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CA 2432202 C 2011/01/25

(11)(21) 2 432 202

(12) BREVET CANADIEN
CANADIAN PATENT

(13) C

(22) Date de dépôt/Filing Date: 2003/06/13

(41) Mise à la disp. pub./Open to Public Insp.: 2004/12/13

(45) Date de délivrance/Issue Date: 2011/01/25

(51) Cl.Int./Int.Cl. *C10J 3/48* (2006.01)

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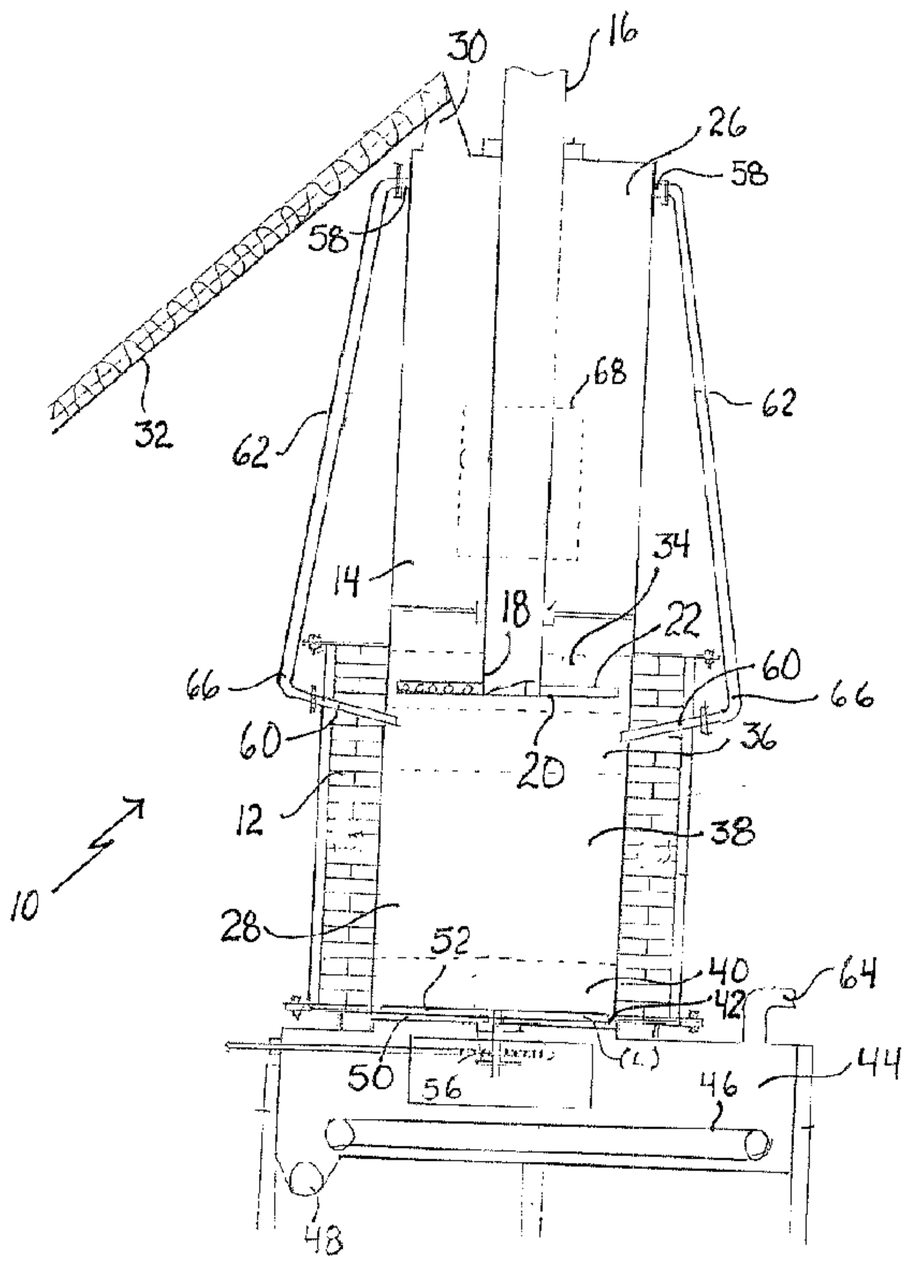
(54) Titre : GAZEIFIEUR DE DECHETS ORGANIQUES
(54) Title: GASIFIER OF ORGANIC WASTE



(57) Abrégé/Abstract:
A gasifier of organic waste which has an insulated body with an interior cavity. A combustion air inlet extends vertically into the interior cavity. A remote end of the combustion air inlet serves to divide the interior cavity into an upper fuel receiving portion and a lower combustion portion. A fuel entry port accesses the upper fuel receiving portion, whereby organic waste to be gasified is introduced into the upper fuel receiving portion. Smoke removal ports are positioned in the upper fuel receiving portion and smoke injection ports are positioned in the lower combustion portion of the interior cavity. Smoke circulation conduits connect the smoke removal ports with the smoke injection ports, whereby smoke is drawn from the upper fuel receiving portion of the interior cavity and introduced into the lower combustion portion of the interior cavity to enhance combustion and promote circulation.

ABSTRACT OF THE DISCLOSURE

A gasifier of organic waste which has an insulated body with an interior cavity. A combustion air inlet extends vertically into the interior cavity. A remote end of the combustion air inlet serves to divide the interior cavity into an upper fuel receiving portion and a lower combustion portion. A fuel entry port accesses the upper fuel receiving portion, whereby organic waste to be gasified is introduced into the upper fuel receiving portion. Smoke removal ports are positioned in the upper fuel receiving portion and smoke injection ports are positioned in the lower combustion portion of the interior cavity. Smoke circulation conduits connect the smoke removal ports with the smoke injection ports, whereby smoke is drawn from the upper fuel receiving portion of the interior cavity and introduced into the lower combustion portion of the interior cavity to enhance combustion and promote circulation.

TITLE OF THE INVENTION:

Gasifier of Organic Waste

FIELD OF THE INVENTION

The present invention relates to gasifiers of organic waste.

BACKGROUND OF THE INVENTION

Gasifiers are used to convert solid organic waste into fuel gas through combustion leading to high temperature gasification. Should combustion not be complete, emissions are given off to atmosphere in the form of smoke. This results in a lowering of volume of gas produced. Furthermore, if there is not adequate circulation, the smoke will tend to accumulate in a flame zone and deprive the flames zone of needed oxygen.

SUMMARY OF THE INVENTION

What is required is an alternative form of gasifier for organic waste which has better circulation of smoke, enchanced combustion, and a higher volume of gas produced.

According to the present invention there is provided a gasifier of organic waste which has an insulated body with an interior cavity. A combustion air inlet extends vertically into the interior cavity of the body. A remote end of the combustion air inlet serves to divide the interior cavity into an upper fuel receiving portion and a lower combustion portion. A fuel entry port accesses the upper fuel receiving portion of the interior cavity, whereby organic waste to be gasified is introduced into the upper fuel receiving portion. An ash removal opening accesses the lower combustion portion of the interior cavity, whereby ash is removed after combustion. Smoke removal ports are positioned in the upper fuel receiving portion of the interior cavity. Smoke injection ports are also positioned in the lower combustion portion of the interior cavity. Smoke circulation conduits connect the smoke removal ports with the smoke injection ports, whereby smoke is drawn from the upper fuel receiving portion of the interior cavity and introduced into the lower combustion portion of the interior cavity to enhance combustion

and promote circulation. An outlet from the interior cavity is provided for gases produced as a result of gasification of the organic waste through combustion.

With the gasifier, as described above, a circulation of smoke occurs via the smoke circulation conduits. This circulation prevents a smoke build up which could deprive the flame zone of needed oxygen. Emissions are reduced by drawing the smoke from the upper fuel receiving portion of the interior cavity. Combustion is enhanced, by directing the smoke, in a controlled fashion, back into the lower combustion portion of the interior cavity, where the smoke will serve as fuel.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other features of the invention will become more apparent from the following description in which reference is made to the appended drawings, the drawings are for the purpose of illustration only and are not intended to in any way limit the scope of the invention to the particular embodiment or embodiments shown, wherein:

FIGURE 1 is a front elevation view, in section, of a gasifier for organic waste constructed in accordance with the teachings of the invention.

FIGURE 2 is a front elevation view, in section, of the gasifier illustrated in **FIGURE 1**;

FIGURE 3 is a perspective view, in section, of the combustion air inlet of the gasifier illustrated in **FIGURE 1**.

FIGURE 4 is a front elevation view, in section, of the lower combustion portion of the gasifier illustrated in **FIGURE 1**.

FIGURE 5 is top plan view of the grate agitator of the gasifier illustrated in **FIGURE 1**;

FIGURE 6 is perspective view of one of the agitator blades of the grate agitator illustrated in **FIGURE 5**;

FIGURE 7 is a front elevation view, in section, of the ash box of the gasifier illustrated in **FIGURE 1**;

FIGURE 8 is a front elevation view, in section, of the lower combustion portion of the gasifier illustrated in **FIGURE 1**;

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The preferred embodiment, a gasifier for organic waste generally identified by reference numeral 10, will now be described with reference to **FIGURES 1** through **8**.

Structure and Relationship of Parts:

Referring to **FIGURE 1**, there is illustrated a gasifier 10 which includes an insulated body 12 that has an interior cavity 14 which is lined with refractory material. A tubular rotatable combustion air inlet 16 extends vertically into interior cavity 14 of body 12. Referring to **FIGURE 3**, at a remote end 18 of combustion air inlet 16 is an air distributor 20 which has radially extending arms 22. Arms 22 are provide with outflow ports 24 for distributing air into interior cavity 14 illustrated in **FIGURE 1**. Referring to **FIGURE 1**, remote end 18 serves to divide interior cavity 14 into an upper fuel receiving portion 26 and a lower combustion portion 28. A fuel entry port 30 accesses upper fuel receiving portion 26 of interior cavity 14, whereby organic waste to be gasified is introduced into upper fuel receiving portion 26. A feed auger 32 is provided for carrying organic waste to fuel entry port 30. Lower combustion portion 28 includes a flame zone 34, a charcoal layer 36, a coal layer 38 and a layer of ceramic balls 40. An ash removal opening 42 accesses lower combustion portion 28 of interior cavity 14, whereby ash is removed after combustion. Referring to **FIGURE 8**, in the illustrated embodiment, an ash box 44 is provided which has a slatted conveyor 46 that sweeps the ashes into an auger 48.

Referring to **FIGURE 4**, a grate 50 is provided in ash removal opening 42. Referring to **FIGURE 1**, a grate agitator 52 is positioned between layer of ceramic balls 40 and ash removal opening 42. Referring to **FIGURE 5**, grate agitator 52 is equipped with triangular agitator blades 54 illustrated in **FIGURE 6**. Referring to **FIGURE** 7, grate agitator 52 is operated by an open type rack and pinion drive mechanism generally referenced by numeral 56.

Referring to **FIGURE** 2, smoke removal ports 58 are positioned in upper fuel

receiving portion 26 of interior cavity 14 while smoke injection ports 60 are positioned in lower combustion portion 28 of interior cavity 14. Circulation conduits 62 connect smoke removal ports 58 with smoke injection ports 60, whereby smoke is drawn from upper fuel receiving portion 26 of interior cavity 14 and introduced into lower combustion portion 28 of interior cavity 14 to enhance combustion and promote circulation. Referring to **FIGURE 1**, an outlet 64 from interior cavity 14 is provided for gases produced as a result of gasification of the organic waste through combustion.

Referring to **FIGURE 1**, in the illustrated embodiment, gasifier 10 is of the sealed down-draft stratified type and can use any type of combustible raw material such as sawmill waste, railway ties, wood demolition material, rubber, oil refinery coke, coal, etc. It is a closed system and operates on a slight negative pressure so that there is no emission or noxious odors whatsoever.

Operation:

Referring to **FIGURE 1**, raw organic waste material is loaded into upper fuel receiving portion 26 by feed auger 32 and is slightly stirred as combustion air inlet 16 slowly rotates. The organic waste material eventually works it's way down to flame zone 34 in lower combustion portion 28 where the combustion of the raw material takes place. About 10% of the raw material is used in this step and the remaining raw material is converted into charcoal, smoke, tars and water vapor. At this time the gasification process starts in charcoal layer 36.

As the material proceeds downward, charcoal layer 36 becomes white-hot coals within coal layer 38 which is also known as a cracking zone. As the gas is drawn off coal layer 38, the raw material is then completely used up and the remaining material is ash. Under coal layer 38, layer of ceramic balls 40 serves to protect grate 50 from the excessive heat of coal layer 38 and also acts like a ball-mill to breaks up any clinkers that are caused by fusion of the ash. Ceramic balls 40 are stirred by grate agitator 52 which is operated by open type rack and pinion drive mechanism 56. As ashes exit through ash

removal opening 42 and collect in ash box 44, slatted conveyor 46 sweeps the ashes into auger 48 where the ashes are augured out of gasifier 10 for disposal.

Air is drawn down through combustion air inlet 16 and air distributor 20 into flame zone 34 where 20% oxygen is added to the air stream which enhances combustion and also rids the gas of most of the nitrogen which is drawn in with the atmospheric air. Referring to **FIGURE 3**, the air and oxygen mixture exit combustion air inlet 16 through outflow ports 24 in arms 22 of air distributor 20. Referring to **FIGURE 1**, as the combustion air inlet 16 is slowly turning it supplies air throughout flame zone 34 and insures complete burn in the entire flame zone 34. The heat of flame zone 34 is controlled by the amount of air and oxygen permitted to enter combustion air inlet 16. Once the oxygen in the mix is burned off combustion ceases and the remaining components of the air become inert.

Smoke circulation conduits 62 serve a dual function. They permit the smoke, vaporized tars and water vapor to be reintroduced into charcoal layer 36 below flame zone 34 which enhances the efficiency of flame zone 34. At a lower end 66 of smoke circulation conduits 62, the reaction of the smoke, tars and water vapor being cracked into gases creates a slight negative pressure which causes the vortex reaction in upper fuel receiving portion 26. Referring to **FIGURE 2**, a blow out door 68 is provided on insulated body 12.

Referring to **FIGURE 1**, the draw on air into gasifier 10 is supplied by an outside source, for example a compressor or blower. With gasifier 10, the moisture content is not as critical as in an up-draft or cross-draft unit. The moisture content in the raw material can exceed 40% as the high heat (2300° F) in the reactor cracks the water into hydrogen through what is called a water shift reaction.

Gasifier 10 is not limited to one size. It can be scaled-up to units of differing sizes and can very easily be custom built to supply gas for co-generation of electrical power or

as a single unit to replace natural gas, for example as in lumber drying kilns.

In this patent document, the word "comprising" is used in its non-limiting sense to mean that items following the word are included, but items not specifically mentioned are not excluded. A reference to an element by the indefinite article "a" does not exclude the possibility that more than one of the element is present, unless the context clearly requires that there be one and only one of the elements.

It will be apparent to one skilled in the art that modifications may be made to the illustrated embodiment without departing from the spirit and scope of the invention as hereinafter defined in the Claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A gasifier of organic waste, comprising:

an insulated body having an interior cavity;

a combustion air inlet extending vertically into the interior cavity of the body, a remote end of the combustion air inlet serving to divide the interior cavity into an upper fuel receiving portion and a lower combustion portion;

a fuel entry port accessing the upper fuel receiving portion of the interior cavity, whereby organic waste to be gasified is introduced into the upper fuel receiving portion;

an ash removal opening accessing the lower combustion portion of the interior cavity, whereby ash is removed after combustion;

smoke removal ports positioned in the upper fuel receiving portion of the interior cavity;

smoke injection ports positioned in the lower combustion portion of the interior cavity;

smoke circulation conduits connecting the smoke removal ports with the smoke injection ports, whereby smoke is drawn from the upper fuel receiving portion of the interior cavity and introduced into the lower combustion portion of the interior cavity to enhance combustion and promote circulation; and

an outlet from the interior cavity for gases produced as a result of gasification of the organic waste through combustion.

2. The gasifier as defined in claim 1, wherein the combustion air inlet is rotatable.

3. The gasifier as defined in claim 1, wherein a grate is positioned in the ash removal opening, and a grate agitator is provided, the grate agitator causing movement of ash through the ash removal opening.

4. The gasifier as defined in Claim 3, wherein a layer of ceramic balls are provided above the grate, the layer of ceramic balls thermally insulating the grate from excessive heat from the

lower combustion portion of the interior cavity, the grate agitator agitating the ceramic balls, such that the ceramic balls serve as a ball-mill to break up clinkers formed by fusion of ash.

5. The gasifier as defined in claim 1, wherein the insulated body is lined with refractory material.

6. The gasifier as defined in claim 1, wherein a feed auger is provided for carrying organic waste to the fuel entry port.

7. The gasifier as defined in claim 1, wherein a blow out door is provided in the insulated body.

8. A gasifier of organic waste, comprising:

an insulated body having an interior cavity;

a rotatable combustion air inlet extending vertically into the interior cavity of the body, a remote end of the combustion air inlet serving to divide the interior cavity into an upper fuel receiving portion and a lower combustion portion;

a fuel entry port accessing the upper fuel receiving portion of the interior cavity, whereby organic waste to be gasified is introduced into the upper fuel receiving portion;

an ash removal opening accessing the lower combustion portion of the interior cavity, whereby ash is removed after combustion;

an ash collection receptacle for collecting ash which passes through the ash removal opening;

a grate positioned in the ash removal opening;

a rotatable grate agitator adjacent to the grate for agitating the grate to facilitate the movement of ash through the grate;

means for rotating the grate agitator;

a layer of ceramic balls positioned above the grate, the layer of ceramic balls thermally insulating the grate from excessive heat from the lower combustion portion of the interior cavity, the grate agitator agitating the ceramic balls, such that the ceramic balls serve as a ball-mill to break up clinkers formed by fusion of ash;

smoke removal ports positioned in the upper fuel receiving portion of the interior cavity;

smoke injection ports positioned in the lower combustion portion of the interior cavity, combustion of the organic waste forming into a flame zone layer, a charcoal layer, and a coal layer in the lower combustion portion of the interior cavity, the smoke injection posts being positioned where the charcoal layer forms;

smoke circulation conduits connecting the smoke removal ports with the smoke injection ports, whereby smoke is drawn from the upper fuel receiving portion of the interior cavity and introduced into the lower combustion portion of the interior cavity to enhance combustion and promote circulation; and

an outlet from the interior cavity for gases produced as a result of gasification of the organic waste through combustion.

9. The gasifier as defined in claim 8, wherein the means for rotating the grate agitator is a rack and pinion drive assembly.

10. The gasifier as defined in claim 8, wherein the insulated body is lined with refractory material.

11. The gasifier as defined in claim 8, wherein a feed auger is provided for carrying organic waste to the fuel entry port.

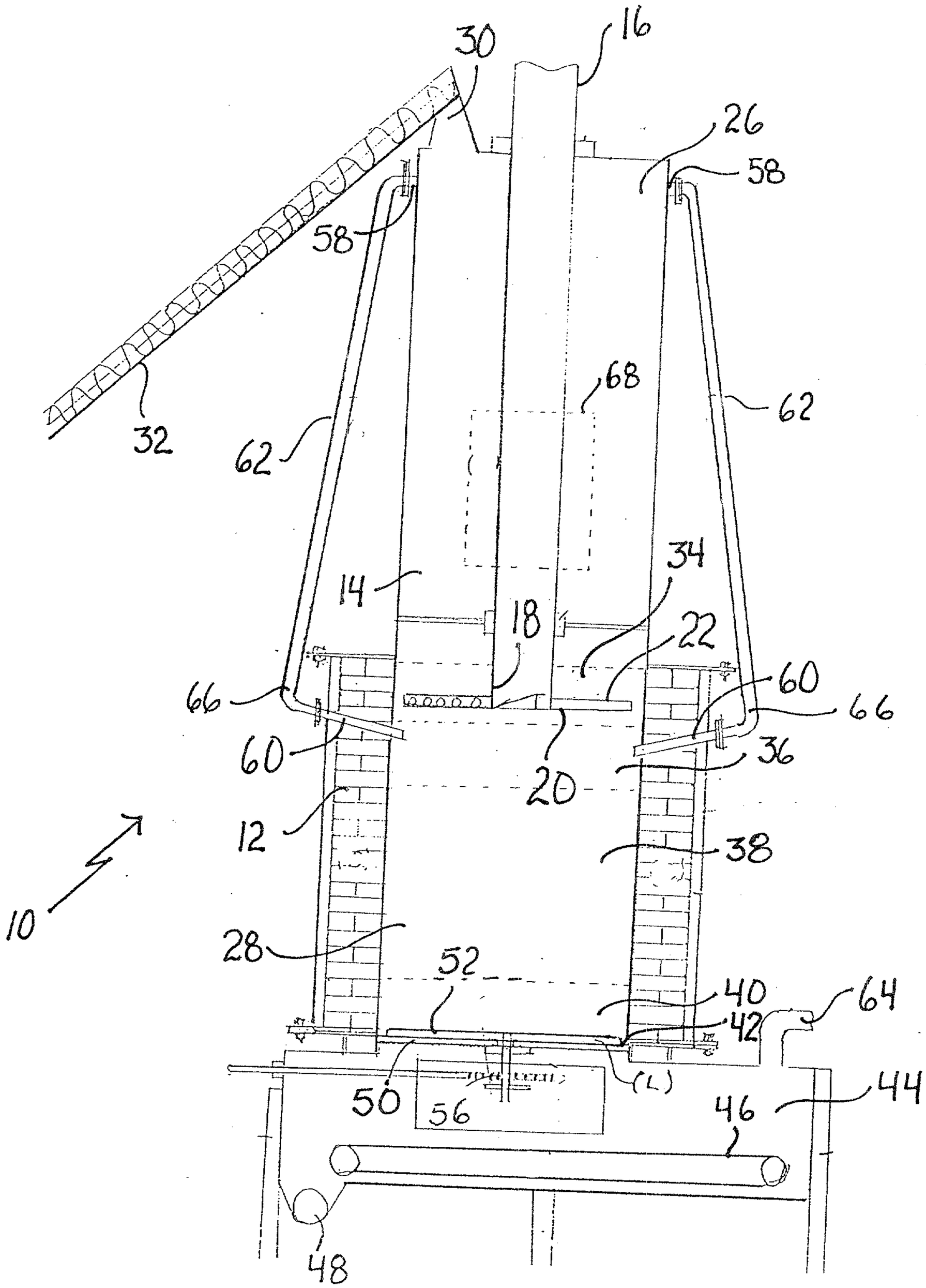

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FIG. 1

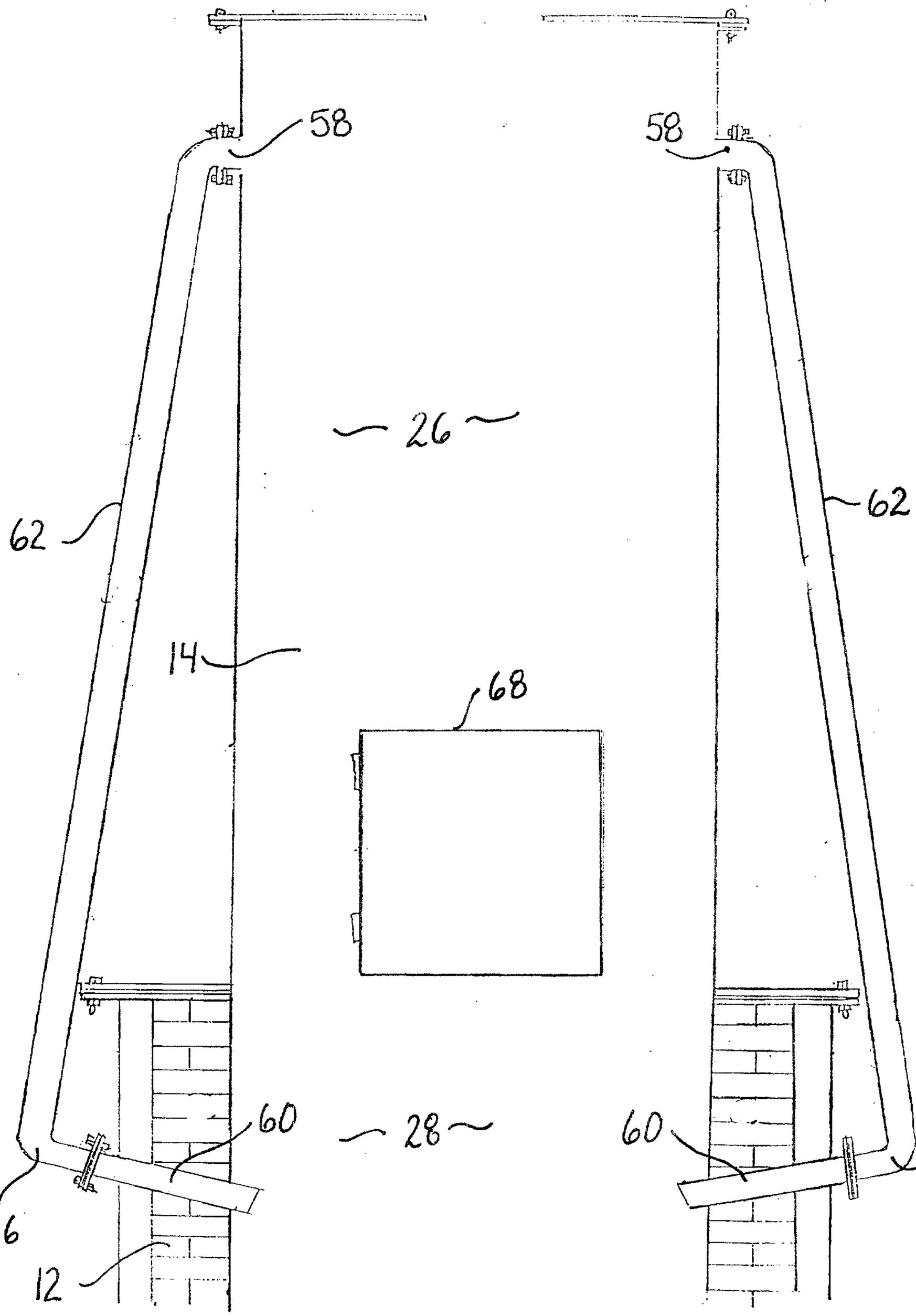
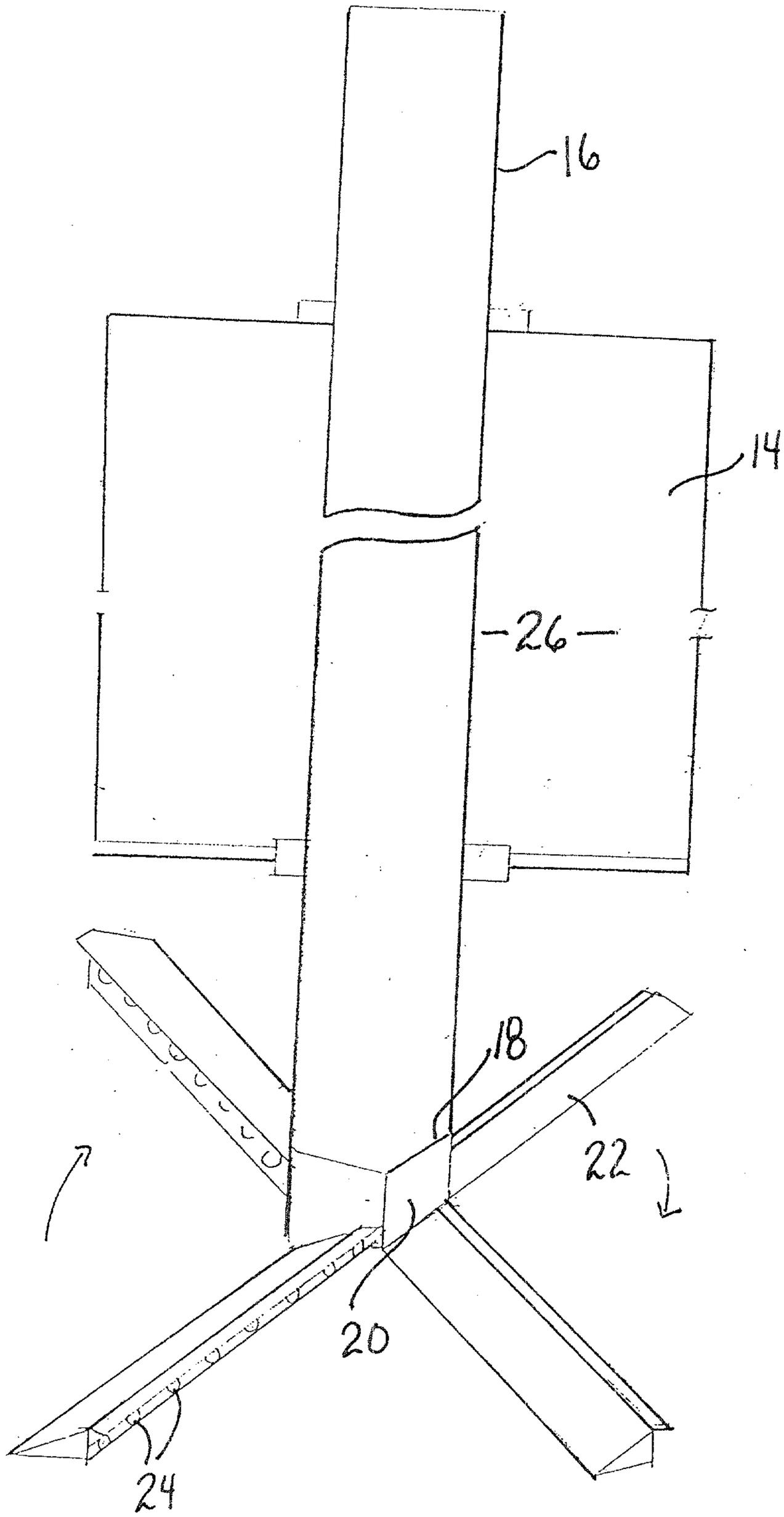


FIG. 2



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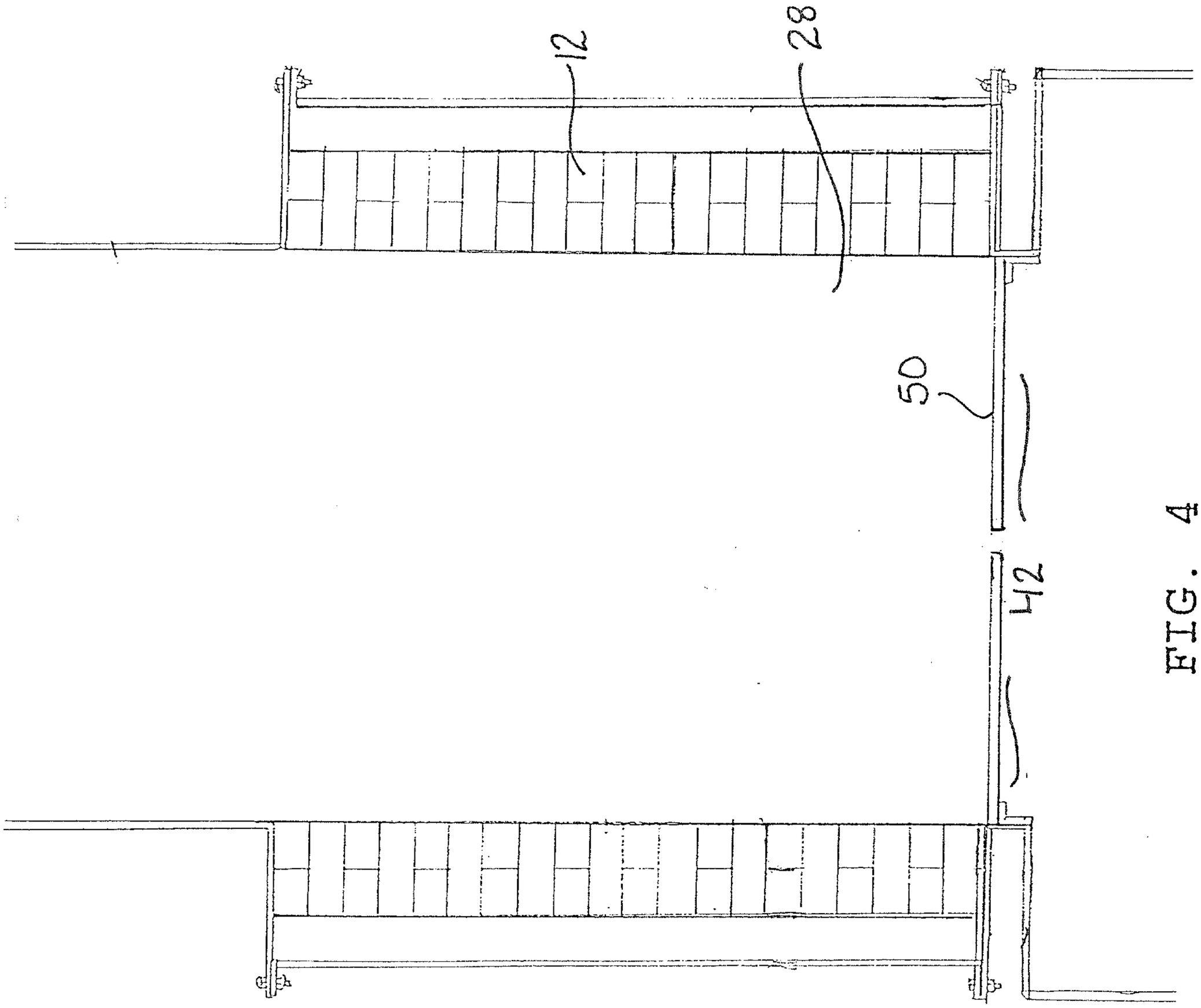

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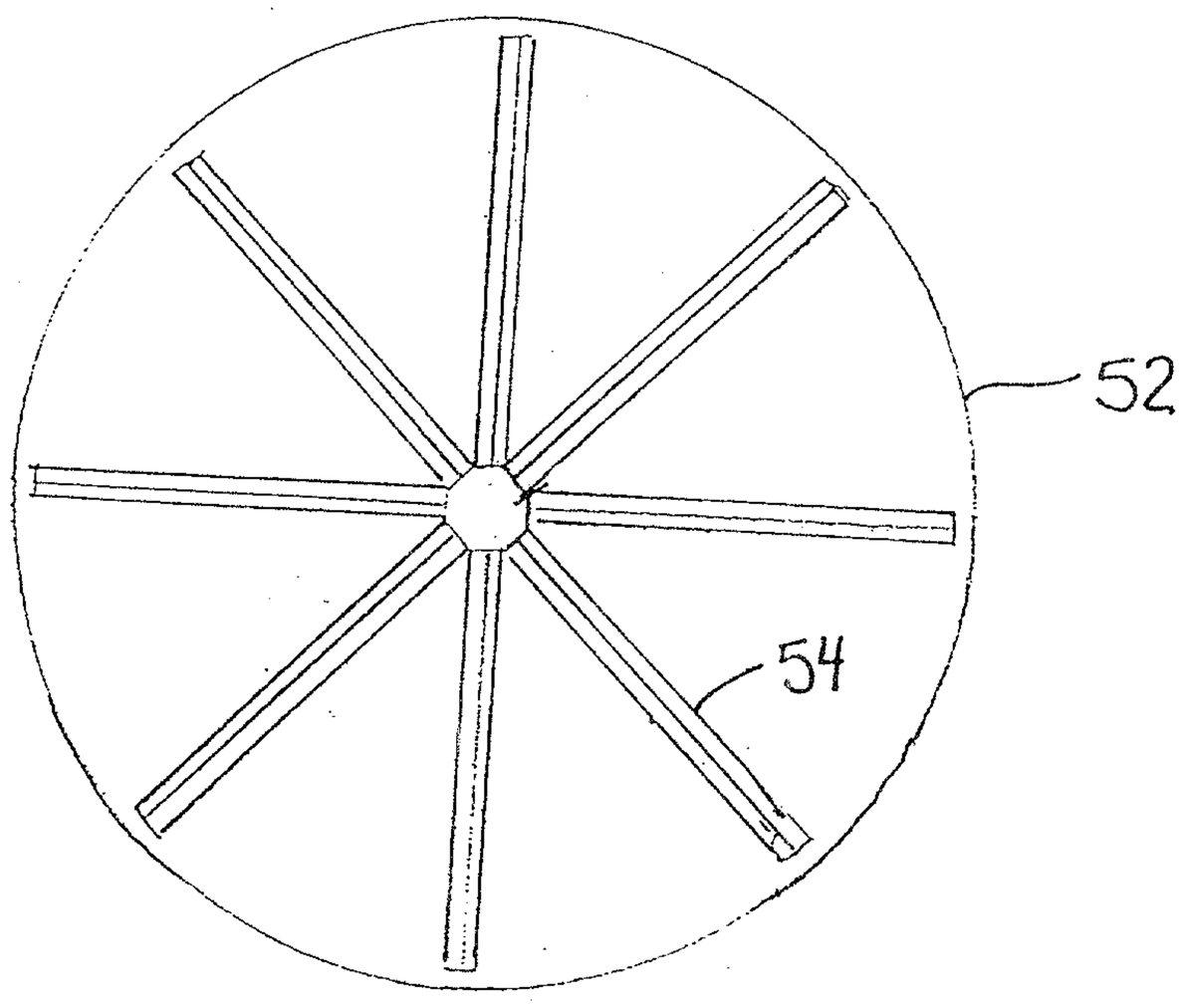

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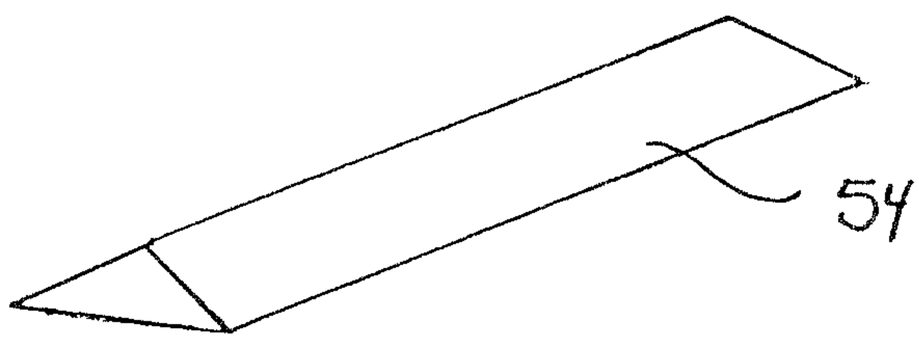

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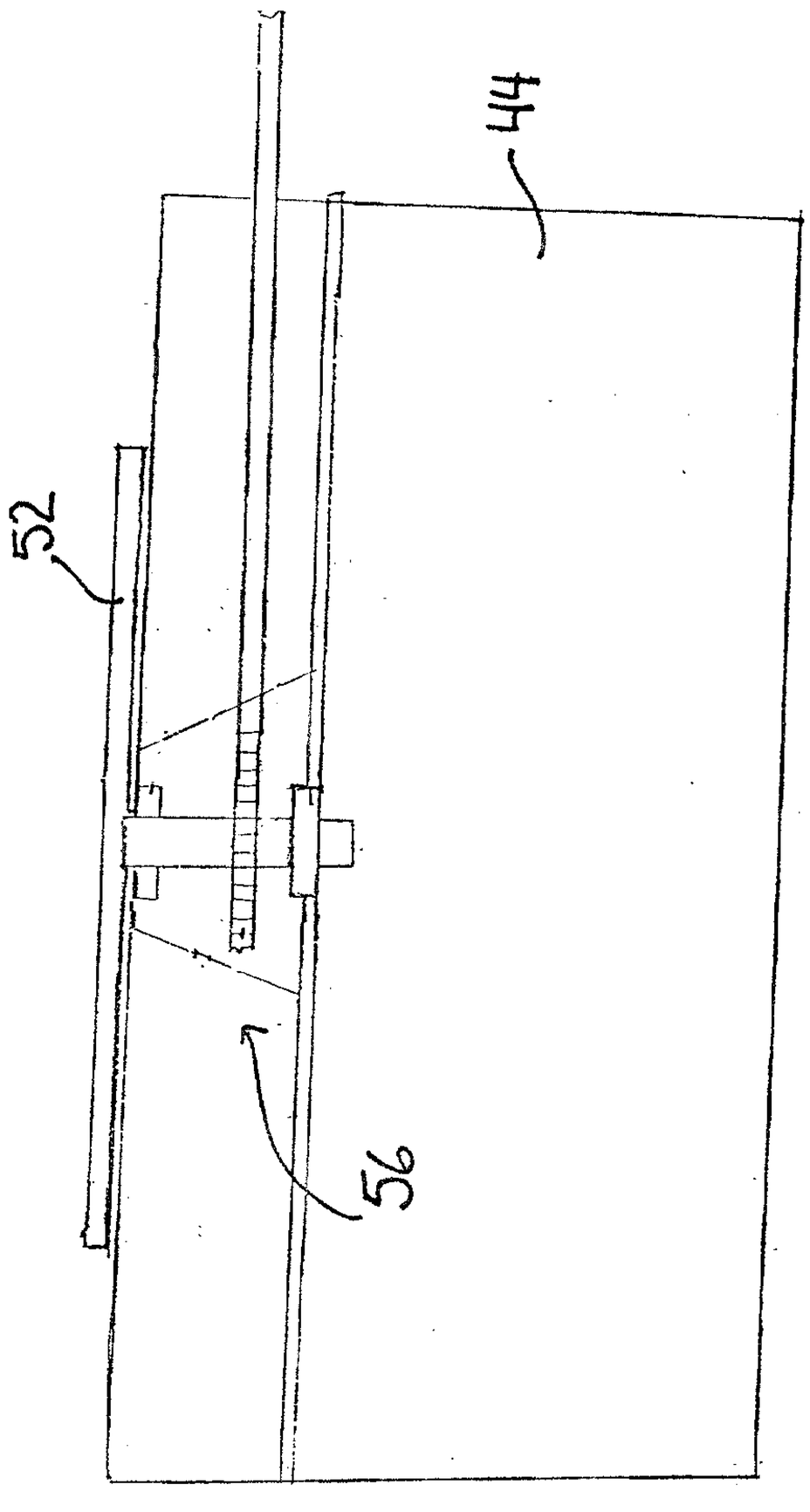
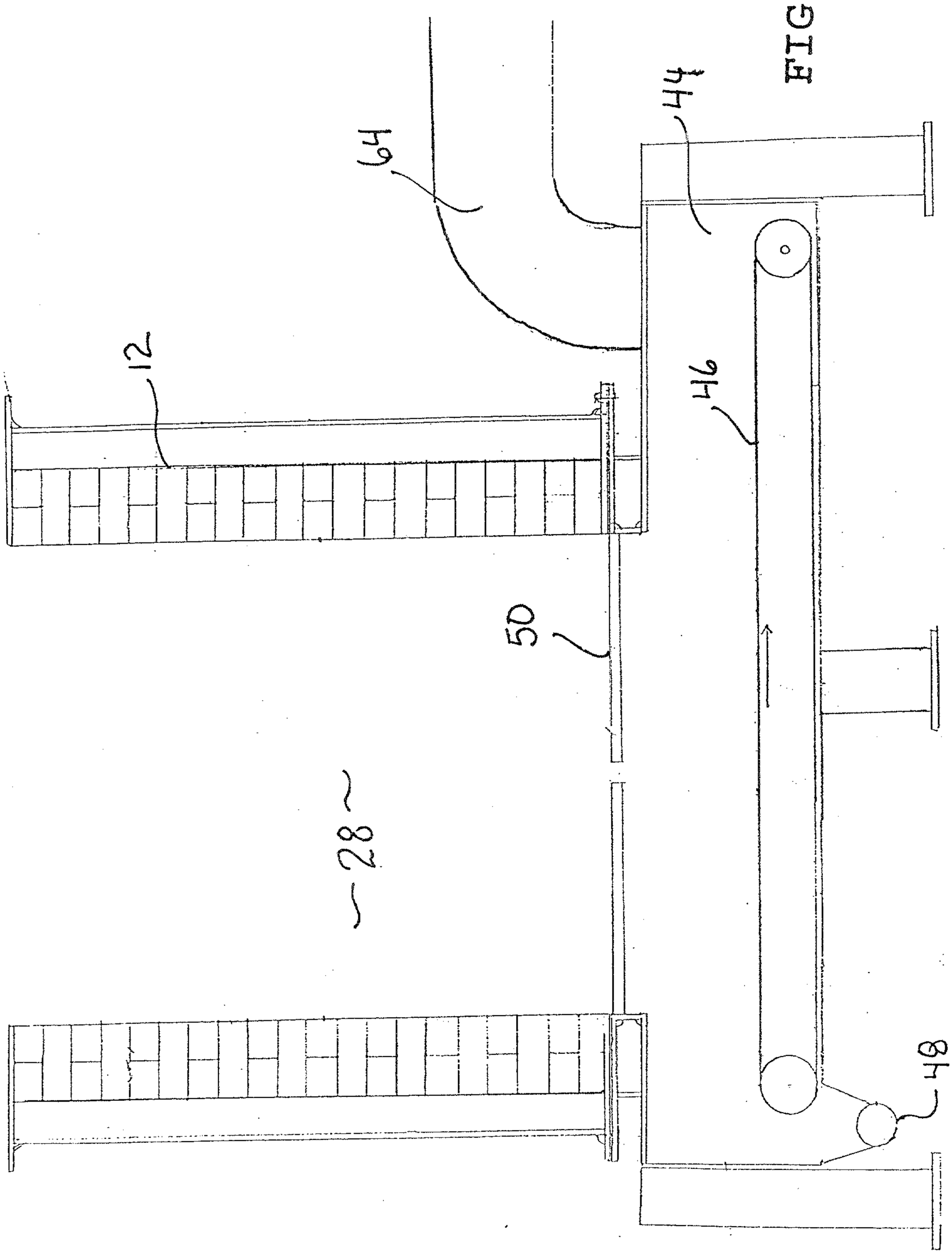
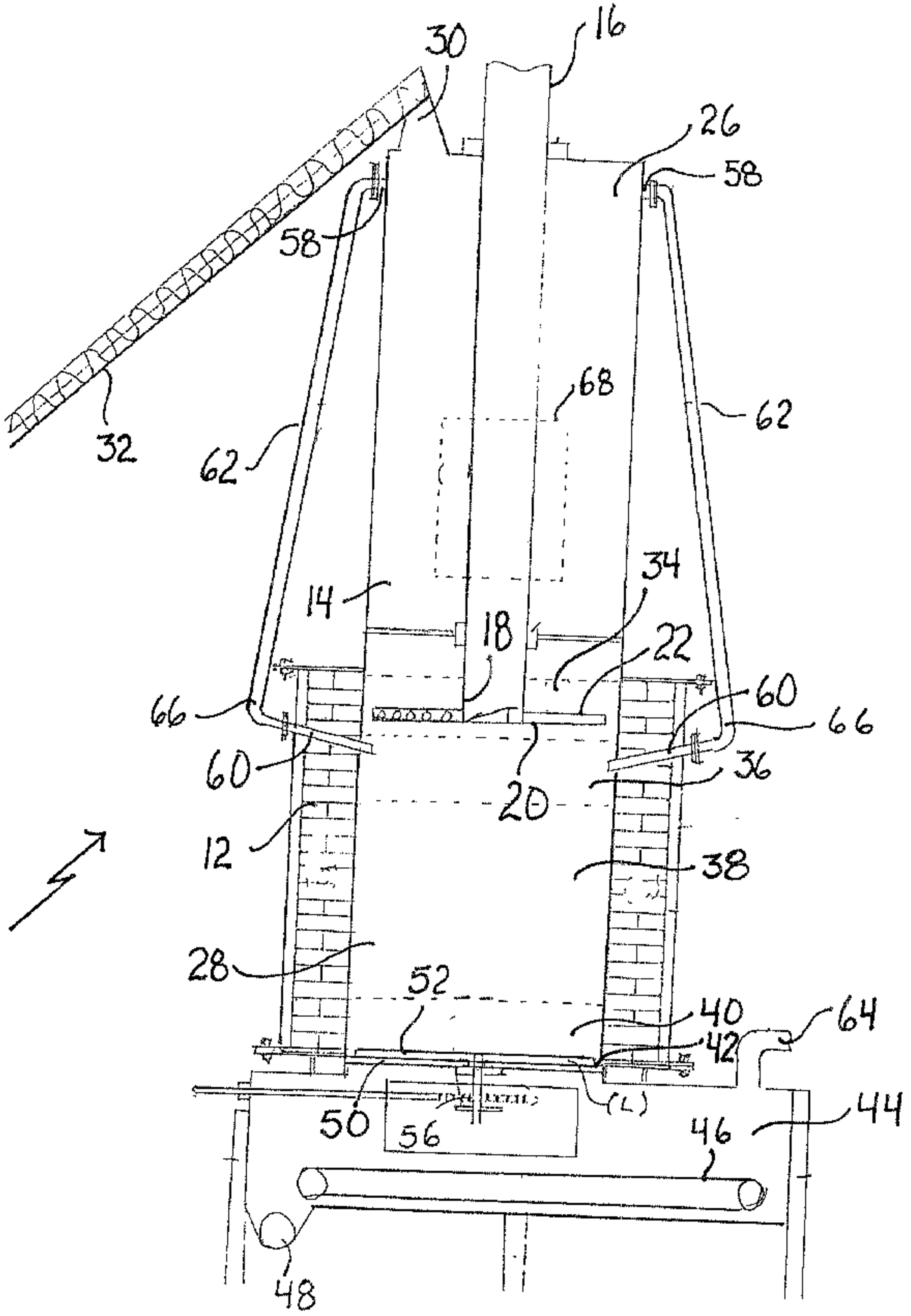


FIG. 7

FIG. 8

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