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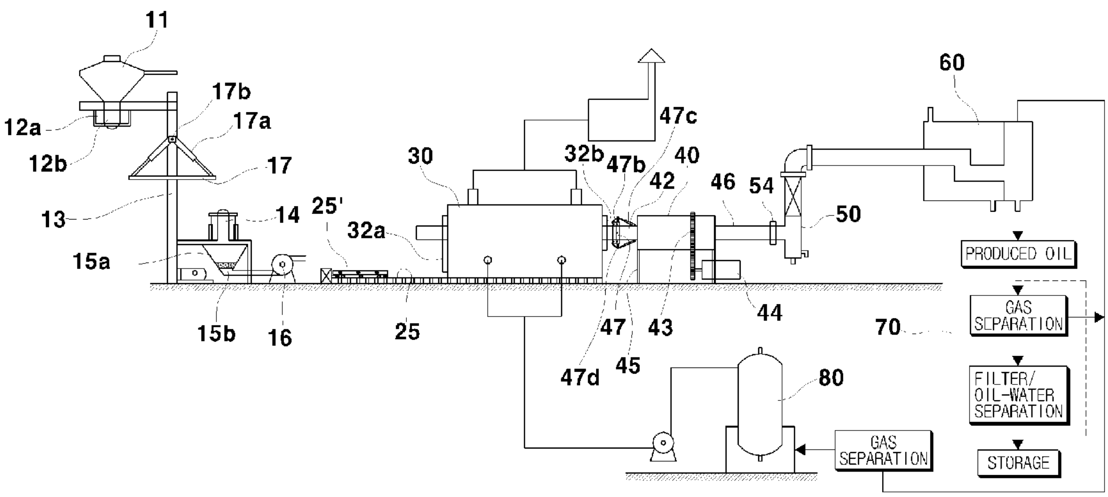
(54) Title: OIL EXTRACTION DEVICE FOR PYROLYSIS OF PLASTICS WASTE MATERIAL AND EXTRACTION METHOD THEREOF



(57) Abstract: An oil extraction system and method for pyrolyzing waste plastic materials are disclosed. The oil extraction system includes: a waste feeding device for supplying waste plastic materials contained in a hopper to a primary pyrolysis chamber through a feed inlet, wherein the primary pyrolysis chamber pyrolyzes the supplied waste plastic materials; a double jacket furnace having a burner and for heating the primary pyrolysis chamber loaded into a burning room of the furnace; a rotation device for rotating the primary pyrolysis chamber loaded into the burning room of the furnace; a secondary pyrolysis chamber for re-pyrolyzing gas produced in the primary pyrolysis chamber, and for separating carbides and residue; a condenser for liquefying the gas separated from the secondary plyrolysis chamber by compression and forming oil; and an oil-water separator for separating oil and water condensed in the condenser.

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Description

OIL EXTRACTION DEVICE FOR PYROLYSIS OF PLASTICS WASTE MATERIAL AND EXTRACTION METHOD THEREOF

Technical Field

[1] The present invention relates to an oil extraction system and method for pyrolyzing waste plastic materials, and more particularly, to an oil extraction system and method for producing oil from industrial wastes such as waste plastic materials and waste Styrofoam, by pyrolyzing the industrial wastes in a pyrolysis chamber of a furnace, condensing gas produced by pyrolysis, and separating oil and water. The oil extraction system according to the present invention improves efficiency of gas collection in a pyrolysis process, and thereby oil production efficiency and thereby increasing economical efficiency.

Background Art

[2] Various oil extraction systems using pyrolysis of industrial wastes such as waste plastic materials, waste Styrofoam, and waste tires, have been introduced.

[3] However, most of conventional pyrolyzing systems have a disadvantage of low economical efficiency, because oil extraction yield is not satisfactory compared with installation and operation costs of the pyrolyzing systems. Therefore, the conventional pyrolyzing systems are not successful in industrial applications.

[4] For example, a waste treatment system disclosed in Korean Patent Publication No. 1995-7048 has the following configuration. A waste decomposition furnace is configured with an inner furnace and an outer furnace. The inner furnace is installed to rotate with an axis of a double hollow shaft (inner and outer). One end of the double hollow shaft is connected to a reprocessing and collecting unit that is successively connected to an adsorption chamber containing active carbon, gas neutralization chamber containing neutralizing agent, and cooling chamber by using pipes. Gas pyrolyzed from wastes in the inner furnace is filtered, neutralized, and cooled while passing the above chambers. The outer furnace is formed in the outside of the inner furnace, and has a burning room formed at its bottom, a flue formed in a zigzag shape on the top of the outer furnace, and a cooling water jacket formed around the flue. The flue is connected to the adsorption chamber through a duct and one end of the adsorption chamber is connected to the gas neutralization chamber through a transport duct such that gas produced by the burning room is neutralized in the gas neutralization chamber and exhausted to the outside. A gas supply line is installed between the burning room and cooling chamber to supply the pyrolyzed gas into the burning room as a substitutive fuel.

[5] In this patent publication, the pyrolyzed gas is transported to the reprocessing and collecting unit through a plurality of holes formed at the outer hollow shaft. However, films are formed in the holes by rotation of the outer hollow shaft while the inner furnace is rotated by a reduction motor, and the holes become blocked by the films. Accordingly, gas is not smoothly exhausted and oil extraction yield is decreased.

[6] An oil extraction system using waste plastic materials disclosed in Korean Patent No. 0486159 is configured with: a transport screw for transporting crushed waste plastic materials contained in a hopper by a motor; a reactor for producing gas containing oil from the waste plastic materials by heating the reactor with a burner; a cooling tower for cooling the gas containing oil; a primary filtering device; a catalyst tower for deodorizing and decolorizing; and a secondary filtering device. A pre-melting device is installed between the transport screw and reactor to convert the crushed waste plastic materials into a half-melt state by heating, which is to be transported to the reactor. However, this patent has a problem that gas containing oil is partially lost in the step of pre-melting the waste plastic materials. That is, gas is partially lost in the step of pre-melting and compressing the waste plastic materials such as Styrofoam and vinyl, and in the step of pyrolyzing the waste plastic materials. Therefore, oil extraction yield is decreased.

[7] Additionally, the conventional waste treatment systems generally have a huge size. However, the volume of gas produced by pyrolyzing waste materials is relatively small and efficiency of collecting the pyrolyzed gas for reprocessing is low, and thereby economical efficiency of the waste treatment facility becomes low. Although hundreds of waste treatment systems were registered or applied for Korean patent, there is almost no waste treatment system practically running now. This means that most of the waste treatment systems registered or applied for Korean patents are not economical yet.

Disclosure of Invention

Technical Problem

[8] The present invention has been made in view of the above problems, and an object of the present invention is to improve economical efficiency in an oil extraction system for pyrolyzing industrial waste materials such as waste plastic materials and waste Styrofoam, by pyrolyzing the waste materials in a pyrolysis chamber of a furnace, producing gas, efficiently collecting the pyrolyzed gas, condensing the gas, and separating oil and water.

[9] Another object of the present invention is to reduce costs in waste treatment of waste plastic materials.

[10] Another object of the present invention is to prevent environmental pollution of soil

and air by avoiding landfill and incineration.

[11] Further, another object of the present invention is to reduce import of energy sources in oil importing countries.

Technical Solution

[12] In order to achieve the above objects, an oil extraction system according to an exemplary embodiment of the present invention includes: a waste feeding device for supplying waste plastic materials contained in a hopper to a primary pyrolysis chamber(referred to 'reactor' through a feed inlet, the primary pyrolysis chamber pyrolyzing the supplied waste plastic materials; a double jacket furnace having a burner and for heating the primary pyrolysis chamber loaded in a burning room of the furnace; a rotation device for rotating the primary pyrolysis chamber loaded in the burning room of the furnace; a secondary pyrolysis chamber for re-pyrolyzing gas produced by the primary pyrolysis chamber, and for separating carbides and residue; a condenser for liquefying the gas separated from the secondary pyrolysis chamber by condensing and forming mixture of produced oil and water ; and an oil-water separator for separating the produced oil and water condensed in the condenser.

[13] An oil extraction method according to another exemplary embodiment of the present invention utilizes the above oil extraction system to efficiently produce oil from industrial waste materials such as waste plastic materials and waste Styrofoam.

Advantageous Effects

[14] According to the above exemplary embodiments of the present invention, waste treatment costs of waste plastic materials may be reduced, environmental pollution of soil and air may be prevented by avoiding landfill and incineration, import of energy sources may be reduced in oil importing countries, and gas suction rate and oil extraction yield may be improved by sucking a large amount of produced gas by using gas suction pipes formed with bent ends in the primary pyrolysis chamber.

Brief Description of the Drawings

[15] The above and other objects, features and advantages of the present invention will become more apparent from the following detailed description in conjunction with the accompanying drawings, in which:

[16] FIG. 1 is a view showing a configuration of an oil extraction system according to an exemplary embodiment of the present invention;

[17] FIG. 2 is a view showing a configuration of a waste feeding device and a carbide collecting device according to the exemplary embodiment of the present invention;

[18] FIG. 3 is a view showing a configuration of a primary pyrolysis chamber located in a furnace according to the exemplary embodiment of the present invention;

[19] FIG. 4 is a side view showing an outer configuration of the furnace of FIG. 3;

[20] FIG. 5 is a sectional view showing an inner configuration of the furnace of FIG. 3;

[21] FIG. 6 is a view showing a configuration of a rotation device for rotating the primary pyrolysis chamber of FIG. 3;

[22] FIG. 7 is view showing a configuration of shaft brackets for supporting the rotation device of FIG. 6;

[23] FIG. 8 is a view showing a secondary pyrolysis chamber for re-pyrolyzing gas produced by the primary pyrolysis chamber of FIG. 3;

[24] FIG. 9 is a view showing a configuration of a carrier for moving the primary pyrolysis chamber of FIG. 3 on rails;

[25] FIG. 10 is a view showing a connection state of a gas exhaust tube of the primary pyrolysis chamber of FIG. 3 and a rotating gas tube of the rotation device of FIG. 6;

[26] FIG. 11 is a block diagram showing a pyrolyzing process according to an exemplary embodiment of present invention; and

[27] FIG. 12 is a more detailed block diagram showing a pyrolyzing process of FIG. 11.

[28] <Description of the elements in the drawings>

[29] 10 : waste feeding device 10': carbide collecting device

[30] 11 : hopper 12a: hydraulic cylinder

[31] 12b: feed tube 13 : supporting fixture

[32] 14 : carbide discharge tube 15a: collector

[33] 15b: screen filter 16 : blower

[34] 17 : reactor rotating device 20 : primary pyrolysis chamber

[35] 21 : slop 22 : gas exhaust tube

[36] 23, 23': rotating rollers 24 : gas suction pipe

[37] 25 : rail 25': carrier

[38] 26 : gas exhaust tube flange 30 : furnace

[39] 31 : double jacket body 32a: door

[40] 32b: auxiliary door 33 : burner

[41] 34 : firebrick 35 : flue

[42] 40 : rotation device 41,41': shaft brackets

[43] 42 : rotating gas tube 43 : chain gear

[44] 44 : motor 45 : support

[45] 46 : connecting tube 47 : rotating gas tube flange

[46] 50 : secondary pyrolysis chamber 51 : heating plate

[47] 52 : ash removal valve 53 : residue collector

[48] 54 : backflow prevention device 55 : catalyst stack

[49] 56 : blower 60 : condenser

[50] 70 : oil-water seperator

Best Mode for Carrying Out the Invention

[51] Hereinafter, exemplary embodiments of the present invention are described in detail with reference to the accompanying drawings. The same reference numbers are used throughout the drawings to refer to the same or like parts. Detailed descriptions of constructions or processes known in the art may be omitted to avoid obscuring the subject matter of the present invention.

[52] An oil extraction system for pyrolyzing waste plastic materials according to an exemplary embodiment of the present invention includes: a waste feeding device 10 and a carbide collecting device 10' for feeding wastes collected in a hopper 11 and collecting residual carbides respectively; a primary pyrolysis chamber 20 for pyrolyzing the waste, that can be loaded on the top of a carrier 25' moving on rails 25 and be coupled with an outer surface of a gas exhaust tube 22; a furnace 30 having a burning room formed for receiving the primary pyrolysis chamber 20, a burner for heating the primary pyrolysis chamber 20, and a double jacket body 31; a rotation device 40 for rotating the primary pyrolysis chamber 20 located in the burning room of the furnace 30 by connecting the primary pyrolysis chamber 20 to a rotating gas tube 42; and a secondary plyrolysis chamber 50 for receiving gas produced by the primary pyrolysis chamber 20 through the rotating gas tube 42, re-pyrolyzing the gas, separating the gas and carbide particles, and preventing backflow of the gas and carbide particles; wherein the pyrolyzed gas in the secondary plyrolysis chamber 50 is condensed by a condenser 60 and oil is extracted by a oil-water separator 70 having an oil-water separation filter.

[53] The waste feeding and carbide collecting device includes: a waste feeding device 10 configured with a hopper 11 having a hydraulic cylinder 12a and a feed tube 12b at the bottom of the hopper 11 and installed on the top of a supporting fixture 13; a reactor rotating device 17 installed in a middle level of the supporting fixture 13 and having hydraulic cylinders 17a fixed to the supporting fixture 13 by a fixing pin 17b; and a carbide collecting device 10' located at the bottom of the supporting fixture 13 and having a carbide discharge tube 14, collector 15a, screen filter 15b, and blower 16.

[54] The primary pyrolysis chamber 20 includes: rotating rollers 23 and 23' installed at two sides of the gas exhaust tube 22; a plurality of gas suction pipes 24 for sucking gas, and formed on the surface of the gas exhaust tube 22 and between the rotating rollers 23 and 23'; a cylindrical body containing the plurality of gas suction pipes 24 therein and a slope 21 formed in a side of its inner space.

[55] A plurality of connecting pins 26a are formed at one side surface of a gas exhaust tube flange 26 of the primary pyrolysis chamber 20 and protrude outwards from the gas exhaust tube flange 26, and two hooking grooves 26b are formed at two edges in

the other side surface of the gas exhaust tube flange 26.

[56] The plurality of gas suction pipes 24 are formed by piercing the circumferential surface of the gas exhaust tube 22, and the inlet 24' of the gas suction pipe 24 is formed as a slope to maximize a suction rate and is equipped with a metal screen.

[57] The furnace preferably includes: a burning room whose inner walls are formed with firebricks 34; a burner 33 installed at one side of the burning room; a double jacket body 31 for containing water; a water supply pipe 37a and a water drain pipe 37b installed at the upper side and lower side of the double jacket body 31 respectively; flues 35 installed at the top of the double jacket body 31 and connected to the burning room; and a door 32a and an auxiliary door 32b formed at the front and rear of the furnace respectively.

[58] The rails 25 are preferably installed between the carbide collecting device 10' and the inside of the furnace 30.

[59] Preferably, the rotation device 40 includes a chain gear 43 installed at the circumferential surface of the rotating gas tube 42 and installed in the middle between shaft brackets 41 and 41'; the chain gear 43 is driven by a motor 44 via a chain; and one end of the rotating gas tube 42 is connected to the gas exhaust tube 22 of the primary pyrolysis chamber 20 and the other end of the rotating gas tube 42 is rotatively connected to a connecting tube 46 of the secondary pyrolysis chamber 50.

[60] The shaft brackets 41 and 41'are preferably formed as upper and lower brackets having a pair of bushings 41a to sustain the rotating gas tube 42 and a lubrication inlet is formed at the upper surface of the upper bracket.

[61] The rotating gas tube 42 preferably includes: a rotating gas tube flange 47 formed at its one end; a plurality of hooking grooves 26b formed at one side surface of the rotating gas tube flange 47, to which connecting pins 26a are inserted; linkages 47b formed at the upper and lower circumferential positions of the rotating gas tube flange 47, wherein one end of the linkage 47b is connected to a hinged pin and the other end of the linkage 47b is connected to an end of a hydraulic cylinder 47c and locking hook 47d. The other end of the hydraulic cylinder 47c is connected to the rotating gas tube 42.

[62] The rotating gas tube 42 and connecting tube 46 are connected to each other such that the rotating gas tube 42 may rotate freely and the connecting tube 46 remains in a fixed position, and an O-ring 48a and lubrication packings 48 are formed inside the connection part.

[63] The secondary plyrolysis chamber 50 preferably includes a plurality of porous heating plates 51, a connecting tube 46 having a backflow prevention device 54, a residue collector 53 and an ash removal valve 52 formed at the bottom of the residue collector 53, and a catalyst stack 55 formed at the upper part of the secondary

plyrolysis chamber 50. The secondary plyrolysis chamber 50 is covered by a heat insulating material to prevent heat loss.

[64] An oil extraction method for pyrolyzing waste plastic materials according to an exemplary embodiment of the present invention includes the steps of: crushing waste plastic materials containing waste plastics and waste Styrofoam, and feeding the crushed waste plastic materials into a hopper; settling a primary pyrolysis chamber to a reactor rotating device by lifting the primary pyrolysis chamber with a crane and by adjusting the position of the primary pyrolysis chamber with a hydraulic cylinder; supplying the waste plastic materials contained in the hopper into the primary pyrolysis chamber through a feed inlet; lifting the primary pyrolysis chamber with the crane, loading the primary pyrolysis chamber to a carrier located on rails, transporting the primary pyrolysis chamber into a burning room of a furnace, closing a door, and rotating and heating the primary pyrolysis chamber with a motor and a burner respectively; transporting gas produced by heating the waste plastic materials in the furnace of the primary pyrolysis chamber to a secondary pyrolysis chamber through gas suction pipes and re-pyrolyzing the gas in the secondary pyrolysis chamber; condensing the re-pyrolyzed gas by the secondary plyrolysis chamber to form oil; and separating water and the oil with an oil-water separator having an oil-water separation filter.

[65] Hereinafter, the oil extraction method for pyrolizing waste plastic materials is described in more detail.

[66]

[67] Step 1: Loading Waste Plastic Materials in Hopper

[68] Firstly, waste plastic materials are sorted, crushed, and loaded into a hopper 11 of a waste feeding device 10. The waste plastic materials may be loaded into the hopper 11 by using a conveyor or screw system. The waste plastic materials are crushed by a proper crushing device prior to loading into the hopper 11. The hopper 11 has an enclosed vessel and an air filter to prevent dust from flying.

[69]

[70] Step 2: Feeding Waste Plastic Materials to Primary Pyrolysis Chamber

[71] The waste plastic materials are fed from the hopper 11 of the waste feeding device 10 into a primary pyrolysis chamber 20.

[72] The primary pyrolysis chamber 20 is carried by a carrier 25' moving on rails 25 to the waste feeding device 10, and is lifted to a reactor rotating device 17 by a crane. If the pyrolysis chamber 20 is rotated using a fixing pin 17b as an axis by a hydraulic cylinder 17a, the primary pyrolysis chamber 20 is located in a vertical state to locate an inlet of the primary pyrolysis chamber 20 to face the hopper 11. If the primary pyrolysis chamber 20 is located in the vertical state, an feed tube 12b of the flexible

tube is inserted into the primary pyrolysis chamber 20 and the waste plastic materials are input into the primary pyrolysis chamber 20.

[73]

[74] Step 3: Heating and Rotating Primary Pyrolysis Chamber

[75] The waste plastic materials are fed from the waste feeding device 10 into the primary pyrolysis chamber 20. The primary pyrolysis chamber 20 is lifted, located on a carrier 25′on the rail 25, pulled or pushed, and moved into a burning room of a furnace.

[76] One end of the gas exhaust tube 22 of the primary pyrolysis chamber 20 is connected to the rotating gas tube 42 of the rotation device 40.

[77] Namely, a gas exhaust tube flange 26 of the primary pyrolysis chamber 20 is contacted to a rotating gas tube flange 47 of the rotation device 40, connecting pins 26a protruding from the gas exhaust tube flange 26 are inserted into insertion grooves 47a of the rotating gas tube flange 47, and one end of a locking hook 47d is connected to an end of the linkage 47b and the other end of the locking hook 47d is hooked to a hooking groove 26b of the gas exhaust tube flange 26.

[78] After the hooking groove 26b of the gas exhaust tube flange 26 is hooked by the locking hook 47d of the rotating gas tube flange 47, the linkages 47b installed at the top and bottom of the rotating gas tube flange 47 are pulled by operating hydraulic cylinders 47c installed at the rotating gas tube 42 and thereby the gas exhaust tube flange 26 is attached to the rotating gas tube flange 47. The gas exhaust tube flange 26 may be securely attached to the rotating gas tube flange 47 by the locking hook 47d using the hydraulic cylinders 47c or springs.

[79] When the primary pyrolysis chamber 20 is separated from the rotating gas tube 42 for discharging carbide, the gas exhaust tube flange 26 may be separated from the rotating gas tube flange 47 by pulling the linkage 47b using the hydraulic cylinders and thereby releasing the locking hook 47d.

[80] After the primary pyrolysis chamber 20 loaded with waste plastic materials is moved to a burning room of the furnace 30, a door 32a of the furnace 30 is closed and the primary pyrolysis chamber 20 is heated by operating a burner 33.

[81] While heating the primary pyrolysis chamber 20 by the burner 33, the primary pyrolysis chamber 20 is rotated in the furnace 30 by rotating the rotation device 40 connected to primary pyrolysis chamber 20 through the rotating gas tube 42.

[82] The primary pyrolysis chamber 20 is located in the burning room of the furnace 30. Rotating rollers 23 and 23' are installed on the gas exhaust tube 22, and an end of the gas exhaust tube 22 is connected to the rotating gas tube 42 of the rotation device 40.

[83] The primary pyrolysis chamber 20 has the gas exhaust tube 22 connected to a plurality of gas suction pipes 24 located between the rotating rollers 23 and 23', and a cylindrical body formed with a slope 21 at one side of the inner surface thereof. Waste

plastic materials are melt and decomposed in the closed primary pyrolysis chamber 20, and gas is produced.

[84] Gas produced in the primary pyrolysis chamber 20 is discharged through the gas suction pipes 24 of the gas exhaust tube 22.

[85] The gas suction pipes 24 are bent to a direction, a slope is formed at an inlet 24' of the gas suction pipe 24 and thereby increasing the size of inlet to which gas is sucked.

[86] The gas suction pipes 24 are bent and rotate together with the gas exhaust tube 22. A large amount of gas is sucked and moved to the secondary pyrolysis chamber 50 through the gas exhaust tube 22.

[87] The inlet of the gas suction pipes 24 is covered with a metal screen and thereby preventing residue of carbide to be sucked.

[88] If the metal screen is clogged due to soot, it may be cleaned after the primary pyrolysis chamber 20 is removed from the furnace.

[89] The furnace 30 has a burning room having a predetermined space, and inner walls of the burning room are formed with firebricks 34.

[90] The burner 33 is installed at an outside of the burning room and the primary pyrolysis chamber 20 rotating in the burning room is heated by the burner 33.

[91] A body 31 of the furnace 30 is formed in a double jacket and filled with water in the double jacket, water supply pipe 37a is formed at the upper surface of the body 31 to supply water to the jacket, water drain pipes 37b are installed at both bottom side surfaces of the body 31 to drain water. The cross section of the double jacket of the body 31 is formed in a shape of a horse′s hoof.

[92] Flues 35 are connected to the burning room at the top of the furnace 30, filter is installed in the flue 35, thereby discharging smoke from the burning room to the outside. The smoke is combustion gas produced by the burner 33, and is not gas produced by burning waste plastic materials.

[93] A steam discharge tube 36a is installed at a upper surface of the body 31 of the furnace to discharge steam produced by heating water in the jacket, and a safety valve 36b is installed at a upper surface of the body 31 to automatically reduce steam pressure in case of emergency.

[94] Various components are installed in the furnace 30 to check and control steam pressure and heating temperature, and are similar to those of conventional furnaces.

[95] An auxiliary door 32b is installed at the rear side of the furnace 30 to manage and maintain the furnace 30.

[96] A door 32a of the furnace 30 may be opened or closed even in the case that rails 25 are installed at the bottom of the furnace 30, and is configured to keep the burning room to be closed.

[97] The primary pyrolysis chamber 20 in the burning room of the furnace 30 is rotated

by the rotation device 40 connected thereto, the rotation device 40 is installed with a chain gear 43 attached to the rotating gas tube 42 between shaft brackets 41 and 41', and the chain gear 43 is driven by a motor 44 via a chain to drive the rotation device 40. The rotation device 40 may be driven by other methods different from the chain gear.

[98] The O-ring 48a and lubrication packings 48 are installed to keep a connection unit of the connecting tube 46 airtight for connecting the rotating gas tube 42 of the rotation device 40 and secondary pyrolysis chamber 50. The connecting tube 46 is not rotating and the rotating gas tube 42 is rotated to rotate the primary pyrolysis chamber 20.

[99]

[100] Step 4: Pyrolizing Carbide Particles and Produced Gas in Secondary Pyrolysis Chamber

[101] Gas is produced from waste plastic materials in the primary pyrolysis chamber 20 heated by the furnace 30,and is fed to the secondary pyrolysis chamber 50 by passing through the gas suction pipes 24, gas exhaust tube 22, rotating gas tube 42 of the rotation device 40, and connecting tube 46.

[102] A backflow prevention device 54 is installed between connecting tube 46 and the secondary pyrolysis chamber 50 to prevent backflow of gas from the secondary pyrolysis chamber 50.

[103] Gas produced in the primary pyrolysis chamber 20 is heated again in the secondary pyrolysis chamber 50 to pyrolyze and separate carbide particles(carbon), un-decomposed residues and gas.

[104] Gas produced in the primary pyrolysis chamber 20 is a mixture of carbide and un-decomposed residues, and may clog a transport path or lowering quality of produced oil.

[105] A plurality of heating plates 51 are installed inside the secondary pyrolysis chamber50 at a predetermined interval, and an ash removal valve 52 and residue collector 53 are installed at the lower part of the secondary pyrolysis chamber 50. Gas fed to the secondary pyrolysis chamber 50 is heated and decomposed by the heating plates 51, carbide and residues are collected by a residue collector 53, decomposed gas is separated and is fed to a condenser 60 by suction of a blower 56.

[106] Ash collected in the residue collector 53 is disposed of afterwards.

[107] A blower 56 moves gas from the primary pyrolysis chamber 20 to the secondary pyrolysis chamber 50, and moves gas from the secondary pyrolysis chamber 50 rapidly to the condenser 60 to prevent explosion of gas due to long retention time.

[108] Various gauges, monitoring window and drain valve are installed to manage and control the secondary pyrolysis chamber 50, using a method similar to conventional methods.

[109] A catalyst stack 55 is installed at the upper part of the secondary pyrolysis chamber 50 to remove chlorine gas and easily solidified wax.

[110] The catalyst stack 55 neutralizes toxic gas produced during decomposition of waste plastic materials, and thereby improving quality of produced oil.

[111]

[112] Step 5: Gas Condensation

[113] Gas separated from carbide and residue in the secondary pyrolysis chamber 50 is fed to the condenser 60 by the blower 56, and is liquefied in the condenser 60.

[114] The condenser 60 may be a conventional condenser that liquefies gas, and the liquefied gas is fed to an oil-water separator 70. Uncondensed gas is fed to a gas reserve tank 80 through a pipe, and gas in the gas reserve tank is supplied to the burner 33 of the furnace30.

[115]

[116] Step 6: Oil-water Separation

[117] Liquefied oil in the condenser 60 is separated into refined oil and water by a filter of the oil-water separator 70 and is stored in an oil reserve tank.

[118] The oil-water separator 70 separates oil and water from condensed oil, water is collected in a water tank, and refined oil is collected in the oil reserve tank. Gas that is not separated in the condenser 60 is separated again and fed to the gas reserve tank.

[119] An oil extraction system according to an embodiment of the present invention is described in detail in reference with the drawings.

[120] FIG. 1 is a view showing a configuration of an oil extraction system according to an exemplary embodiment of the present invention.

[121] Referring to FIG. 1, the oil extraction system has the following steps: loading waste plastic materials to a hopper 11 and feeding the waste plastic materials to a primary pyrolysis chamber 20 through a feed tube, in a waste feeding device 10 → pyrolyzing the fed waste plastic materials in the primary pyrolysis chamber 20 that is operating as a reactor → heating the primary pyrolysis chamber 20 in a burning room of a furnace 30 formed with a double jacket shape with a burner 33 → rotating the primary pyrolysis chamber 20 by a rotation device 40 → pyrolyzing gas produced in the primary pyrolysis chamber 20 and separating gas, carbide and residues, in a secondary pyrolysis chamber 50 → condensing gas separated in the secondary pyrolysis chamber 50 to produce reproduced oil in a condenser 60 → separating refined oil and water from the reproduced oil condensed in the condenser 60, in a oil-water separator 70.

[122] FIG. 2 is a view showing a configuration of a waste feeding device and a carbide collecting device according to the exemplary embodiment of the present invention.

[123] Referring to FIG. 2, waste plastic materials in the hopper 11 are fed into the primary

pyrolysis chamber 20 through a feed tube 12b at the bottom of the hopper 11, after the primary pyrolysis chamber 20 is lifted to the reactor rotating device 17 by a crane.

[124] After the waste plastic materials are heated and gas is produced in the primary pyrolysis chamber 20 located in the furnace, a door 32a of the furnace 30 is opened, and the primary pyrolysis chamber 20 on rails 25 is pulled and moved towards a carbide collecting device 10'.

[125] The primary pyrolysis chamber 20 is rotated by hydraulic cylinders 17a of the reactor rotating device 17, and carbide in the primary pyrolysis chamber 20 is collected in the carbide collecting device 10'.

[126] The carbide collecting device 10' includes a carbide discharge tube 14 moved by hydraulic cylinders on the carbide collecting device 10' and a carbide collector 15a under the carbide discharge tube 14. A screen filter 15b is installed at the bottom of the carbide collector 15a, and filters foreign materials such as iron and stone. The bottom of the carbide collector 15a is connected to a blower 16 through a pipe, the carbide in the primary pyrolysis chamber 20 is transported to the carbide collector 15a, and the carbide in the carbide collector 15a is discharged to a treatment facility through a carbide discharge tube. The carbide in the primary pyrolysis chamber20 is discharged by being slid by a slope 21 formed in the inside of the primary pyrolysis chamber 20.

[127] FIG. 3 is a view showing a configuration of a primary pyrolysis chamber located in a furnace according to the exemplary embodiment of the present invention.

[128] Referring to FIG. 3, a gas exhaust tube 22 is connected to gas suction pipes 24, the primary pyrolysis chamber 20 is formed in a cylinder shape in the outside of the gas exhaust tube 22, and a slope 21 is formed in the inner side of the primary pyrolysis chamber 20 to easily remove carbide.

[129] Rotating rollers 23 and 23' are installed at two sides of the gas exhaust tube 22 to smoothly rotate the primary pyrolysis chamber 20. The rotating rollers 23 and 23' are located fixedly in the burning room of the furnace 30 to support the primary pyrolysis chamber 20 in the air.

[130] FIG. 4 is a side view showing an outer configuration of the furnace of FIG. 3.

[131] Referring to FIG. 4, two flues 35, steam discharge tube 36a, and safety valve 36b are installed on the top of a body 31 of the furnace 30, and a door 32a and auxiliary door 32b are installed in two opposite sides of the body of the furnace 30.

[132] FIG. 5 is a sectional view showing an inner configuration of the furnace of FIG. 3.

[133] Referring to FIG. 5, the body of the furnace 30 is formed in a double jacket, and firebricks 34 are attached on the inner wall of the burning room in which the primary pyrolysis chamber 20 is located. A burner 33 is installed in the outside of the burning room.

[134] The burner 33 is ignited by using gas stored separately for an initial operation, and

gas that is produced in the primary pyrolysis chamber 20 and left after condensing in the condenser may be supplied to the burner 33.

[135] The furnace 30 has a double jacket body in which water is contained, water supply pipe and discharge tube. Various gauges and components are installed to operate the furnace 30.

[136] FIG. 6 is a view showing a configuration of a rotation device for rotating the primary pyrolysis chamber of FIG. 3.

[137] Referring to FIG. 6, one end of a rotating gas tube 42 is connected to the gas exhaust tube 22 0f the primary pyrolysis chamber 20, and the other end of the rotating gas tube 42 is connected to a connecting tube 46 of the secondary plyrolysis chamber 50. The rotating gas tube 42 is supported by shaft brackets 41 and 41', and the shaft brackets 41 and 41' are fixed on a support 45.

[138] A chain gear 43 is installed on the rotating gas tube 42, and driven by a motor 44 mounted on the support 45. The motor 44 and chain gear 43 are connected by a chain.

[139] A rotation device 40 is covered by a rotation device cover 49 to protect the shaft brackets and chain gear from external environment such as rain and snow.

[140] A plurality of insertion grooves 47a to which connecting pins 26a are inserted are formed in one side of the rotating gas tube flange 47 of the rotating gas tube 42 connected to the primary pyrolysis chamber 20, ends of linkages 47b are connected by hinged pins at the top and bottom of the rotating gas tube flange 47 ,and another ends of the linkages 47b are connected to hydraulic cylinders 47c and locking hooks 47d.

[141] The gas exhaust tube flange 26 of the gas exhaust tube 22 in the primary pyrolysis chamber 20 is contacted to the rotating gas tube flange 47 of the rotation device 40. The connecting pins 26a protruding from the gas exhaust tube flange 26 are inserted into the insertion grooves 47a of the rotating gas tube flange 47. The locking hook 47d to which one end of the linkage 47b is connected is hooked to the hooking groove 26b of the gas exhaust tube flange 26, and is tightened by hydraulic cylinders 47c installed on the rotating gas tube 42.

[142] FIG. 7 is view showing a configuration of shaft brackets for supporting the rotation device of FIG. 6.

[143] Referring to FIGS. 6 and 7, shaft brackets 41 and 41' are fixed on the support 45 of the rotation device 40 to support the rotating gas tube 42. When the rotating gas tube 42 is driven by the motor 44, the shaft brackets 41 and 41' support two sides of the rotating gas tube 42 to provide smooth rotation of the rotating gas tube 42.

[144] FIG. 8 is a view showing a secondary pyrolysis chamber for re-pyrolyzing gas produced by the primary pyrolysis chamber of FIG. 3.

[145] Referring to FIG. 8, a secondary pyrolysis chamber 50 has a cylindrical chamber in the vertical direction. A catalyst stack 55 is installed at the upper part of the secondary

pyrolysis chamber 50, and a plurality of heating plates 51 having a ring shape are installed at predetermined intervals in the middle of the secondary pyrolysis chamber 50.

[146] The distances between the heating plates 51 depends on a capacity of the secondary pyrolysis chamber 50.

[147] The heating plates 51 are heated to pyrolyze produced gas, and have a plurality of holes for gas to move upwards and for carbide and residue to fall into a residue collector 53 due to their weight. An ash removal valve 52 is installed at a side of the residue collector 53 to open and close the residue collector 53 for discharging collected carbide and residue.

[148] A backflow prevention device 54 is installed between the secondary pyrolysis chamber 50 and connecting tube 46 to prevent gas in the secondary pyrolysis chamber 50 from backflowing into the primary pyrolysis chamber 20 due to pressure difference between the primary pyrolysis chamber 20 and secondary pyrolysis chamber 50.

[149] The catalyst stack 55 removes chlorine gas and wax having a high solidifying property from the re-pyrolyzed gas.

[150] Waste plastic materials produce toxic gases during a pyrolyzing process, and the toxic gases are modified, neutralized and removed by the catalyst stack 55, and thereby improving quality of produced oil.

[151] A blower 56 on the top of the secondary pyrolysis chamber 50 rapidly transfers gas separated in the secondary pyrolysis chamber 50 to a condenser 60 to prevent expansion of the produced gas.

[152] FIG. 9 is a view showing a configuration of a carrier for moving the primary pyrolysis chamber of FIG. 3 on rails.

[153] Referring to FIG. 9, a carrier 25' is installed movably on the rails 25, and the primary pyrolysis chamber 20 is placed on the carrier to easily push the primary pyrolysis chamber 20 into or pull the primary pyrolysis chamber 20 out of the furnace 30 and to easily locate the primary pyrolysis chamber 20 on the carrier 25' when the primary pyrolysis chamber 20 lifted or lowered by a crane.

[154] FIG. 10 is a view showing a connection state of a gas exhaust tube of the primary pyrolysis chamber of FIG. 3 and a rotating gas tube of the rotation device of FIG. 6.

[155] Referring to FIG. 10, when the primary pyrolysis chamber 20 is pushed into a burning room of the furnace, an end of the gas exhaust tube 22 is protruded outwardly from the furnace 30, and is connected to an end of the rotating gas tube 42.

[156] FIG. 11 is a block diagram showing a pyrolyzing process according to an exemplary embodiment of present invention.

[157] FIG. 11 shows a flow diagram of an oil extraction system of FIG. 1.

[158] FIG. 12 is a more detailed block diagram showing a pyrolyzing process of FIG. 11.

[159] Several processes of FIG. 12 are not described in the present invention.

[160] An oil extraction system according to the present invention pyrolyzes waste plastic materials produced in several industries to produce oil, and prevents environmental pollution.

[161] Experimental examples of oil production according an exemplary embodiment of the present invention are described as follows.

[162]

[163] Experimental Example

[164] * Volume of a reactor that may be filled with waste materials; 6.944□,

[165] * Filling ratio; 80%

[166] * Weight of filled material; 0.1003×0.8×0.45(specific gravity)=2.5t(input weight)

[167] * Composition analysis of product; oil: 60%, gas: 20%, carbide(char): 15%, and moisture: 5%, wherein oil is separated by an oil-water separator because oil and moisture are mixed together.

[168] Amount of products is calculated as follows.

[169] * Oil: 2,5ton×0.6÷0.87(specific gravity)= 1,724 L

[170] * Gas: 2.5ton×0.2 = 500kg

[171] * Carbide: 2.5ton×0.15 = 375kg

[172] * Moisture: 2.5ton×0.05 = 125kg

[173] Accordingly, oil of 1,724 L is produced from 2.5 ton of waste materials and production efficiency is high.

[174] Energy balance for producing oil is described as follows.

[175] < Waste material >

[176] *Type of waste material: Waste tire

[177] *Filling amount: 2.5ton/batch (Specific gravity is applied.)

[178] *Composition of product

[179] 1)Oil: 45%~50% → Applied value: 50%

[180] 2)Gas: 10%~15% → Applied value: 15%

[181] 3)Carbide: 25%~30% → Applied value: 30%

[182] 4)Moisture: 5%~8% → Applied value: 5%

[183] * Amount of product

[184] 1)Oil: 2.5ton/batch×0.5 = 1.25 ton

[185] 1.25 ton ×(1/0.87×1,000L/ton)=1,437 L(as a refined oil)

[186] 2)Gas: 2.5ton/batch ×0.15 = 0.375 ton

[187] 0.375ton×1,000kg/ton = 375 Kg

[188] 3)Char: 2.5ton/batch ×0.3 =0.75 ton

[189] 4)Moisture: 2.5ton/batch ×0.05 = 0.125 ton

[190] ※0.87 is a specific gravity of the refined oil

[191] <Fuel consumption of burner>

[192] *Specification of burner

[193] 1) Main burner: 320,000kcal/hr ×2 sets

[194] 2) Auxiliary burner: 80,000kcal/hr ×2 sets

[195] *Energy consumption: 800,000 kcal/hr ×2.5 hr =2,000,000 kcal/batch

[196] * Calculation of fuel consumption

[197] 1) Light oil consumption/hr for burner operation: 123.1 L

[198] 2) Burner operation time: 2.5 hour (150 min.)

[199] 3) Light oil consumption: 123.1 L ×2.5 hr = 307.75 L/batch

[200] 4) Consumed energy: 307.75L/hr ×9,200kcal/L (Calorie of light oil = 9,200 kcal/L)= 2,831,300kcal/bacth

[201] < Energy balance of system>

[202] * Energy of gas when light oil is substituted by the produced gas:

[203] 375kg/batch×11,900kcal/kg(Calorie of produced gas)= 4,462,500kcal/batch

[204] ※Energy of produced gas : (Calorie of butane gas + Calorie of propane gas)/2(∵produced gas ⇒LPG)

[205] * Energy required for one batch operation

[206] 1) Energy required for burners : 2,000,000kcal/batch

[207] 2) Energy required for 2.5 hour operation when light oil is used: 2,831,300kcal/batch

[208] * Energy surplus:

[209] * 4,462,500kcal/batch - 2,831,300kcal/batch = 1,631,200kcal/batch (during 2.5 hour operation)

[210] * 1,631,200kcal/batch can be used for operating machines in a factory.

[211] An oil extraction system according to the present invention can reduce energy consumption required to operate the system by using produced gas after using energy required for an initial operation.

Industrial Applicability

[212] According to the above exemplary embodiments of the present invention, waste treatment costs of waste plastic materials may be reduced, environmental pollution of soil and air may be prevented by avoiding landfill and incineration, import of energy sources may be reduced in oil importing countries, and gas suction rate and oil extraction yield may be improved by using gas suction pipes formed with bent inlets in a primary pyrolysis chamber.

Claims

[1] An oil extraction system for pyrolyzing waste plastic materials comprising:
a waste feeding device and a carbide collecting device for feeding wastes collected in a hopper and collecting residual carbides respectively;
a primary pyrolysis chamber for pyrolyzing the wastes, being loaded on the top of a carrier moving on rails and being coupled with an outer surface of a gas exhaust tube;
a furnace having a burning room formed for receiving the primary pyrolysis chamber, a burner for heating the primary pyrolysis chamber, and a double jacket body;
a rotation device for rotating the primary pyrolysis chamber located in the burning room of the furnace by connecting the primary pyrolysis chamber to a rotating gas tube; and
a secondary plyrolysis chamber for receiving gas produced by the primary pyrolysis chamber through the rotating gas tube, re-pyrolyzing the gas, separating the gas and carbide particles, and preventing backflow of the gas and carbide particles;
wherein the pyrolyzed gas by the secondary plyrolysis chamber is condensed by a condenser and oil is extracted by a gas separator having an oil-water separation filter.

[2] The oil extraction system of claim 1, wherein the waste feeding and carbide collecting device comprises:
a waste feeding device configured with a hopper having a hydraulic cylinder and a feed inlet at its bottom and installed on the top of a supporting fixture;
a reactor rotating device installed in a middle level of the supporting fixture and having hydraulic cylinders fixed to the supporting fixture by a fixing pin; and
a carbide collecting device located at the bottom of the supporting fixture and having a carbide discharge tube, collector, screen filter, and blower.

[3] The oil extraction system of claim 1, wherein the primary pyrolysis chamber comprises:
rotating rollers installed at two sides of the gas exhaust tube;
a plurality of gas suction pipes for sucking gas, and formed on the surface of the gas exhaust tube and between the rotating rollers;
a cylindrical body containing the plurality of gas suction pipes and a slope formed in its inner space.

[4] The oil extraction system of claim 1, wherein the furnace comprises:
a burning room whose inner walls are formed with firebricks;

a burner installed at one side of the burning room;
a double jacket body for containing water;
a water supply pipe and a water drain pipe installed at the upper side and lower side of the double jacket body respectively;
flues installed at the top of the double jacket body and connected to the burning room; and
a door and an auxiliary door formed at the front side and rear side of the furnace.

[5] The oil extraction system of claim 1, wherein the rotation device comprises a chain gear installed at the circumferential surface of the rotating gas tube and in the middle between shaft brackets; the chain gear is driven by a motor via a chain; and one end of the rotating gas tube is connected to the gas exhaust tube of the primary pyrolysis chamber and the other end of the rotating gas tube is rotatively connected to a connecting tube of the secondary pyrolysis chamber.

[6] The oil extraction system of claim 1, wherein the secondary pyrolysis chamber comprises a plurality of porous heating plates, a connecting tube having a backflow prevention device, a residue collector and an ash removal valve formed at the bottom of the residue collector, and a catalyst stack formed at the upper side of the secondary pyrolysis chamber.

[7] The oil extraction system of claim 3, wherein the plurality of gas suction pipes are formed by piercing the circumferential surface of the gas exhaust tube, and an inlet of the gas suction pipes is formed as a slope to maximize a suction rate and is equipped with a metal screen.

[8] The oil extraction system of claim 3, wherein a plurality of connecting pins protruding outwards are formed at one side surface of a gas exhaust tube flange of the primary pyrolysis chamber and a plurality of hooking grooves are formed at the other side surface of the gas exhaust tube flange.

[9] The oil extraction system of claim 5, wherein the shaft brackets are formed as upper and lower brackets having a pair of bushings to sustain the rotating gas tube and a lubrication inlet is formed at the upper surface of the upper bracket.

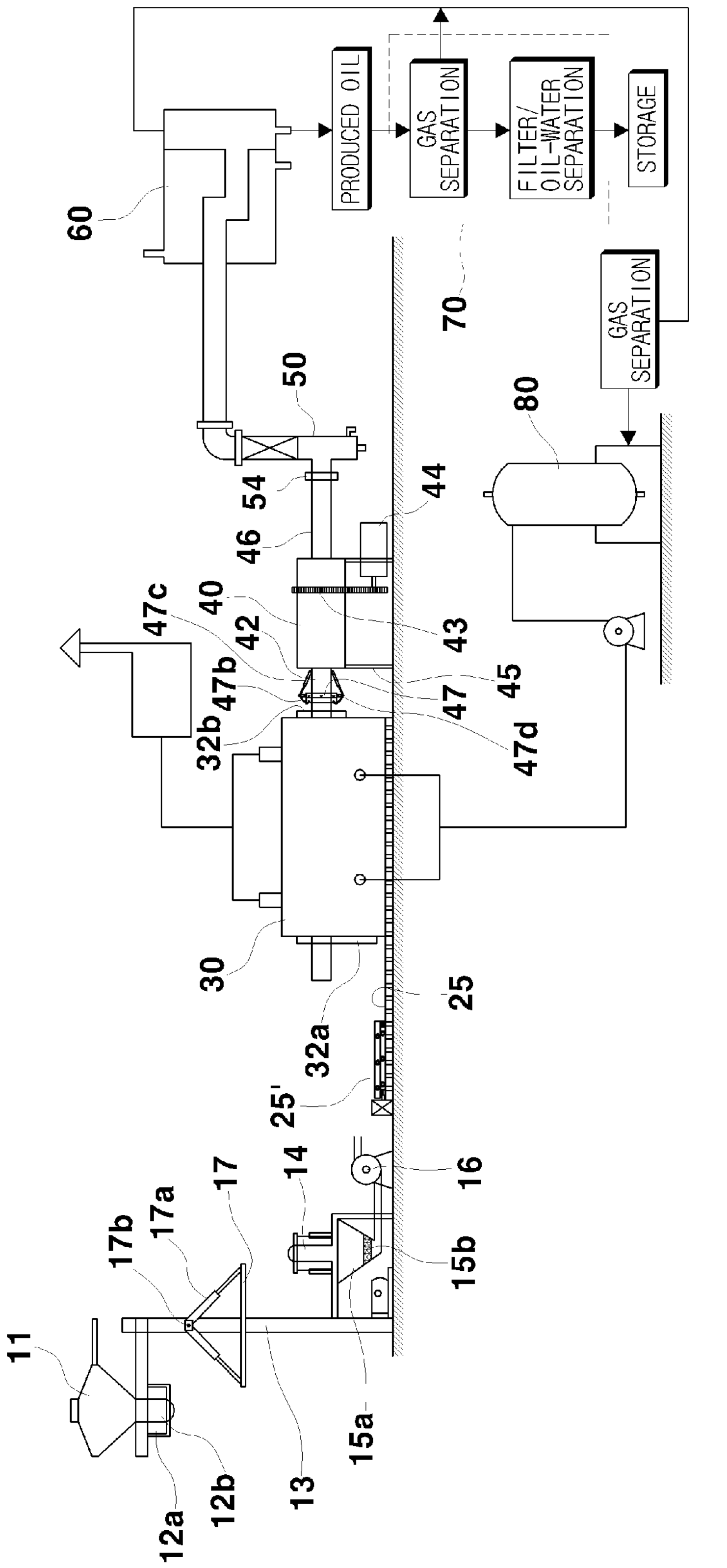
[10] The oil extraction system of claim 5, wherein the rotating gas tube and connecting tube are connected to each other such that the rotating gas tube may rotate freely and the connecting tube remains in a fixed position, and an O-ring and lubrication packings are formed inside the connection part.

[11] The oil extraction system of claim 5, wherein the rotating gas tube comprises:
a rotating gas tube flange formed at its one end;
a plurality of hooking grooves formed at one side surface of the rotating gas tube flange, to which connecting pins are inserted;
linkages formed at the upper and lower circumferential positions of the rotating

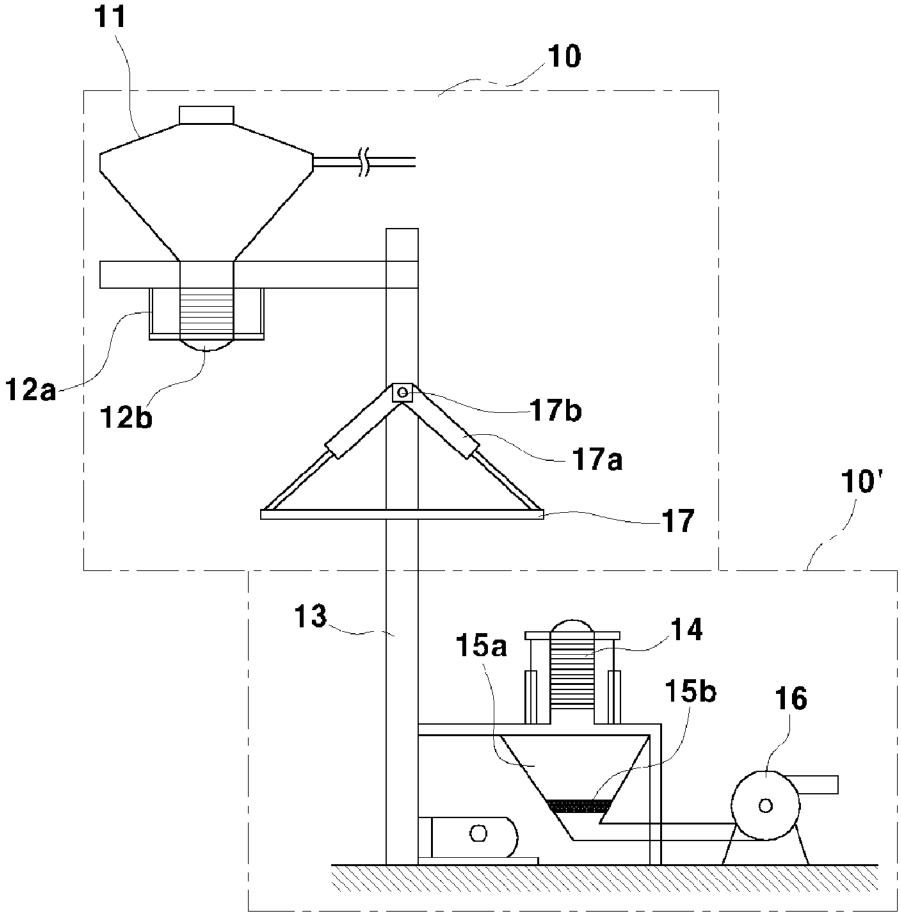
gas tube flange, wherein one end of the linkage is connected to a hinged pin and the other end of the linkage is connected to a hydraulic cylinder and locking hook.

[12] An oil extraction method for pyrolyzing waste plastic materials comprising:
crushing waste plastic materials containing waste plastics and waste Styrofoam and feeding the crushed waste plastic materials into a hopper;
settling a primary pyrolysis chamber to a reactor rotating device by lifting the primary pyrolysis chamber with a crane and by adjusting the position of the primary pyrolysis chamber with a hydraulic cylinder;
supplying the waste plastic material contained in the hopper into the primary pyrolysis chamber through a feed inlet:
lifting the primary pyrolysis chamber with the crane, loading the primary pyrolysis chamber to a carrier located on rails, transporting the primary pyrolysis chamber into a burning room of a furnace, closing a door, and rotating and heating the primary pyrolysis chamber with a motor and a burner respectively;
transporting gas produced by heating the waste plastic materials in the furnace of the primary pyrolysis chamber to a secondary pyrolysis chamber through gas suction pipes and re-pyrolyzing the gas in the secondary pyrolysis chamber;
condensing the re-pyrolyzed gas in the secondary plyrolysis chamber to produce oil; and
separating water from the oil with an oil-water separator having an oil-water separation filter.

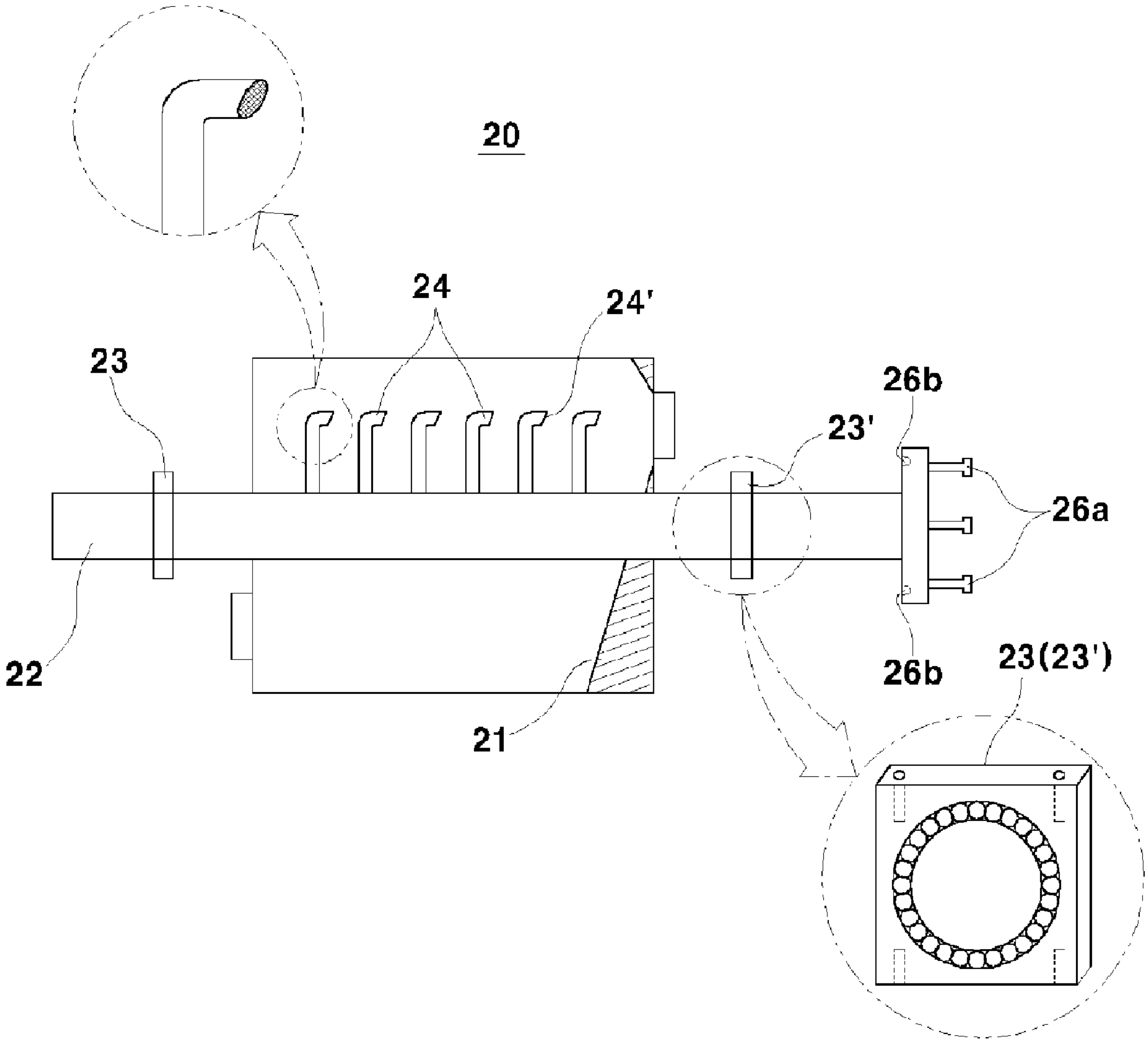
[Fig. 1]


PRODUCED OIL
GAS SEPARATION
FILTER/ OIL-WATER SEPARATION
STORAGE
GAS SEPARATION
60
70
50
80
54
44
46
40
47c
42
43
47b
45
47
32b
47d
30
25
32a
25'
14
16
17
17a
15b
17b
11
15a
13
12b
12a

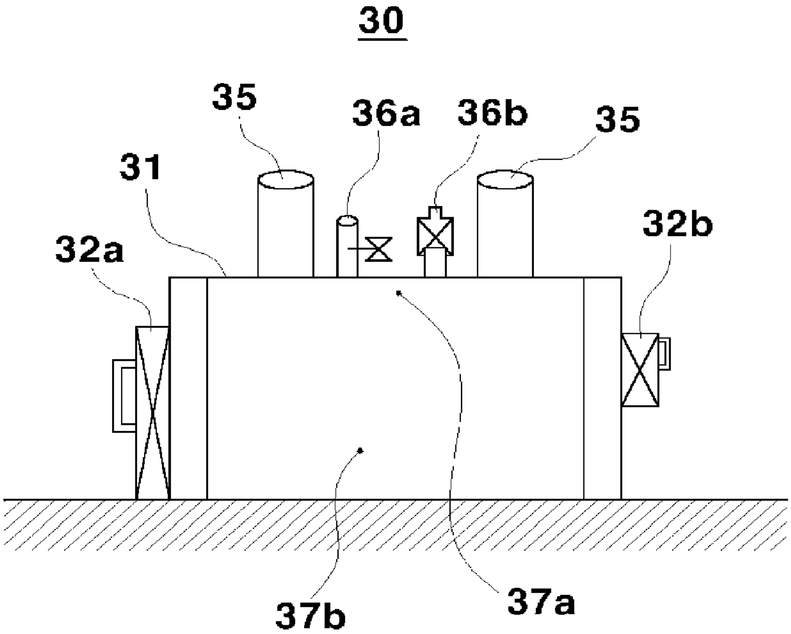
[Fig. 2]



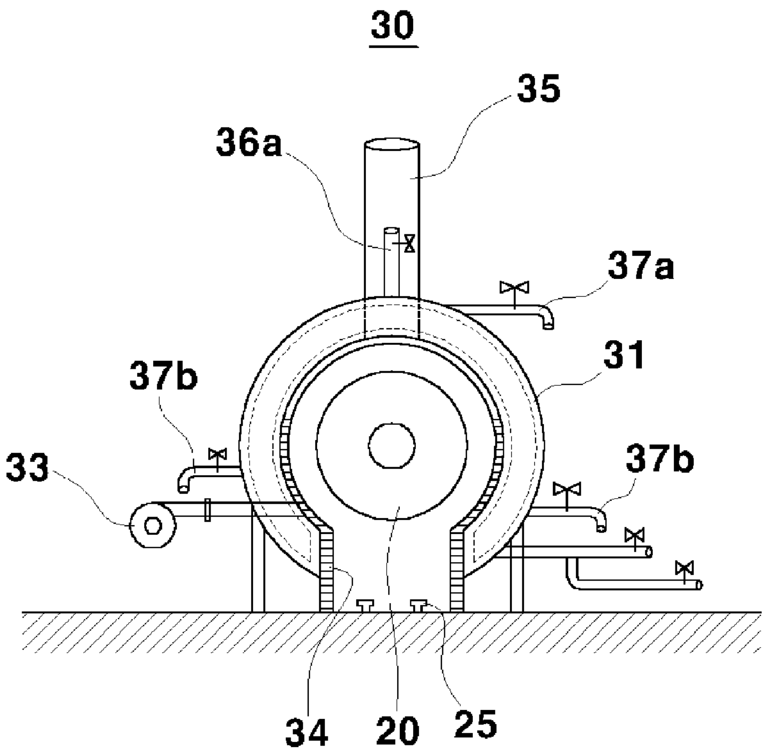
[Fig. 3]


20
24
24'
23
26b
23'
26a
22
26b
23(23')
21

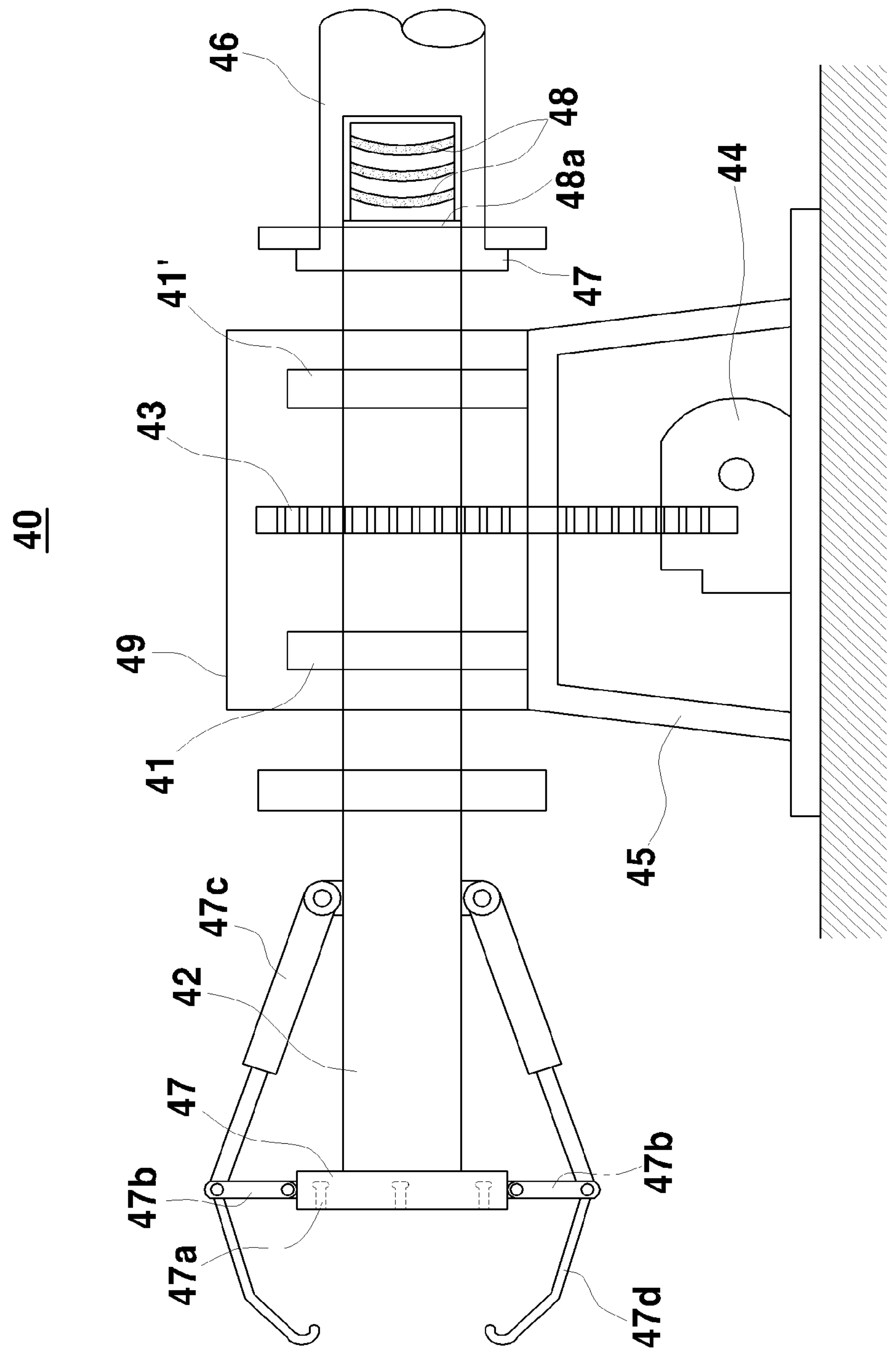
[Fig. 4]


30
35
36a
36b
35
31
32b
32a
37b
37a

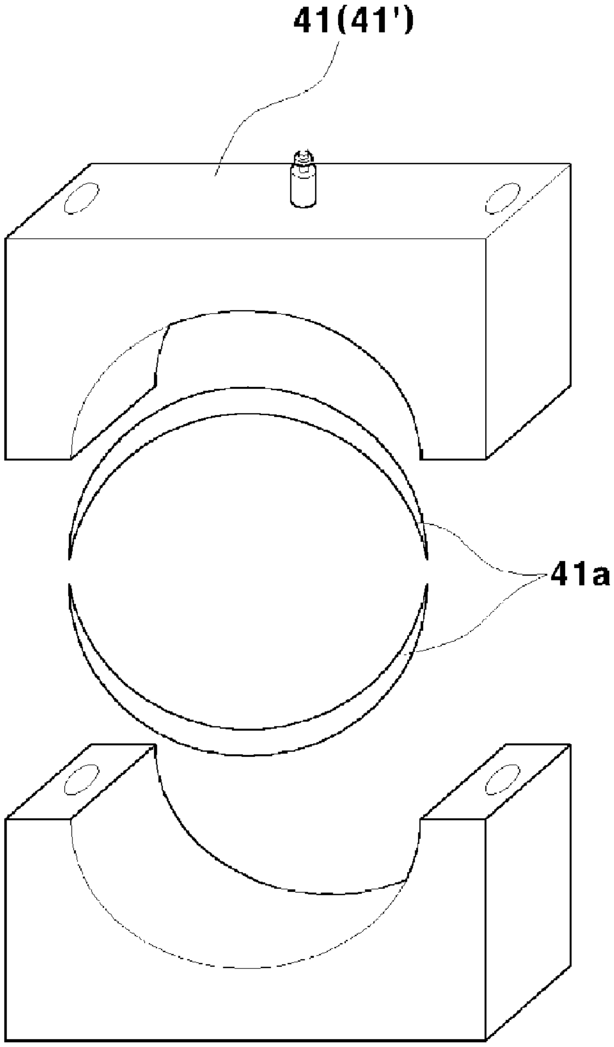
[Fig. 5]



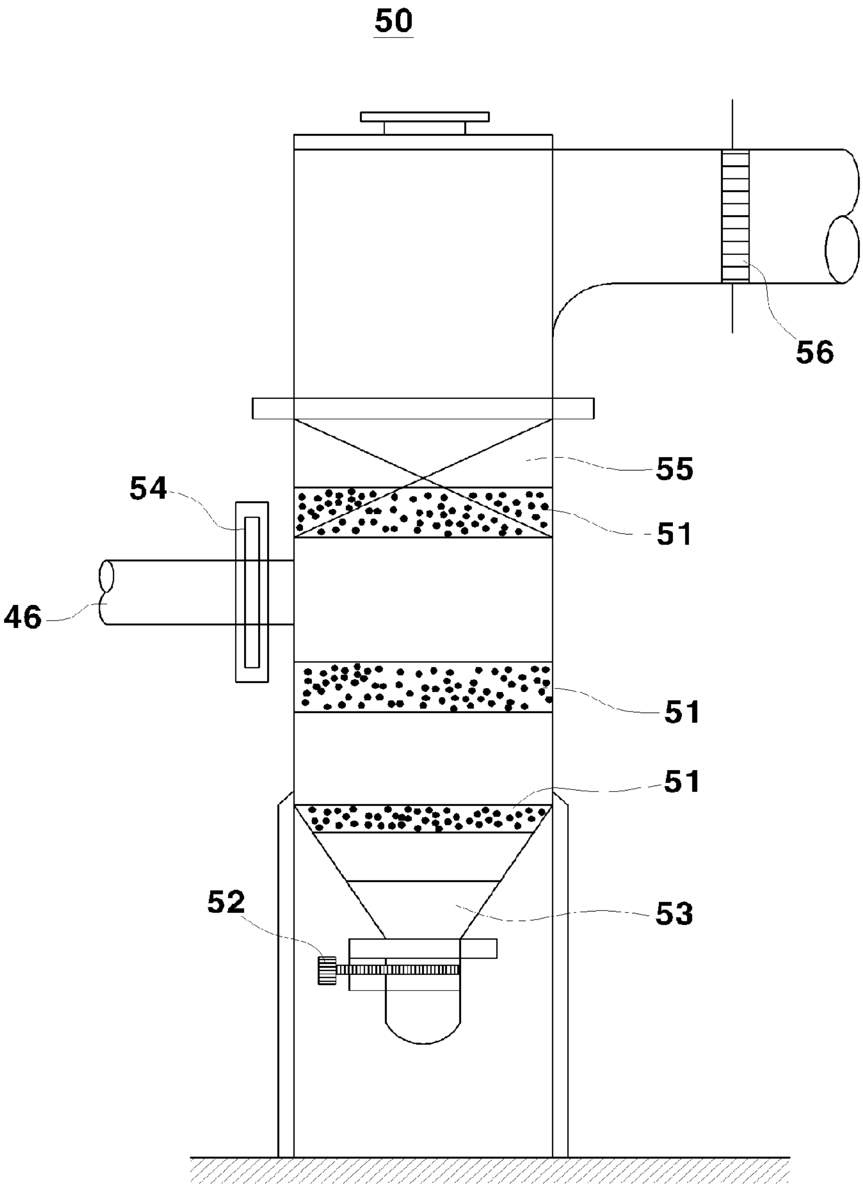
[Fig. 6]



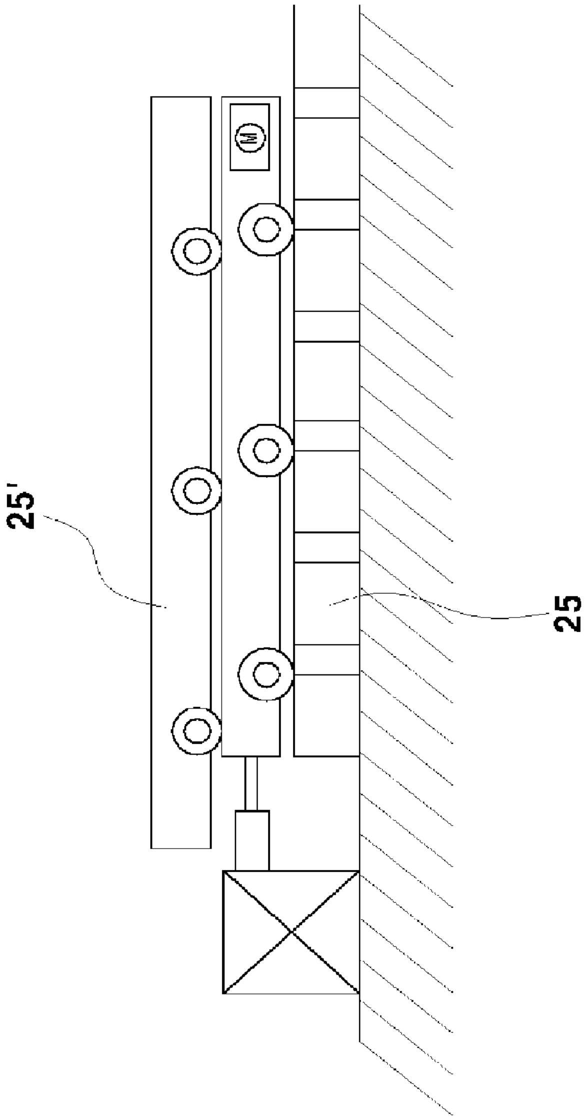
[Fig. 7]



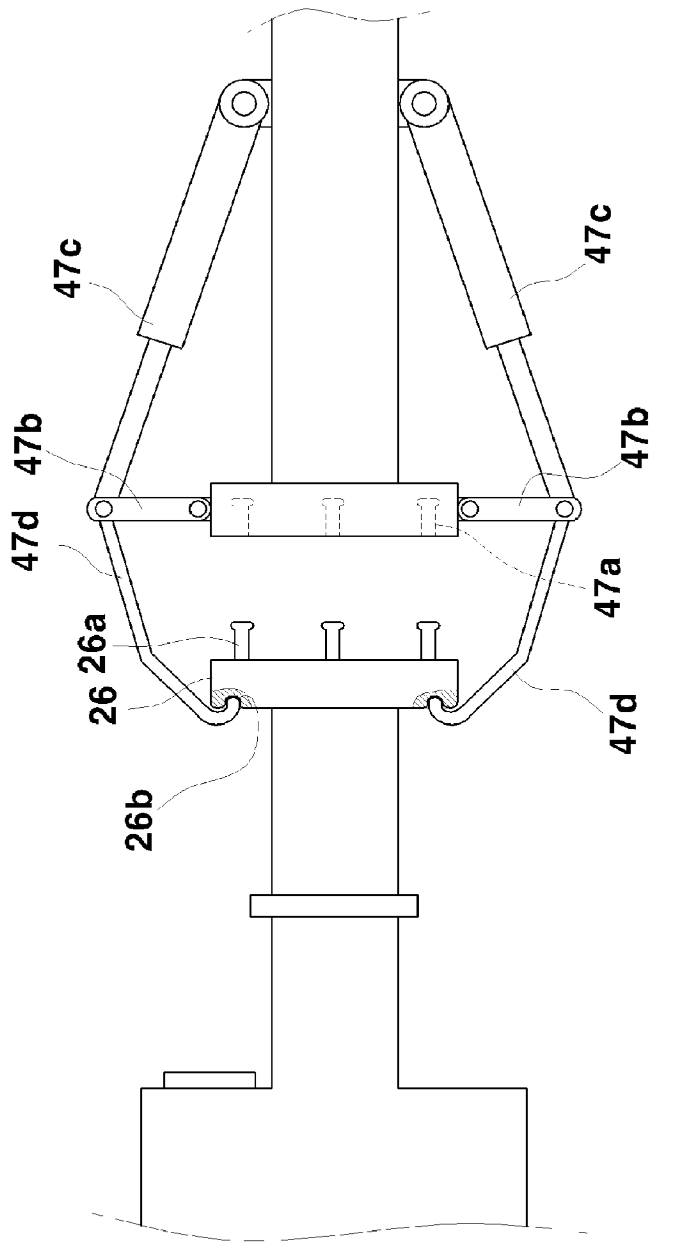
[Fig. 8]



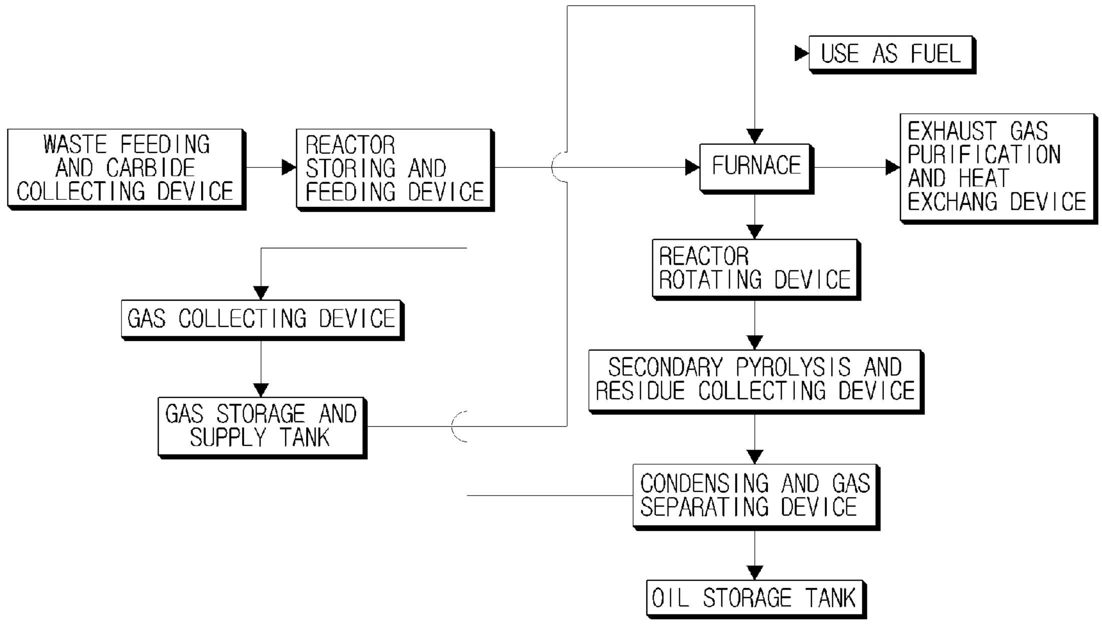
[Fig. 9]



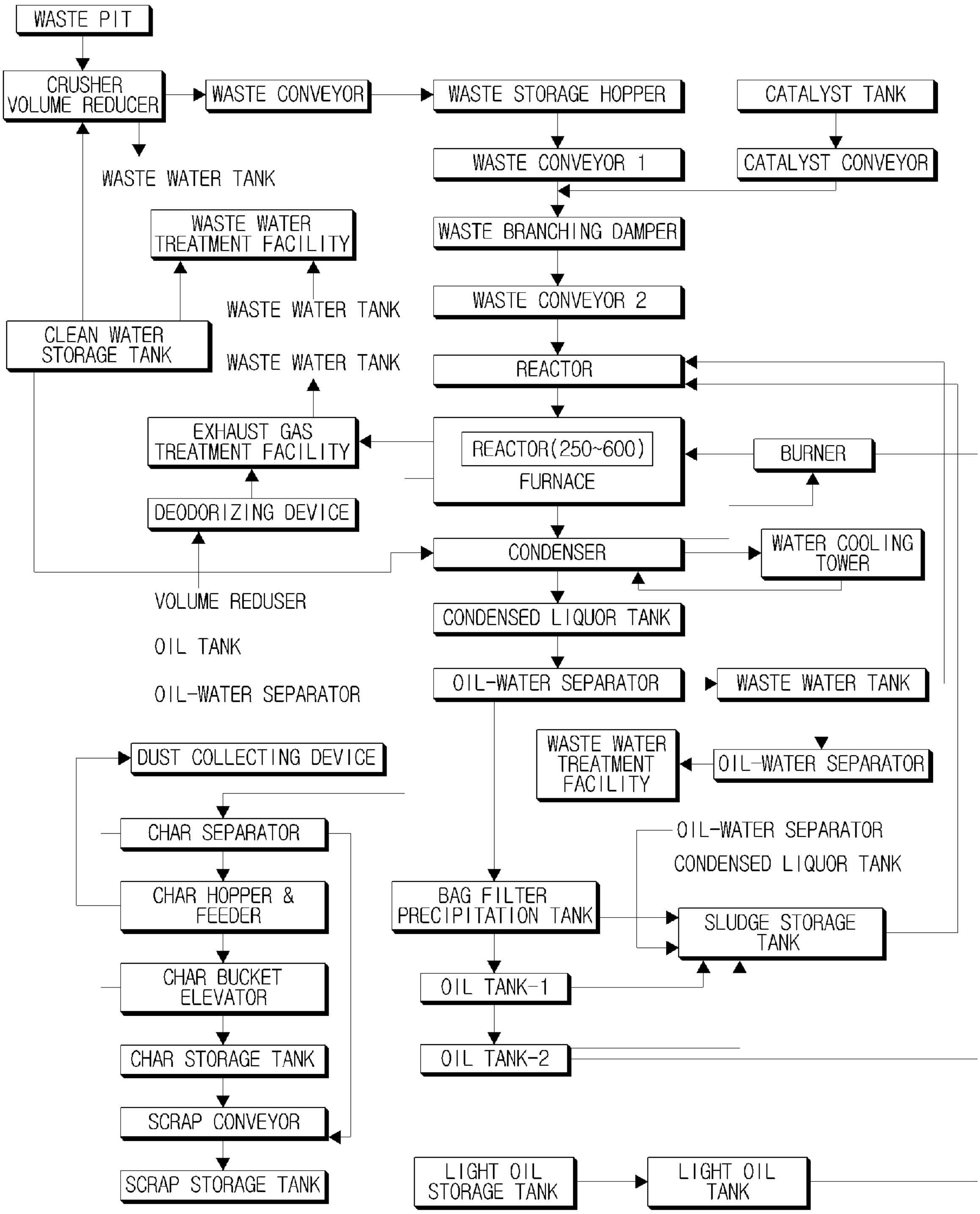
[Fig. 10]



[Fig. 11]


USE AS FUEL
WASTE FEEDING AND CARBIDE COLLECTING DEVICE
REACTOR STORING AND FEEDING DEVICE
FURNACE
EXHAUST GAS PURIFICATION AND HEAT EXCHANG DEVICE
REACTOR ROTATING DEVICE
GAS COLLECTING DEVICE
GAS STORAGE AND SUPPLY TANK
SECONDARY PYROLYSIS AND RESIDUE COLLECTING DEVICE
CONDENSING AND GAS SEPARATING DEVICE
OIL STORAGE TANK

[Fig. 12]


WASTE PIT
CRUSHER
VOLUME REDUCER
WASTE CONVEYOR
WASTE STORAGE HOPPER
CATALYST TANK
WASTE WATER TANK
WASTE CONVEYOR 1
CATALYST CONVEYOR
WASTE WATER
TREATMENT FACILITY
WASTE BRANCHING DAMPER
WASTE WATER TANK
WASTE CONVEYOR 2
CLEAN WATER
STORAGE TANK
WASTE WATER TANK
REACTOR
EXHAUST GAS
TREATMENT FACILITY
REACTOR(250~600)
FURNACE
BURNER
DEODORIZING DEVICE
CONDENSER
WATER COOLING
TOWER
VOLUME REDUSER
CONDENSED LIQUOR TANK
OIL TANK
OIL-WATER SEPARATOR
OIL-WATER SEPARATOR
WASTE WATER TANK
DUST COLLECTING DEVICE
WASTE WATER
TREATMENT
FACILITY
OIL-WATER SEPARATOR
CHAR SEPARATOR
OIL-WATER SEPARATOR
CONDENSED LIQUOR TANK
CHAR HOPPER &
FEEDER
BAG FILTER
PRECIPITATION TANK
SLUDGE STORAGE
TANK
CHAR BUCKET
ELEVATOR
OIL TANK-1
CHAR STORAGE TANK
OIL TANK-2
SCRAP CONVEYOR
SCRAP STORAGE TANK
LIGHT OIL
STORAGE TANK
LIGHT OIL
TANK

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2006/004726

A. CLASSIFICATION OF SUBJECT MATTER

B09B 3/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 8 B09B 3/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean Utility models and applications for Utility Models since 1975
Japanese Utility Models and applications for Utility Models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKIPASS(KIPO internal) " Keyword : pyrolysis, thermal decomposition and similar terms"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6 178 899 B1 (MASAKI KANEKO et al.) 30 Jan. 2001 See column 7, line 66- column 8, line 37, column 9, line60 -column 10, line 43	1- 12
A	US 6 126 907 A (YOUICHI WADA) 3 Oct. 2000 See columna 5, line 65 - column 6, line 36	1- 12
A	US 4 686 008 A (GIBSON, H. T.) 11 Aug. 1987 See abstract	1- 12
A	US 5 669 317 A (KARL MAY et al.) 23 Sep. 1997 See column 5, line39 - column 6, line 35	1- 12

☐ Further documents are listed in the continuation of Box C.　　☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents,such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
20 JUNE 2007 (20.06.2007)	**20 JUNE 2007 (20.06.2007)**

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
920 Dunsan-dong, Seo-gu, Daejeon 302-701,
Republic of Korea
Facsimile No. 82-42-472-7140

Authorized officer
CHUNG, Ki Ju
Telephone No. 82-42-481-8190

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2006/004726

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