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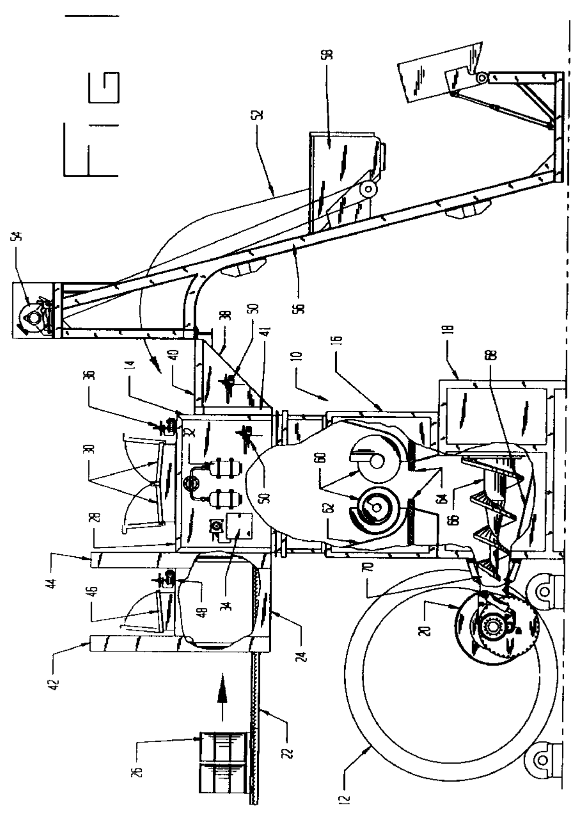
(54) Waste feed system.

(57) A waste feed system is described for feeding an incinerator, kiln or storage container. A drop chamber receives waste material. A primary shredder, preferably a dual auger shredder, receives waste material from the drop chamber to shred and blend the material. A secondary shredder, preferably a single auger shredder, receives material from the primary shredder. A feeder injects material from the secondary shredder into the receptacle.



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The present invention relates to waste feeding systems and, more particularly, to waste feeding systems which reduce the volume of waste material prior to injection into a receptacle such as an incinerator, kiln or sealed storage container.

Pollution concerns and restrictive laws make it undesirable to bury toxic or hazardous material, or dispose of such material in landfills. Burning of such material in incinerators, kilns or rotary reactors, along with treatment of the gaseous effluent of such burning, is becoming more acceptable. Burning of hazardous material appears to be the least environmentally harmful method for disposing of such material, since the complex molecules of such material often can be broken down into less harmful constituents. In any event, the volume of hazardous material is reduced by burning. Accordingly, incinerators,have been adapted to receive hazardous and toxic material for burning.

In order for such incineration processes to be run in an efficient manner, it is desirable to provide a mechanism for feeding different types of hazardous material in different kinds of containers to incinerators so that the material may be injected at a measured rate. It is also desirable to reduce the size of the hazardous material prior to burning to an even homogenous consistency to promote burning of the material or to facilitate its storage in containers. Further, it is desirable to feed the containers used in transporting the hazardous material to the incinerator for burning as well, thereby eliminating potentially dangerous drum storage and manual drum emptying situations.

One example of such a system is disclosed in Houser U.S. Patent No. 4,958,578. That system consists of an incinerator heating system in which containerized solid waste is fed into a shredder which reduces the material and comminutes the material containers, all of which falls downwardly to an auger feeder which injects the shredded material into a rotary kiln through an opening in the face of the kiln. A disadvantage with such a system is that it utilizes a single-pass shredder which cannot ensure consistent particle size, and utilizes a single auger feeder which may cause jamming and burn-back situations.

Accordingly, a need exists for an incinerator feed system in which .hazardous or toxic material can be reduced to a predetermined, homogenized consistency and ,fed into an incinerator at a uniform rate. Furthermore,there is a need for a device which can feed comminuted hazardous material into the face of an incinerator which can be offset from the face of the incinerator to provide clearance for other fuel feed systems.

In accordance with the present invention, we provide a waste feed system characterised in comprising: drop chamber means for receiving waste material; primary shredder means arranged to receive waste material from said drop chamber and adapted to shred and blend said waste material; secondary shredder means arranged to receive said waste material from said primary means and adapted to further shred said ,waste material to reduce size of material; and feeding means arranged to receive said waste material from said secondary means and adapted to pump said material into a receptacle.

Particular embodiments of our feed system, described in detail below, can receive toxic material in either bulk or containerized form and reduce such material to a homogenous consistency of predetermined particle size and inject it into an incinerator or a suitable storage receptacle.

In a preferred embodiment, the primary grinding component includes a dual auger shredder having a pair of opposing, counter-rotating, tapered augers mounted in a contoured grinding chamber having adjustable doors in the bottom which allow the residence time of the material in the chamber to be selectively varied, thereby controlling the ultimate particle size of the material leaving the chamber. The secondary component preferably is a single tapered auger shredder which is mounted within a contoured grinding chamber positioned directly below the,bottom doors of the primary grinding chamber to receive the waste material therefrom. The secondary grinding chamber further reduces the material received from the primary chamber and the single auger discharges the material through a side opening in the secondary grinding chamber.

The feeding component preferably includes a single auger mounted within a conical housing which receives the side discharge of arterial from the secondary grinding component and injects the material into the incinerator. Also in the preferred embodiment, the auger screw of the feeding component is oriented at a right angle to the auger shredder of the secondary component so that the entire system may be offset from the face of the incinerator, thereby providing clearance on the incinerator face for additional fuel devices.

Also in the preferred embodiment, the drop chamber includes an air-lock and conveyor system so that containerized waste, which may be in steel drums, can be deposited into the drop chamber to be ground and shredded without the release of toxic material to the atmosphere. In addition, the drop chamber includes an air lock which accepts bulk waste from a skip loader The drop chamber also includes a screw conveyor for feeding stabilizing material, such as cement, to the waste material.

Further, the entire system is suitably enclosed to prevent the escape of toxic fumes or liquids, and includes oxygen sensing and inert gas purging systems to reduce the likelihood of a fire or explosion during the grinding and shredding operation. The enclosed system also includes fire suppression mechanisms in the event a fire does occur in the system. The incinerator feeding component includes a rotary gate which is positioned downstream of the feeding auger screw to prevent burn-back of material from the incinerator. Our described embodiments also include a computer control which senses the resistance encountered by the grinding elements and can vary the particle size of material in the primary grinding component by selectively positioning the bottom doors of the primary grinding component to allow material to drop into the secondary grinding component.

It will be seen from the following description that we can produce embodiments of our waste feed system which are capable of handling both bulk and drums or other containers of hazardous waste material, reducing the material to a consistent particle size and feeding the material into an incinerator; a waste feed system in which waste is reduced in size in an environment which is closed off from the atmosphere to reduce contamination; a waste feed system which can be positioned in an offset location from the face of an incinerator to provide clearance for other fuel feeding devices; a waste feed system which includes oxygen purge and fire suppression systems to insure that waste material is reduced in size in an environment where explosions and fire are minimized: a waste feed system in which burn-back from the incinerator is prevented; and a waste feed system in which waste material can be continuously fed into a waste reducing means for feeding into an incinerator with a minimum of jamming.

The invention is hereinafter more particularly described by way of example only with reference to the accompanying drawings, in which:-

Fig. 1 is a schematic side elevational view of an embodiment of waste feed system according to the present invention;

Fig. 2 is a detail of the system of Fig. 1 showing the air lock and drop chamber mechanism;

Fig. 3 is a detail of the air lock and drop chamber mechanism of Fig. 1 showing the air lock door for the bulk feed stabilization feeder;

Fig. 4 is a detail of the system of Fig, 1 showing the discharge doors of the primary grinding component in a closed configuration;

Fig. 5 is a detail plan view of the system of Fig. 1, showing the injector component in section adjacent to an incinerator;

Fig. 6 is schematic block diagram of the inputs and outputs to the programmable logic controller of the system of Fig. 1; and Fig

Fig. 7 is a schematic block diagram of the sensors of the system of Fig. 1.

As shown in Fig. 1 and schematically in Fig. 7, the illustrated waste feed system, generally designated 10, is used to feed hazardous or toxic material to a rotary reactor such as an incinerator 12. The system includes a drop : chamber 14, a primary grinding component 16, positioned below the drop chamber, a secondary or base grinding component 18, positioned below the primary grinding component, and a feeding or injector component 20 which interconnects the system 10 with the incinerator 12. The system also includes a horizontal conveyor 22 adjacent to an air lock chamber 24 which is connected to the drop chamber 14 and includes a transport conveyor. Conveyor 22 is used to convey containerized materials, such as a a pallet of steel drums of hazardous material 26, to the drop chamber 14.

As shown in Figs. 1, 2, 3 and 7, the drop chamber 14 includes a rectangular housing 28 having explosion doors 30 mounted in an upper surface, a fire suppression system 32 consisting of tanks of a fire suppressant chemical, connected to discharge into housing 28, an oxygen monitoring system 34, and a safety relief valve 36 to purge the chamber in the event inert gas pressure exceeds a predetermined limit. An infeed chute 38 is connected to the drop chamber 14 and is sealed from the atmosphere by an outer, horizontal, sliding air lock door 40, and from the drop chamber 14 by an inner vertical door 41.

Similarly, air lock 24 includes outer and inner vertically sliding air lock doors 42, 44, an explosion relief door 46 in the upper surface and a safety relief valve 48 for purging an excess of inert gas. The air lock 24, drop chamber housing 28 and chute 38 each include inert gas regulators 50 connected to sources 51 of inerting as. Air lock 24 and chute 38 also include oxygen monitors 34 and fire suppression systems 32.

A skip hoist, generally designated 52, is connected to the chute 38 and includes a motor 54 mounted on a vertically extending track 56 which supports a bucket loader 58. The bucket loader 58 is pulled to the top of the track 56 by the motor 54 to dump its contents into the chute 38.

As shown in Fig. 3, the system 10 preferably includes a screw conveyor 59 which is connected to the drop chamber 14 and is sealable therefrom by an air lock (not shown). conveyor 59 is used to convey bulking or stabilizing agents, such as lime cement, to the material to be ground, shredded and blended by the system 10.

The primary component 16 includes a dual auger shredder having a pair of reverse-oriented tapered augers 60 positioned within a grinding chamber 62 contoured to the shape of the augers and including a pair of adjustable discharge doors 64 in the bottom of the chamber. This apparatus is disclosed in greater detail in U.S. Patent Nos. 4,938,426 and 4,993,649, the disclosures of which are incorporated herein by reference. The secondary component 16 includes an open top which communicates directly with the drop chamber 14. The primary grinding chamber includes oxygen monitors 34 and is connected to a source of inert gas 51.

Directly beneath the primary component 16 is the secondary component 18, which includes a single tapered auger 66 mounted within a grinding chamber 68 shaped to the contour of the auger 66. The design details of the single auger 66 and grind chamber 68 are disclosed in greater detail in U.S. Patent Nos. 4,253;615 and 4,951,884, the disclosures of which are incorporated herein by reference. Secondary component 18 includes oxygen monitoring and inert gas systems 34, 51, respectively.

As shown in Fig. 5, the auger 66 of the secondary component 18 projects into an extrusion tube 70. The extrusion tube 70 is connected to the housing 72 of the feeding component 20 and provides a side discharge for chamber 68. The feeding component 20 includes a single tapered screw 74 and extends sidewardly relative to the extrusion tube 70 into the face 76 of the incinerator 12. The screw 74 is rotatably mounted within a injector tube 78. The injector tube 78 includes a non-tapered section 79 having a rotary gate 80, which can be actuated to open and close the section 79 between the incinerator face 76 and auger 74. The details of the design of the rotary gate 80 are disclosed in U.S. Patent Application Serial Number 07/632,766 filed December 21, 1990, and of the feeding component 20 in U.S. Patent No. 4,915,108 the disclosures of which are incorporated herein by reference.

In the preferred embodiment, the feeding component 20 is oriented such that the auger 74 extends at a right angle to the auger 66 of the secondary component 18, so that the system 10 can be positioned to one side of the face 76 of the incinerator 12, as shown in Figs. 1 and 5.

As shown in Fig. 6, the entire system 10 is operated by a programmable logic controller 82, which receives information from sensors located in the drop chamber 14, primary grinding component 16, secondary grinding component 18 and feeding component 20. Such sensors include a material proximity sensor 84 for the staging conveyor 22 (Fig. 1), open and closed position sensors 86 for the air lock outer door 42, open and closed position sensors 88 for the air lock inner door 44, material proximity sensors 90 for the air lock and oxygen sensors 34 for the air lock and drop chamber 14.

With respect to the primary grinding component 16, the programmable logic controller 82 receives input from sensors 92 connected to the hydraulic system which drives the hydraulic motors (not shown) that rotate the dual augers 60 of the primary grinding component. These sensors 92 detect hydraulic motor rotation, hydraulic system pressure, hydraulic fluid level, hydraulic fluid temperature, main pump condition and hydraulic filter condition. Sensors 94 detect the electric motor amperage of the motor (not shown) driving the hydraulic pump of the auger, Sensors 96 detect the temperature of the bearings (not shown) supporting the augers 60, and the rate of lubricant flow. Sensors 98 detect the position of the material discharge doors 64 of the primary grinding component.

With respect to the secondary grinding component 18, the programmable logic controller 82 receives input from sensors 100 connected to the hydraulic system for the secondary grinding component. This includes sensors that detect the hydraulic motor rotation, hydraulic system pressure, hydraulic fluid level, hydraulic fluid temperature, main pump condition and hydraulic filter condition. Sensor 102 detects the electric motor amperage of the motor driving the hydraulic system of the secondary grinding component 18. Sensors 104 detect the temperature of the support bearings (not shown) for the auger screw 66, the rate of lubricant flow and the level of lubricant fluid. Sensors 34 (see also Fig. 7) detect the level of oxygen in the grinding chamber 68 of the secondary grinding component 18.

Similarly, the programmable logic controller 82 receives input from sensors connected to the feeding component 20. Sensors 106 detect the rotation of the hydraulic motor driving the auger screw 74 (Fig. 5), the hydraulic system pressure, the hydraulic fluid level, the hydraulic fluid temperature, the main pump condition, and the hydraulic filter condition. Sensors 108 detect the amperage of the electric motor driving the hydraulic motor for the auger screw 74, sensors 110 detect the bearing temperature and lubricant flow, and sensors 112 detect whether the isolation door 80 is in an open or closed configuration.

The programmable logic controller 82 also receives input from sensors 106 connected at the infeed conduit 79 (Fig. 5) of the kiln 76, sensors 108 connected to the air lock 24 (Fig. 1) and sensors 110 connected with the fire suppression systems 32. These sensors 106-110 signal the controller 82 to shut the system down should an overload condition occur at the kiln 79, a fire occur anywhere in the system 10, or the air lock become inoperative.

The controller 82 actuates control valves 112 that control the discharge doors 64, control valves 114 for the inner and outer air lock doors 44, 42, pump strokers 116 for the dual augers 60 (also controlling auger speed and direction), the pump stroker 118 for the secondary grinding component (also auger speed and direction), stroker 120 for the feeding component auger (controlling speed and direction) and the directional control valves 122 for the staging conveyor 22 and conveyor in the air lock 24. Further, the controller 82 can store specific sequences of operation for the primary and secondary feeding component 16, 18, which prescribe specific numbers of auger screw rotations in forward and reverse directions. With respect to the dual auger of the primary grinding component 16, the controller 82 also includes programs for rotating the augers in alternately forward and reverse directions so that the auger screws can rotate in unison or counter-rotate as needed.

The operation of the system is as follows. Containerized waste material is placed on the infeed staging conveyor 22 and the conveyor actuated to bring the material to the air lock 24. The inner air lock door 44 is closed and the outer air lock door 42 opens to accept the material. The infeed conveyor deposits the containerized material on the air lock conveyor which conveys it to the interior of the air lock. The outer air lock door 42 closes and the nitrogen purge 51 system is actuated to drive off ambient air until the oxygen sensors 34 detect that the oxygen level is below a predetermined value.

At that time, the inner air lock door 44 opens and the air lock conveyor conveys the containerized material 26 to the drop chamber 14 where it falls downwardly into the grinding chamber 62 of the primary component 16. At this time, the drop doors 64 of the primary component 16 are closed and the augers 60 are actuated to simultaneously grind and shred the containerized material. The energy requirements measured in terms of motor amperage, hydraulic pressure and rotational speed, are read by the controller 82 and these energy requirements gradually decrease to a steady-state value. At that point, the material has been sufficiently blended and reduced in size to be permitted to drop to the secondary or base component 18.

The bottom door 64 opens, allowing the material to drop into the grinding chamber 68 of the secondary component 18, where it is acted upon by auger 66 to be reduced further and, simultaneously, charged into the feeding component 20. The feeding component 20 monitors, by way of reading the hydraulic motor amperage, hydraulic pressure and rate of rotation of the screw 74 of the feeding component 20, and the controller varies the speed of rotation of the auger 66 so that material is fed from the grinding chamber 68 at a sufficient rate to develop a plug of material in the conduit 70.

The feeding component 20, in turn, is actuated by the controller 82 to respond to the fuel requirements of the kiln 12. While the controller 82 is not directly connected to the kiln 12, or the control mechanism for the kiln, it does receive a signal from the kiln control system (not shown) indicating fuel requirements as determined by the temperature within the kiln. Accordingly, the :eat or fuel requirements of,the kiln determine the speed of operation of the feeding component 20 which, in turn, determines the feed rate of the secondary component 18.

The secondary component 18 operates to take material from the grinding chamber 62 of the primary component 16 and further reduce material while simultaneously conveying it to the feeding component 20. This can occur while the primary component 16 is reducing and grinding a subsequent load of material. Further, the controller is programmed such that the drop doors 64 are never opened at the same time as the air lock inner doors 44, so that it is not possible for the arterial to drop through the primary grinding component 16 without being reduced and shredded by the augers 60 of that component.

The process is the same for bulk materials loaded by the skip loader 52. Such materials are dumped into the hopper 58 which is conveyed to the top of the track 56 and dumped into the chute 38 through the open outer air lock door 40. The outer air lock door 40 is closed, the oxygen purged to a predetermined below-ambient levels and the inner air lock door 41 opened to allow the material to fall into the grinding chamber 62 of the primary grinding component 16.

If necessary, the screw 59 is actuated to convey a stabilizing material or bulking agent (which may be cement, lime or fly ash) to the material in order to soak up or stabilize liquid or slurry materials so that they may be fed to the incinerator kiln 12 at an even rate.

In the preferred embodiment, the screw 74 of the feeding component 20 is substantially smaller in diameter than the screw 66 of the secondary component 18. Further, the grinding chamber 78 of the feeding component 20 is preferably smaller in volume than the grinding chamber 68 of the secondary component 18. This size differentiation minimizes the amount of equipment that must be positioned directly in front of the kiln face 76 and the smaller feeding screw 74 can inject the finely reduced material at a faster rate to the kiln 12.

In the event of a fire within the system 10, or a potential "burn-back" of material from the kiln 12, the rotary door 80 is actuated by the controller 82 to isolate the system from the kiln.

Claims

1. A waste feed system characterised in comprising: drop chamber means for receiving waste material; primary shredder means arranged to receive waste material from said drop chamber and adapted to shred and blend said waste material; secondary shredder means arranged to receive said waste material from said primary means and adapted to further shred said waste material to reduce size of material; and feeding means arranged to receive said waste material from said secondary means and adapted to pump said material into a receptacle.

2. A system according to Claim 1, further characterised in that said drop chamber means, primary means, secondary means and feeding means are connected to form an enclosed pathway whereby toxic fumes, dust and liquids from material therein are prevented from escaping to the ambient.

3. A system according to Claim 2 further character-

ised in comprising means for purging said enclosed pathway with an inert gas whereby likelihood of combustion of waste material in said pathway is reduced.

4. A system according to Claim 1, further characterised in comprising air lock means associated with said drop chamber means and adapted for closing an input portion of said drop chamber.

5. A system according to any preceding Claim, further characterised in that said secondary means includes an auger shredder having a substantially sideward discharge, and said feeding means receives material from said sideward discharge.

6. A system according to Claim 5, further characterised in that said feeding means includes auger means adapted for feeding waste material into incinerator means, said auger means being oriented substantially

7. A system according to Claim 6, further characterised in that said feeding means includes rotary gate means, downstream of said auger means, for sealing said system from said incinerator means to prevent a burn-back situation.

8. A system according to Claim 6 or 7, further characterised in that said auger means is of smaller diameter than said auger shredder of said secondary means.

9. A system according to any preceding claim, further characterised in that said secondary means is positioned substantially vertically beneath said primary means.

10. A system according to Claim 9, further characterised in that said primary means includes adjustable discharge doors in a bottom floor thereof, said doors being positionable between a closed configuration, wherein material is retained within said primary means for blending and size reduction, and selectably spaced open configurations, whereby material within said primary means is reduced in size until falling between said open doors to said secondary chamber.

11. A system according to any preceding claim, further characterised in that said primary means is positioned substantially beneath said drop chamber means.

12. A system according to any preceding claim, further characterised in additionally comprising conveyor means for transporting waste material to said drop chamber means.

13. A system according to Claim 12, further characterised in that said conveyor means include air lock means, connected to said drop chamber means, for preventing escape of toxic material as said containerized waste is transported to said drop chamber means.

14. A system according to any of Claims 1 to 11, further characterised in comprising skip loading means for dumping bulk material into said drop chamber means.

15. A system according to Claim 14, further characterised in that said drop chamber means includes gate means for opening and closing said drop chamber to receive bulk material from said skip loading means.

16. A system according to any preceding claim, characterised in comprising means for adding stabilization material to said drop chamber means.

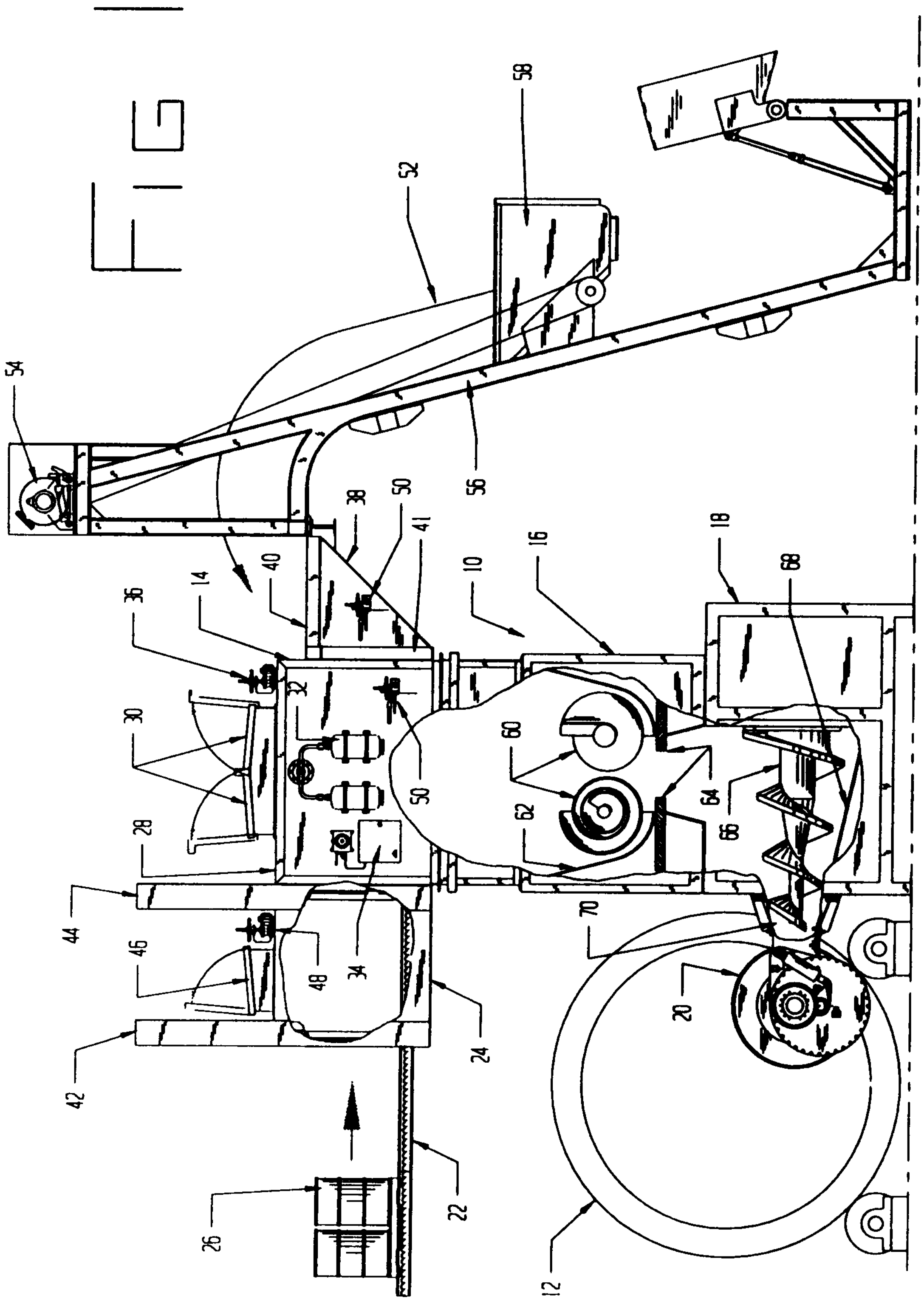

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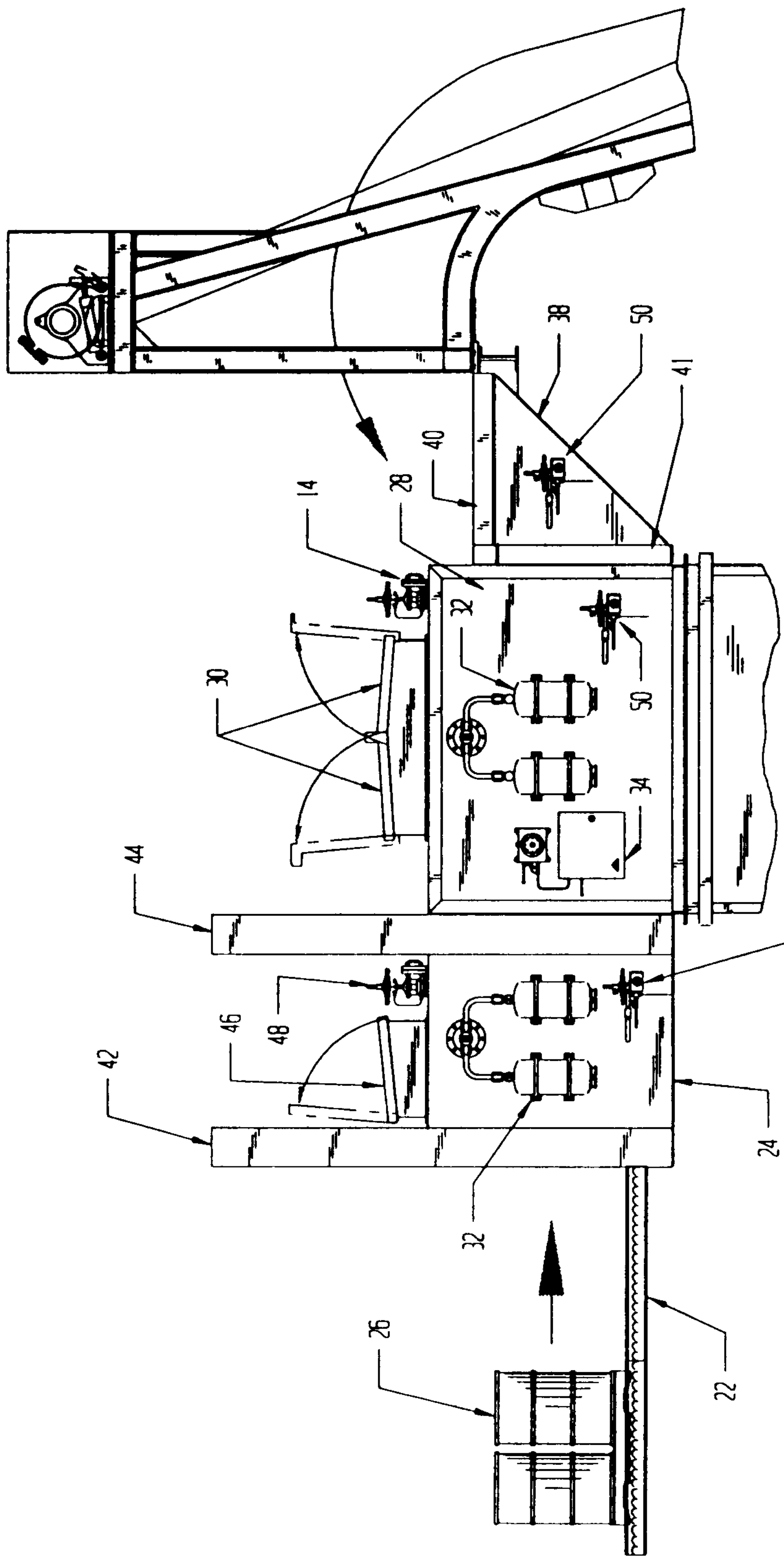
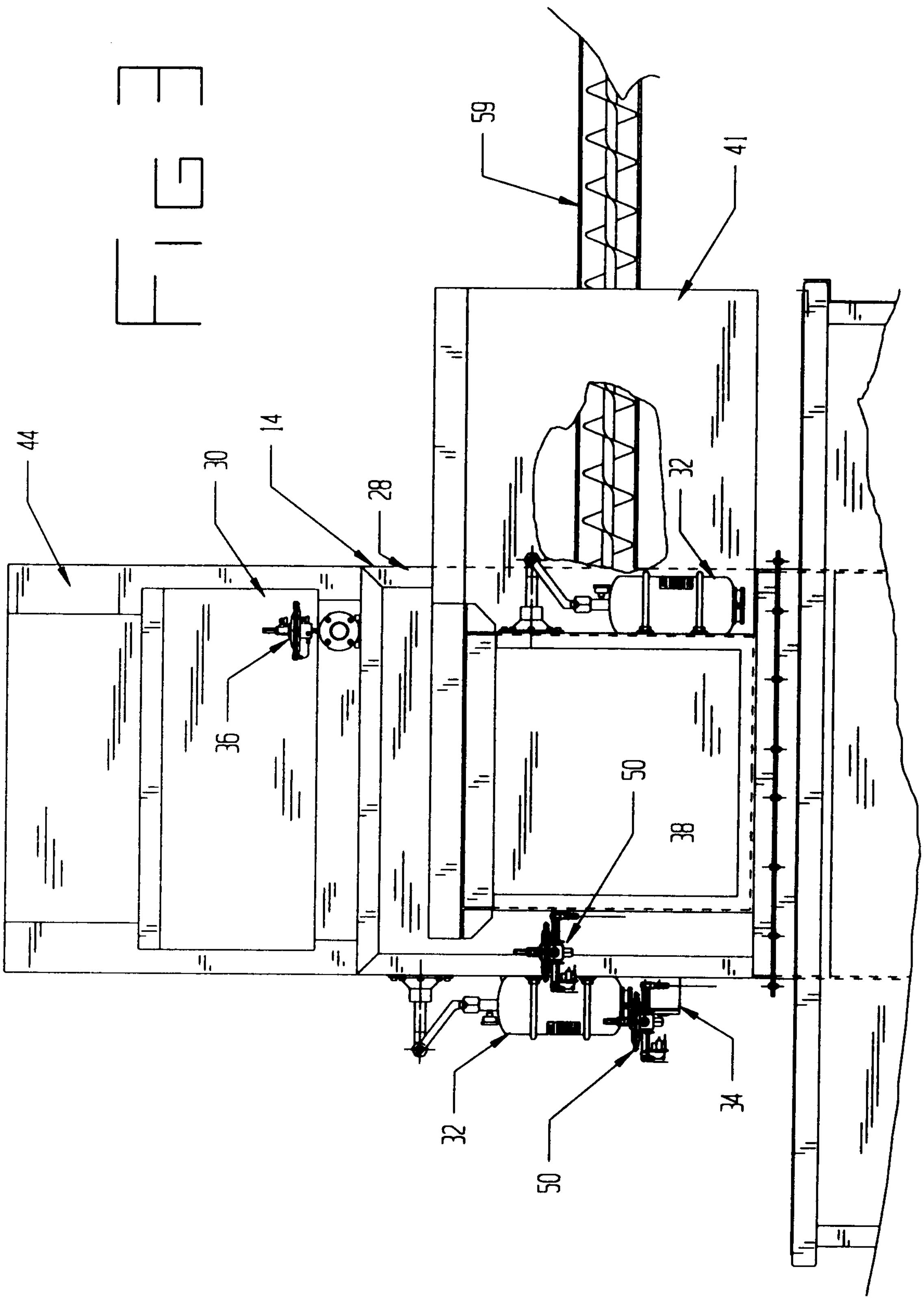
FIG 1

FIG 2





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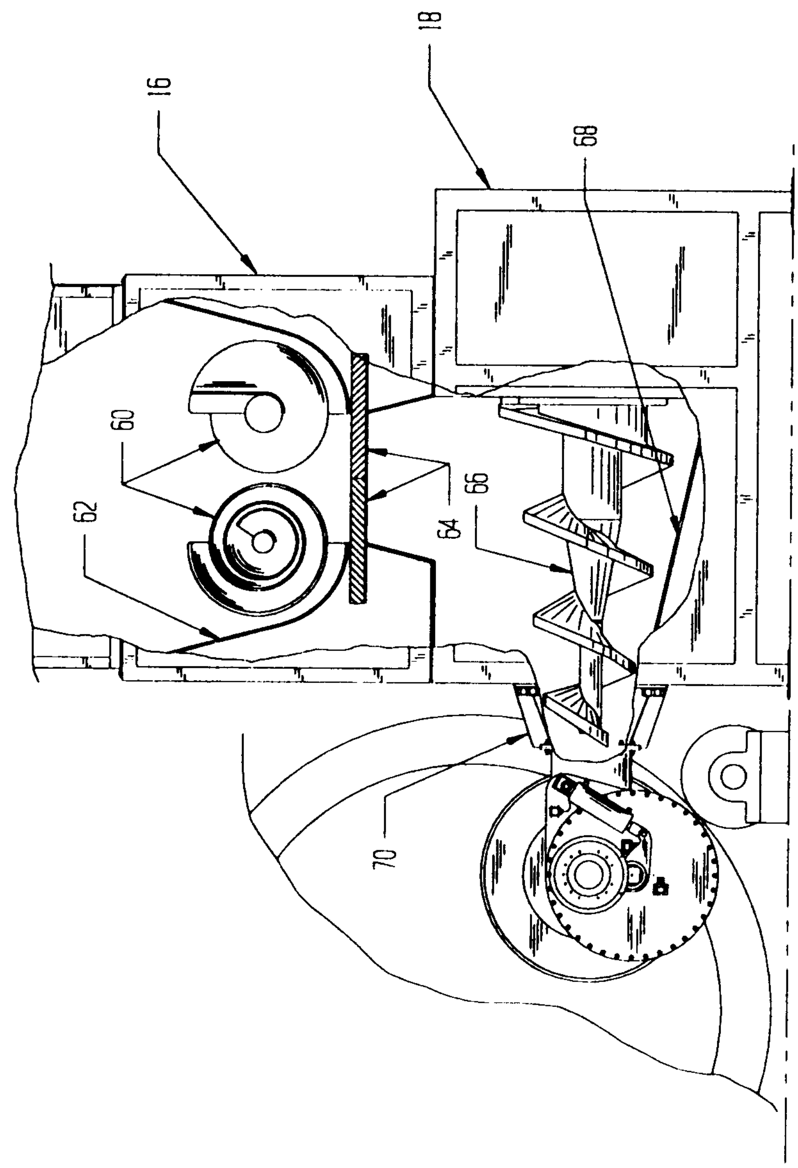

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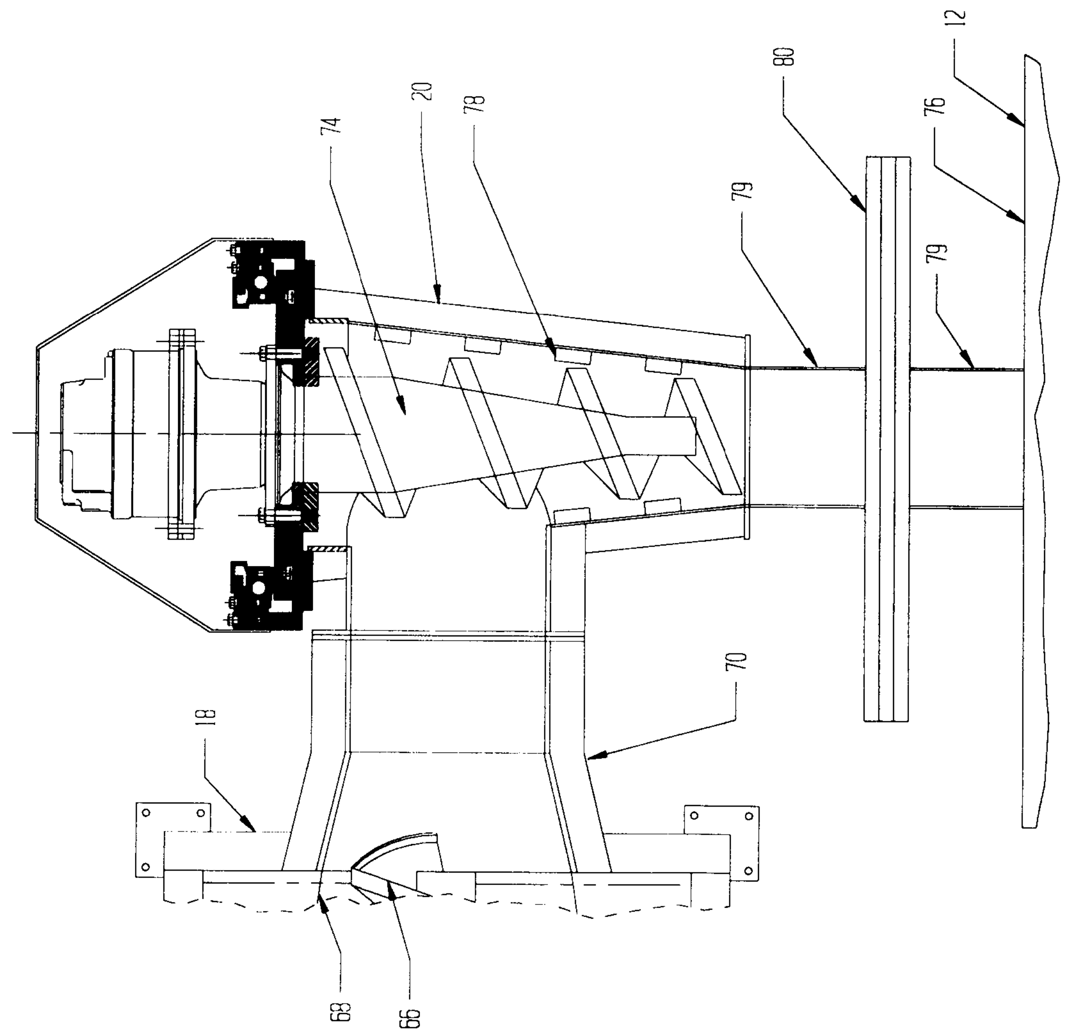

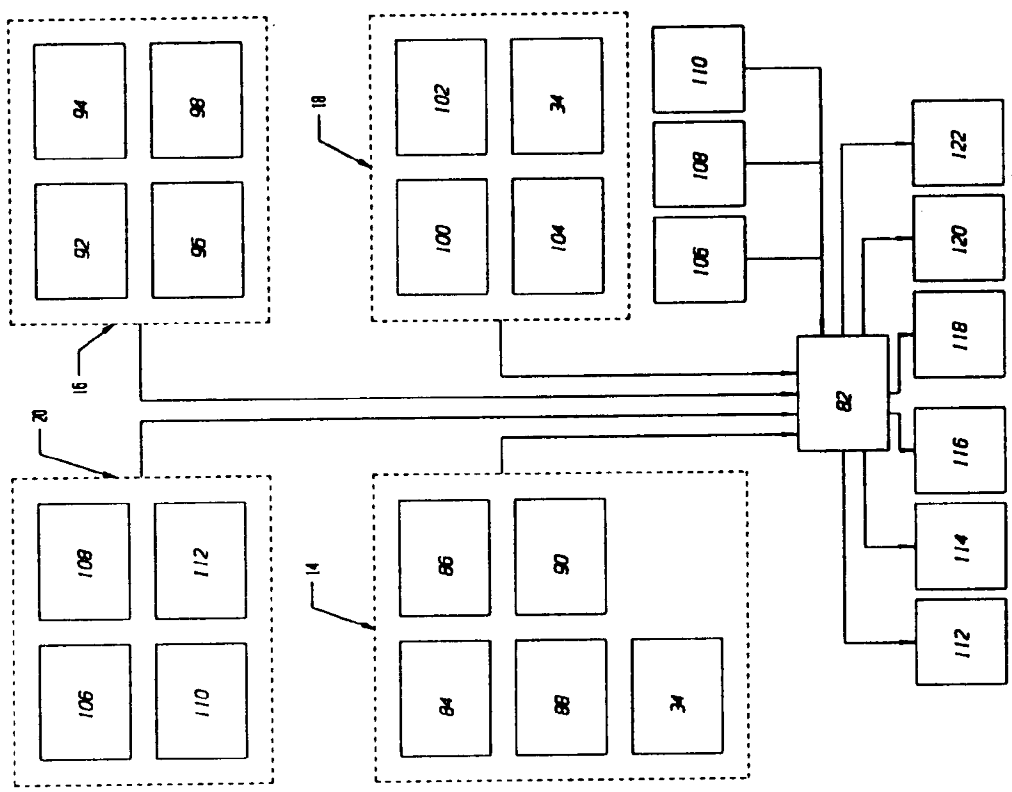

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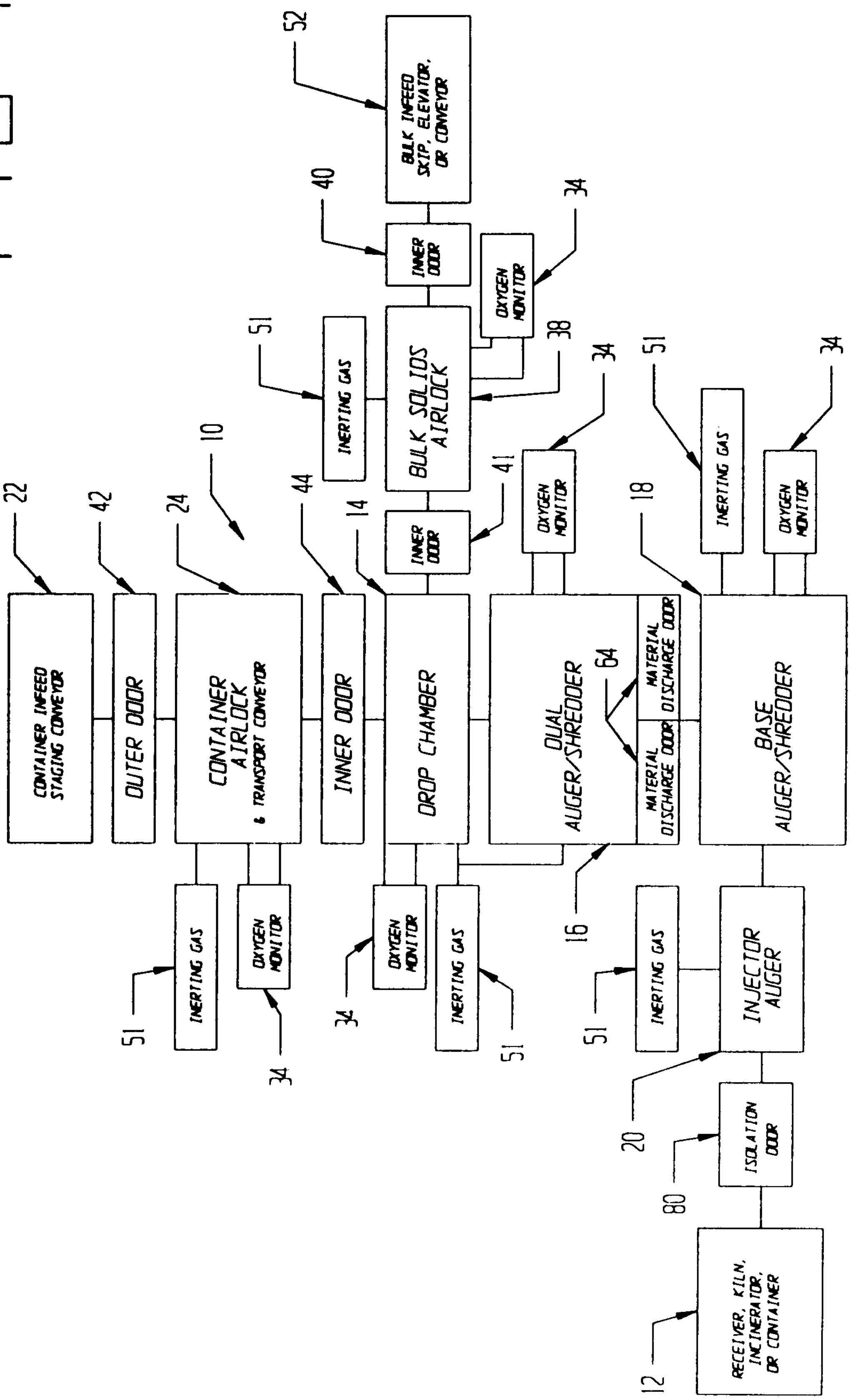
Fig 6

FIG 1


CONTAINER INFEED STAGING CONVEYOR
OUTER DOOR
CONTAINER AIRLOCK & TRANSPORT CONVEYOR
INNER DOOR
DROP CHAMBER
DUAL AUGER/SHREDDER
MATERIAL DISCHARGE DOOR
MATERIAL DISCHARGE DOOR
BASE AUGER/SHREDDER
INJECTOR AUGER
ISOLATION DOOR
RECEIVER, KILN, INCINERATOR, OR CONTAINER
BULK SOLIDS AIRLOCK
INNER DOOR
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BULK INFEED SKIP, ELEVATOR, OR CONVEYOR
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