claim 1 wherein said second position sensor includes a potentiometer mechanically coupled to a reach arm of said reach means.

9. The lift and dump mechanism of claim 1 wherein said third position sensor includes a potentiometer mechanically coupled to a lift arm of said lift means.

10. The lift and dump mechanism of claim 2 wherein said dumping control device is a hand-operated switch.

11. A lift and dump mechanism to automatically lift, dump and return a container of interest to an original location comprising:

- a) a frame attached to a refuse vehicle of the side loading type;
- b) carrying mechanism for carrying the container between pick-up, dump and release location;
- c) swivel mount mechanism attached between said frame and said carrying mechanism for swiveling said carrying mechanism fore and aft relative to said frame, said swivel mount mechanism having a first position sensor coupled thereto for generating a signal representative of a rotational position of said swivel mount mechanism relative to the frame;
- d) reach arm pivotally attached to said swivel mount mechanism for extending the carrying mechanism towards and away from the frame, said reach arm having a second position sensor coupled thereto for generating a signal representative of a position of said reach arm relative to the frame;
- e) lift arm pivotally attached between said reach arm and said carrying mechanism for lifting the container between the pick-up, dump and release locations, said lift arm having a third position sensor coupled thereto for generating a signal

**PCT/US 98 '08990**  
**IPEA/US 01 SEP 1999**

-16-

- representative of a position of said lift arm relative to the reach arm;
- f) a control system for controlling the position of said swivel system, said reach arm, said carrying mechanism and said lift arm, said control system being electrically coupled to said first, second and third position sensors, said swivel mount mechanism, said reach arm, said carrying mechanism, and said lift arm; and
- g) wherein said control system includes:
- (1) a memory programmed to store values related to signals from said position sensors indicative of at least one coincident position of said swivel mount mechanism, said reach arm and said lift arm at said pickup location;
  - (2) control device to reposition said swivel mount mechanism, said reach arm and said lift arm at said release location, said release location being a function of said pickup location.

12. The lift and dump mechanism of claim 11 wherein said memory is further programmed to store values related to signals from said position sensors identifying selected positions addressing at least one fore and one aft dumping location for said swivel mount mechanism and a dumping control device to control the dumping location used.

13. The lift and dump mechanism of claim 11 wherein said second location differs from said first location by a constant amount related to the height of said lift mechanism.

14. The lift and dump mechanism of claim 12 wherein said second location differs from said first location by a constant amount related to the height of said lift mechanism.

15. The lift and dump mechanism of claim 12 wherein said dumping control device is a hand-operated switch.

**PCTAUS** 93/08990  
**IPEAUS** 01 SEP 1999

-17-

16. The lift and dump mechanism as in claim 11 wherein said second and third actuating means can be extended together in a combined power stroke.

17. The lift and dump mechanism of claim 11 wherein said frame is attached to a refuse collection vehicle of the side loading type.

18. The lift and dump mechanism as in claim 11 wherein said second and third actuating means can be extended together in a combined power stroke.

19. The lift and dump mechanism of claim 11 wherein said control means includes a microprocessor-based controller electrically coupled to said first, second and third position sensors and said first second and third actuating means.

20. The lift and dump mechanism of claim 11 wherein said first position sensor includes a potentiometer coupled to the swivel mount.

21. The lift and dump mechanism of claim 11 wherein said second position sensor includes a potentiometer coupled to the reach arm.

22. The lift and dump mechanism of claim 11 wherein said third position sensor includes a potentiometer coupled to the lift arm.

23. The method of automatically engaging lifting, dumping and returning a container of interest comprising the steps of:

(a) providing a lift and dump mechanism having sensors and memory adapted to provide and store data indicative of the position of a container being handled by the lift and dump mechanism and a control system adapted to use stored data to return said lift and dump mechanism to a predetermined position;

(b) operating said lift and dump mechanism to approach and engage a container of interest to be dumped;

- 18 -

- (c) sensing and storing data indicative of the position of the lift and dump mechanism at the time of engagement of said container of interest;
- (d) storing said positional information in memory;
- (e) lifting said container and dumping said container in a selected location; and
- (f) returning said container to a predetermined position related to the position indicated by the stored positional information.

24. The method of claim 19 wherein said container is returned and released at a position just above that from which it was originally retrieved so that it is not forced into its original support.

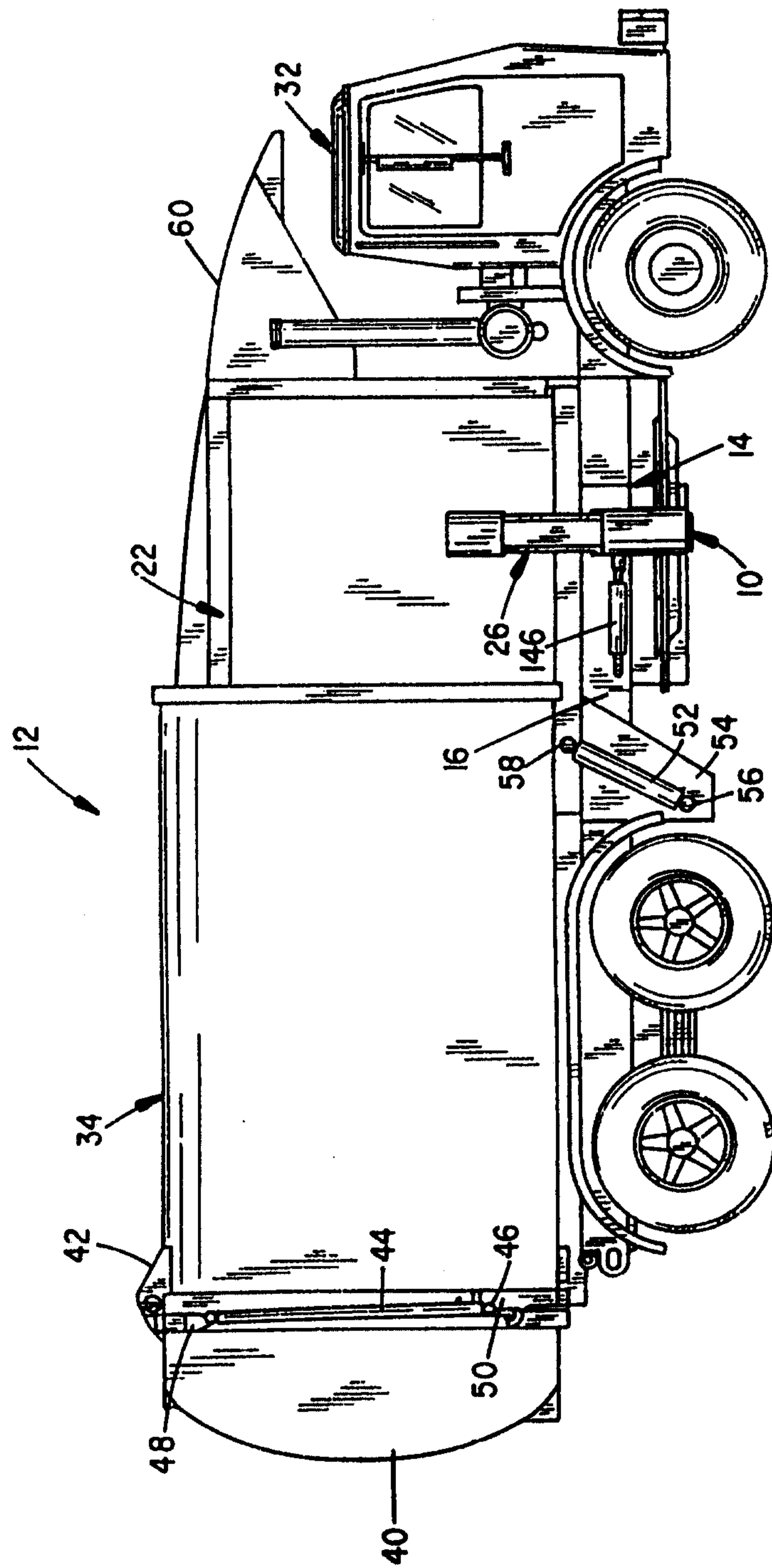


FIG. 1

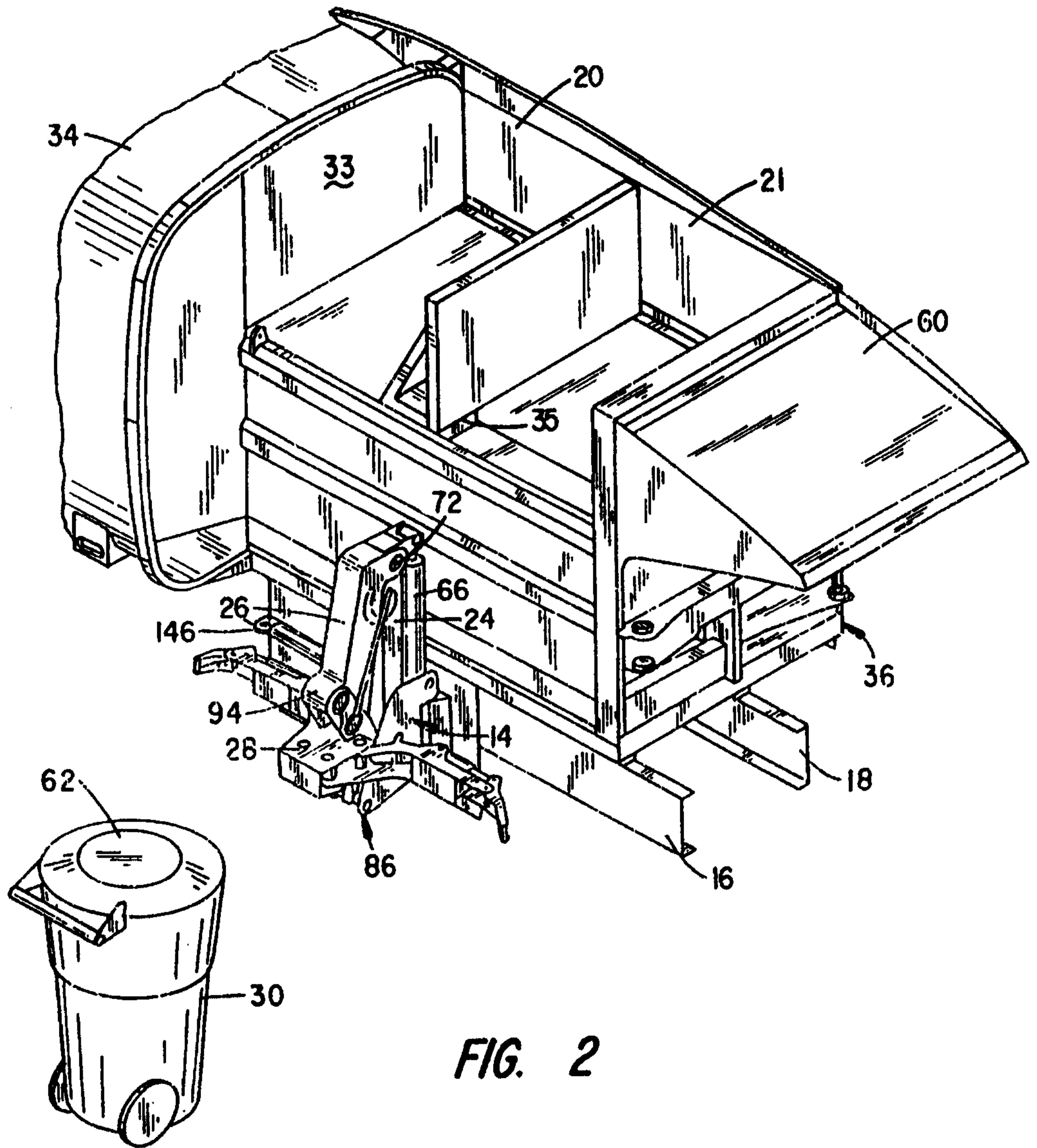


FIG. 2

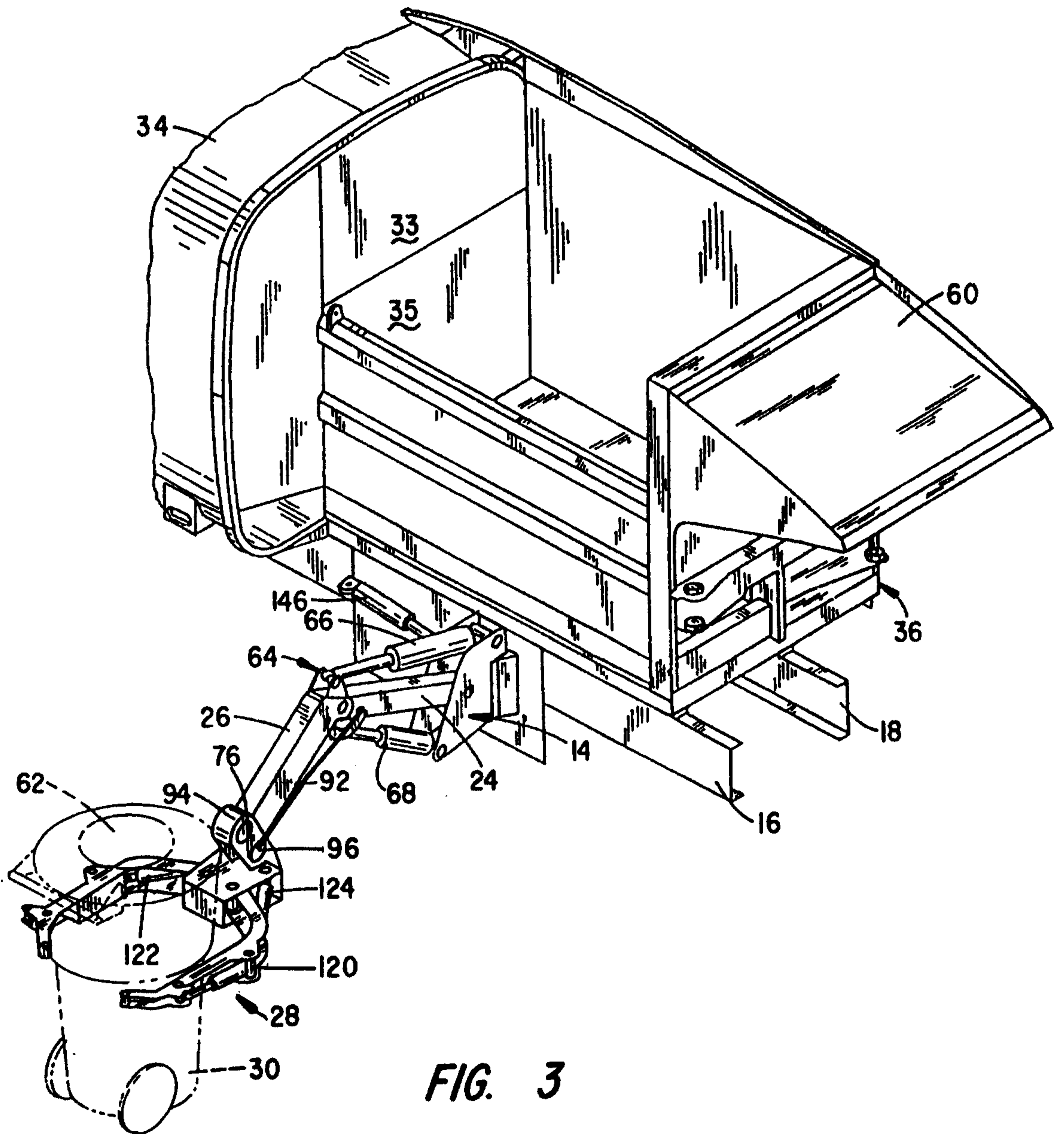


FIG. 3

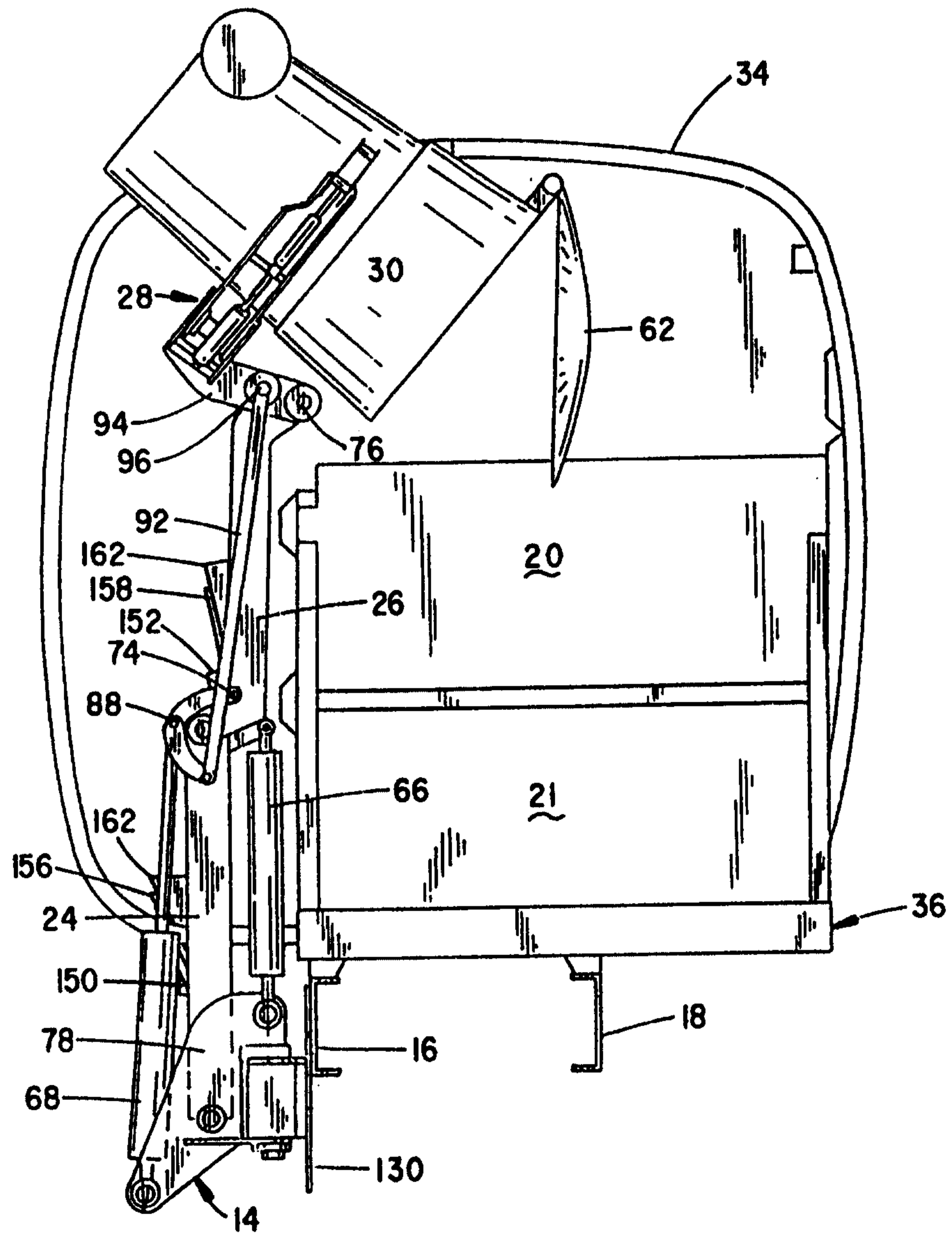


FIG. 4



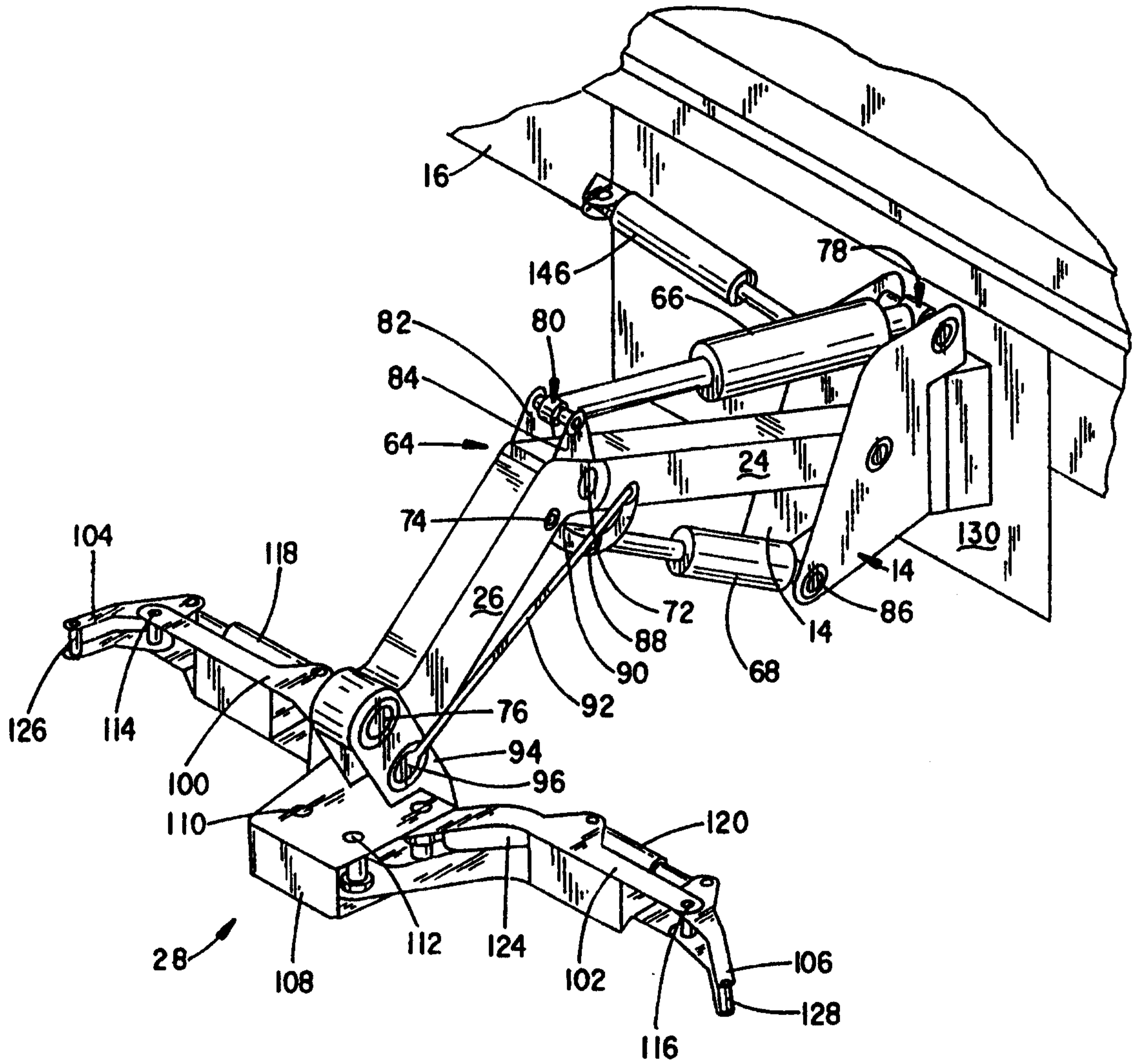


FIG. 5

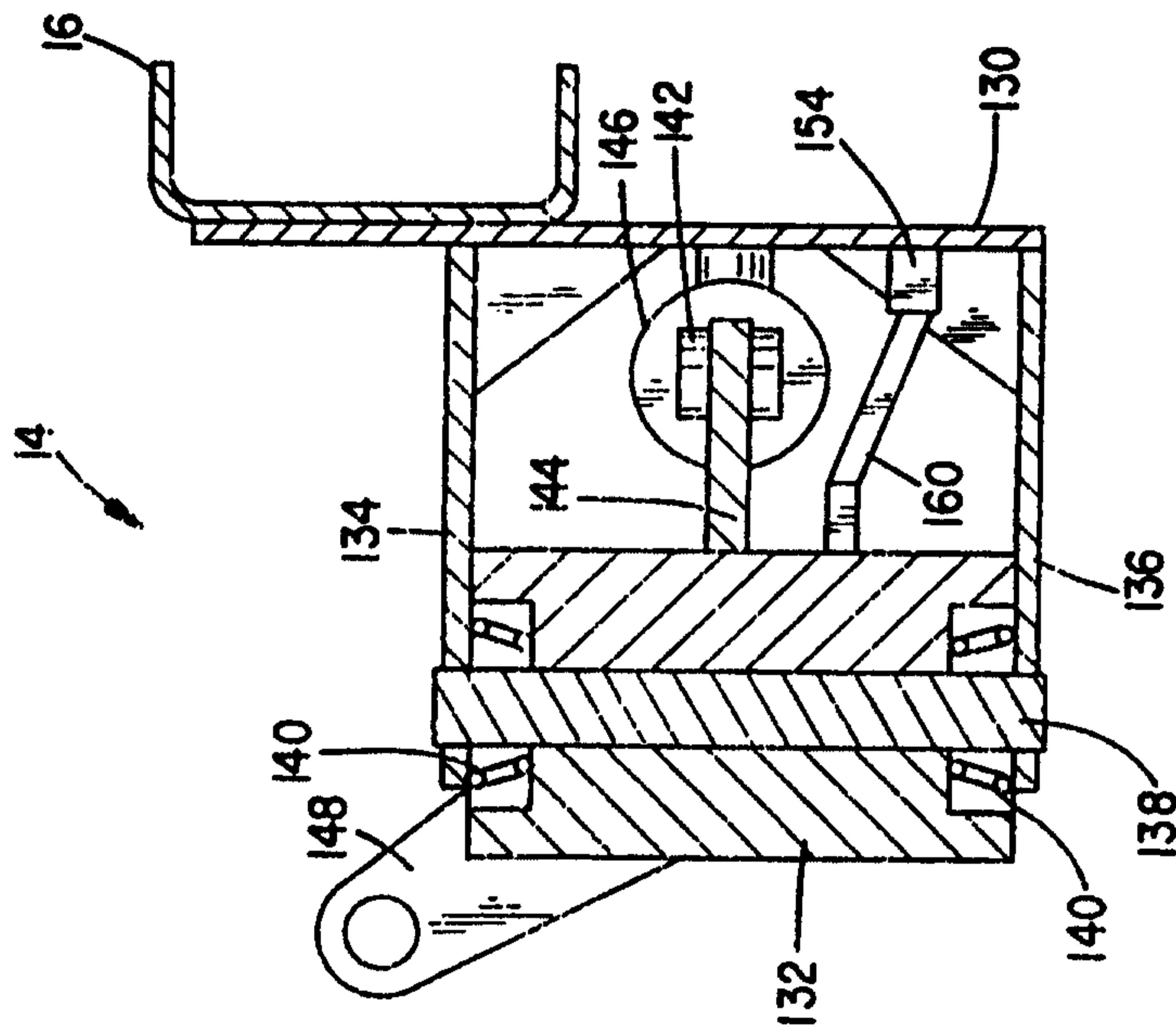


FIG. 6

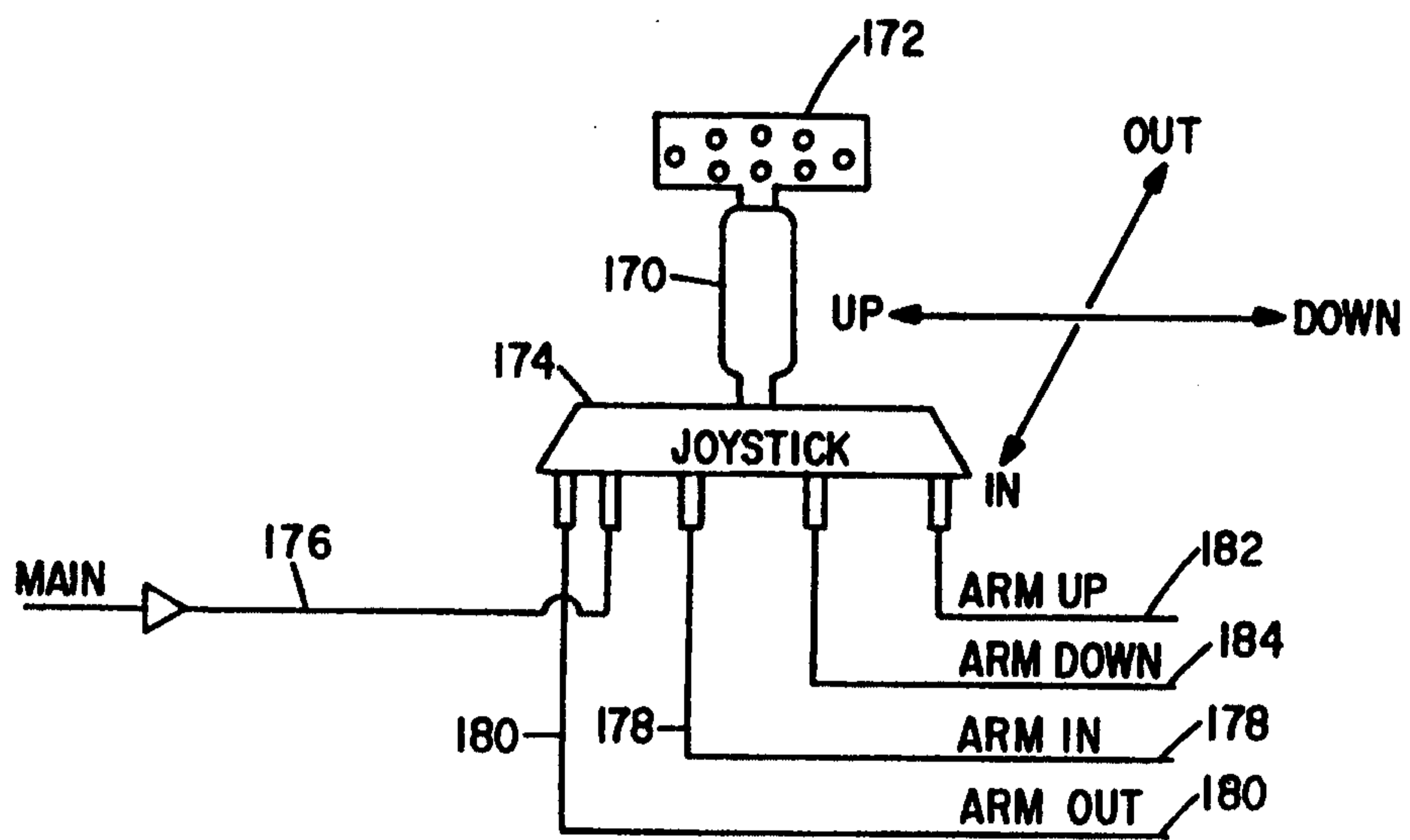


FIG. 7

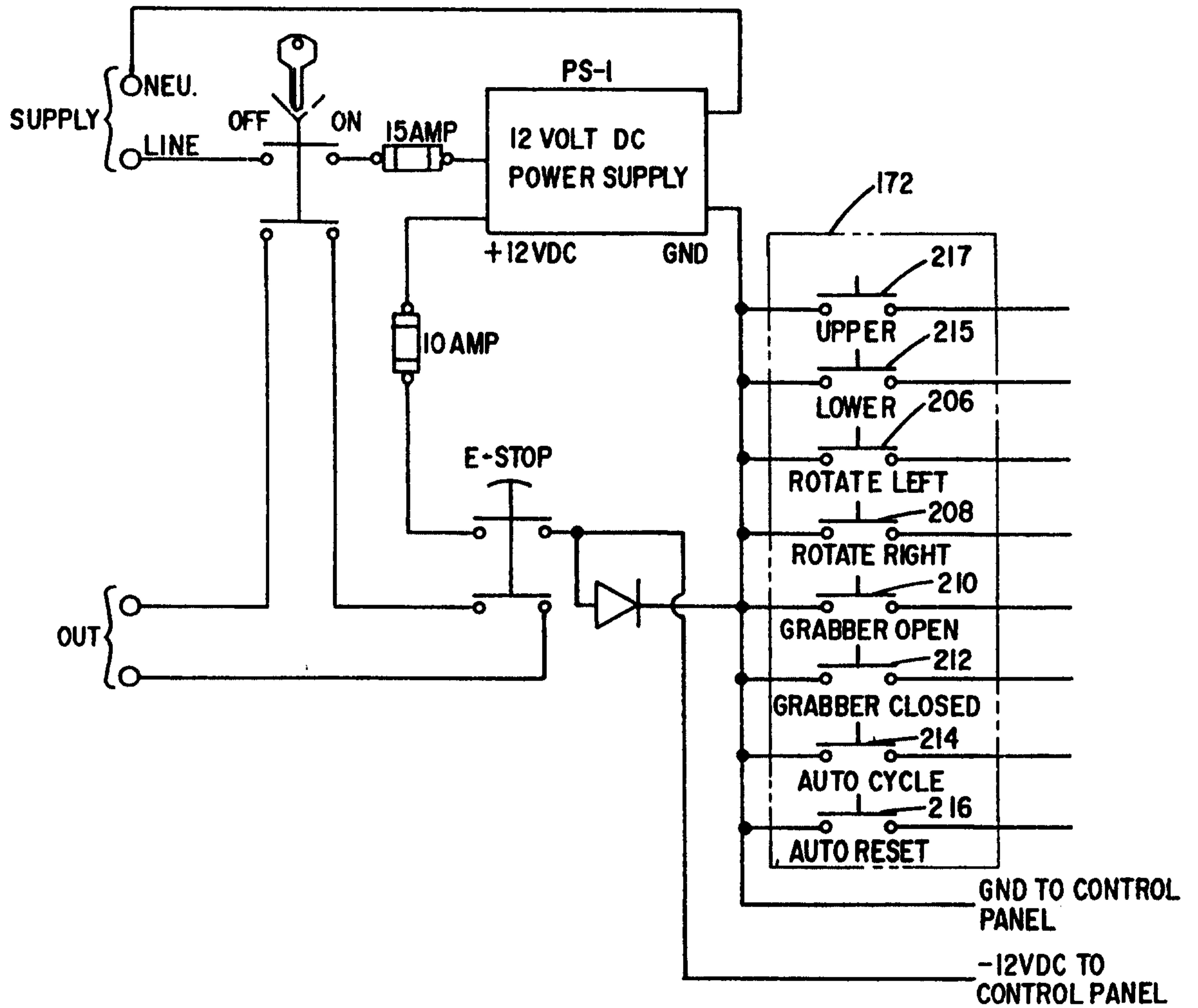


FIG. 8

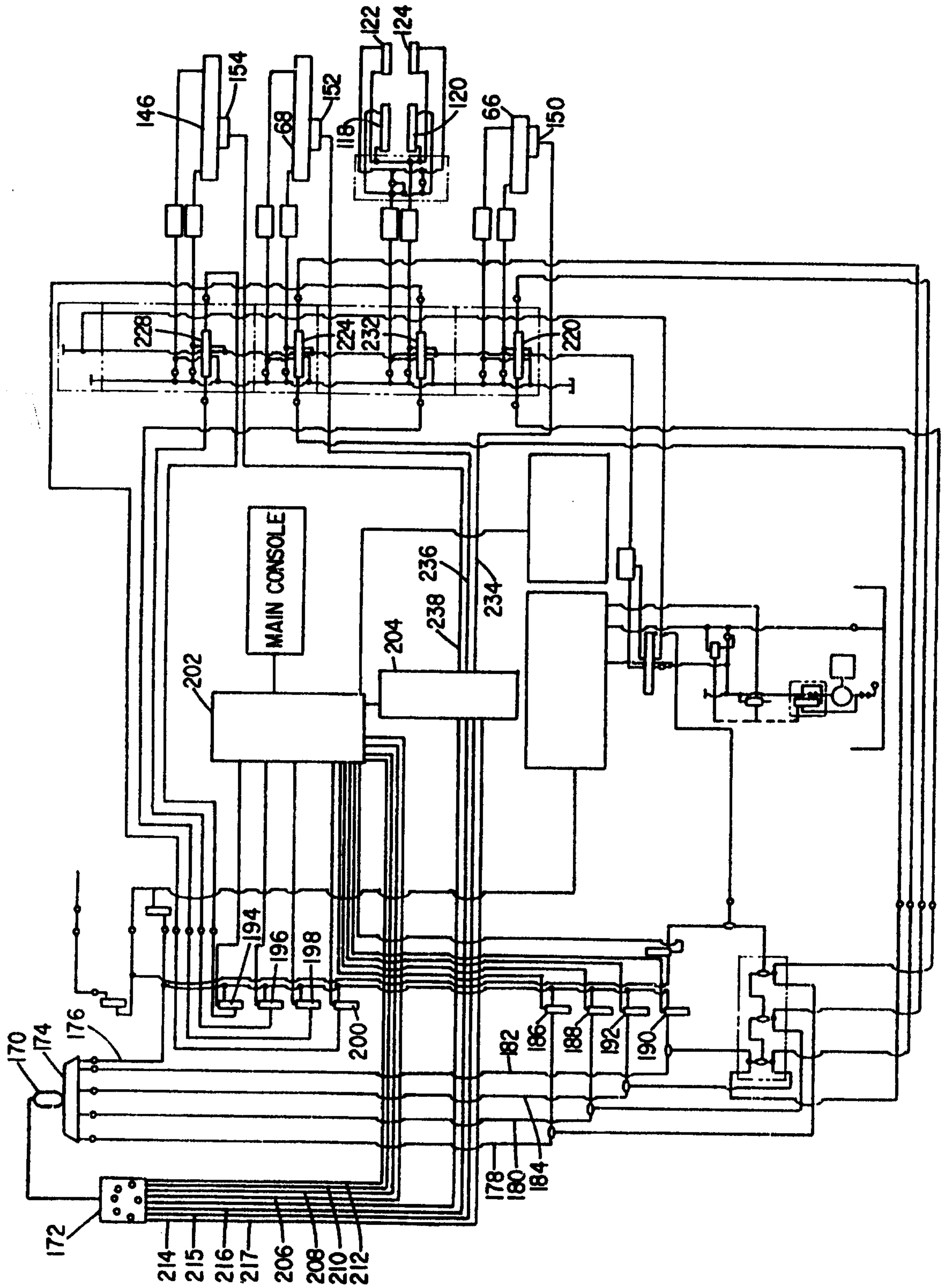


FIG. 9

10/10

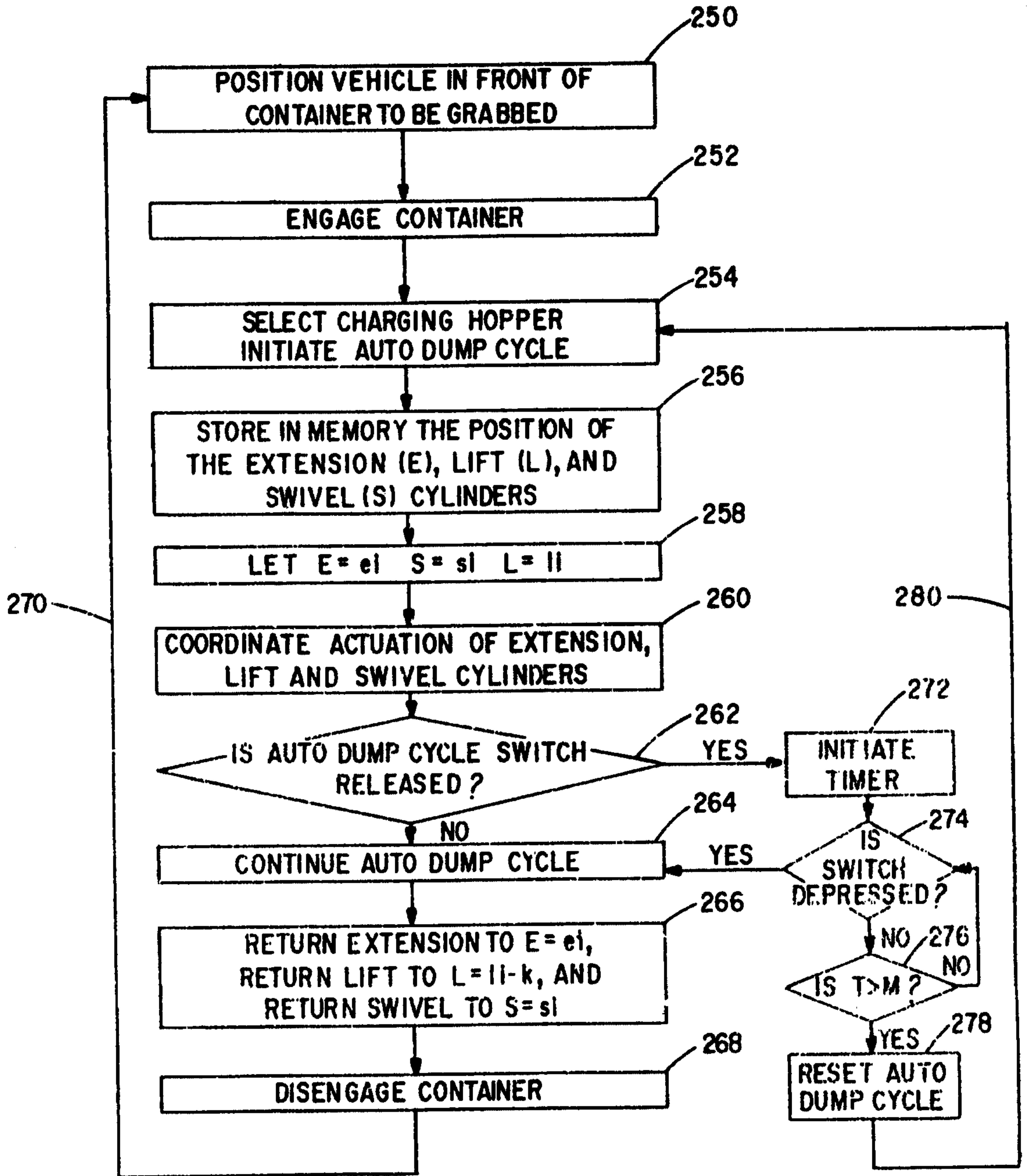


FIG. 10